Global Epidemiology

A GEOGRAPHY OF DISEASE AND SANITATION

By

JAMES STEVENS SIMMONS, B.S., M.D., Ph.D., Dr. P.H., Sc.D. (Hon.)

Brigadier General, United States Army; Chief, Preventive Medicine Service, Office of The Surgeon General, United States Army; Member, National Research Council and Committee on Medical Research, O.S.R.D.; Lecturer, Department of Preventive Medicine, Johns Hopkins University Medical School; Lecturer in Public Health, Yale University School of Medicine; Professorial Lecturer in Preventive Medicine, George Washington University Medical School; Member, Visiting Committee, Harvard School of Public Health; Lecturer in Tropical Medicine, Army Medical School

TOM F. WHAYNE, A.B., M.D.

Lieutenant Colonel, M.C., A.U.S.; Formerly Director, Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, United States Army

GAYLORD WEST ANDERSON, A.B., M.D., Dr. P.H.

Lieutenant Colonel, M.C., A.U.S.; Director, Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, United States Army; Director, School of Public Health, University of Minnesota

HAROLD MACLACHLAN HORACK, B.S., M.D.

Major, M.C., A.U.S.; Chief, Dissemination Branch, Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, United States Army; Instructor in Medicine, Duke University School of Medicine

AND COLLABORATORS

VOLUME ONE

PART ONE: *India and the Far East*
PART TWO: *The Pacific Area*

WILLIAM HEINEMAN, LIMITED

London

THIRD IMPRESSION

PRINTED IN THE UNITED STATES OF AMERICA

DEDICATED TO

RICHARD PEARSON STRONG

Colonel, Medical Corps, Army of the United States, and Dean of American Tropical Medicine, whose untiring and productive labors in this field since 1899 when he was appointed as the first President of the U. S. Army Board for the Investigation of Tropical Diseases in the Philippines, to the present time in his important position as Director of Training in Tropical Medicine at the Army Medical School, have contributed so richly to the health of our troops, to the sanitary improvement of the tropics and to the future welfare of mankind

SED QUAERES *cui bono tot urbium commemoratio? Magno, modo una die spectaveris juxta doctrinam Hippocratis, nam natura loci intelliges qualis sit & mores habitantium, & quam partem praestet eligere, qui morbi regnent: Et ex his quae commodior, nam tota illa pars olim & ob frigus, & nunc magis ob dissidia, parum est utilis.*

BUT, YOU WILL ASK, to what purpose is this account of all these cities? There is great value: for if you will look about you only a single day, according to the suggestion of Hippocrates, you will know what may be the nature of the place and the customs of the inhabitants, what section of the city it is better to choose, and what diseases are prevalent. We may also determine which of the regions we visit is more favorable, for at one time an entire district will prove scarcely habitable because of the cold, and again another district undesirable on account of troublesome times.

JEROME CARDAN OF MILAN (1501-1576)
From Chapter 29, De Propria Vita Liber,
written 1576; first published, Paris, 1643.

Preface

Be it in war or in peace, public health is vital to a nation's strength. As rapid communication shortens effective distances, the problems of international health and the spread of diseases become accentuated. To meet these problems, the widest dissemination of information regarding each other's health problems is essential. It is hoped that publication of the material herewith presented may aid in this process.

The book represents an excursion into the unexplored field of geo-medicine, bringing together in one place certain data on medical, health, and sanitary conditions of various geographic areas of the world. The material is based on surveys made for the Medical Department of the United States Army. Material of purely military interest and information not suitable for publication at this time have been deleted. This first volume includes medical information about India, the Far East and the Pacific area. In subsequent volumes similar data about Africa, Europe, the Near East and the Western Hemisphere will be made available.

The surveys here assembled represent the work of a large number of individuals associated at some time with the Medical Intelligence Division of the Office of The Surgeon General of the United States Army. The present Division of Medical Intelligence had its beginning during May 1940 when the senior author made arrangements for a reserve officer, Lt. Colonel (now Colonel) Ira V. Hiscock, Sn.C., Professor of Public Health at the Yale University School of Medicine, to come on temporary active duty in the Office of The Surgeon General and draw up a plan for health protection of troops who might be assigned for duty outside of the country as part of a program of hemispheric defense. The work was continued by Lt. Col. (now Colonel) William A. Hardenbergh, Sn.C., editor of *Public Works,* and Lt. Col. Albert W. Sweet, Sn.C., of the New Jersey State Health Department. These three prepared surveys of a number of countries of the Western Hemisphere. In June, 1941, this organization with a complement of two officers became a division under the direction of Capt. (now Lt. Col.) Tom F. Whayne who continued in charge until April, 1943, when he departed for overseas duty. Since that time, under the direction of Lt. Col. Gaylord W. Anderson, the activities of the division have continued to expand and its personnel now includes eleven officers, five civilians of professional grade, and clerical staff of fifteen. The individuals who have actually prepared material for inclusion in surveys used in these volumes are as follows:

Captain Paul X. Blattler
Major Richard S. Buker
Captain Orlando Canizares
Miss Rose A. Centanni
Dr. Carl Dauer
Dr. Clara Day
Captain James R. Eckman
Major Ross Gauld
Captain George Gordon
Major David M. Greeley
Captain Carlo Henze
Major Harold M. Horack
Major William A. Howard
Captain Saul Jarcho
Lieutenant Morris Leikind
Miss Jane Lyman
Captain John K. Meneely, Jr.
Mrs. Frances Sullivan Miller
Captain George O. Pierce
Captain George Rosen
Lt. Col. Robert B. Rutherford
Major Paul R. Slater
Dr. Isadore Snapper
Miss Ruth A. Thomas
Dr. Arthur R. Turner
Dr. C. W. Wells

In their work, they have enjoyed the utmost co-operation of a large number of agencies and persons having special knowledge regarding the various areas under study. They have scoured the libraries, obtained assistance from numerous other governmental agencies and had access to a large amount of previously unpublished material. To all these collaborators, many of whom must remain anonymous, who have furnished information or assisted in the collection of this material we are deeply indebted.

Every reasonable attempt has been made to use the latest available information on all the countries studied. The reader will realize, however, that in many countries conditions as to governmental organization, general sanitation and medical facilities have been altered by enemy occupation or as a result of military operations. Exact information on such changes is often not available. Even friendly occupation may have changed many conditions, yet details of change cannot be revealed for obvious reasons. Except as otherwise noted, conditions in countries subjected to enemy occupation have been described as they were known to exist at the outset of hostilities. Other conditions such as fauna and flora are not subject to such immediate change, so it can be assumed for lack of more specific knowledge that conditions existing prior to occupation still prevail.

The arrangement and grouping of diseases has, of necessity, been arbitrary. In the original surveys, grouping was dictated by military considerations; to follow such arrangement in a volume intended for other purposes would result in undesirable groupings. For example, typhoid fever which can be readily prevented by immunization and is therefore a minor military problem, would be separated from the dysenteries which constitute a major military problem. It has seemed preferable to arrange the material so far as possible according to principal mode of spread, though realizing that certain diseases have multiple avenues of transmission and that considerable uncertainty and even controversy persists as to the mode of spread of others, e.g., poliomyelitis and infectious hepatitis.

The globe used as part of the stamping of the front board of this book is drawn from a basic polar map copyrighted by Rand McNally & Company.

In the editing of this material for publication, invaluable assistance has been generously given by Dr. W. C. Davison, Dr. Morris Fishbein, Dr. Richard M. Hewitt and Dr. Robert N. Nye, representing the Division of Medical Sciences of the National Research Council. The arduous editorial details were handled by Captain James R. Eckman. A special debt of gratitude is due to Mr. Elon Clark of Duke University School of Medicine, who prepared the large maps of world-wide disease distribution. The smaller maps of individual countries were prepared by the staff of Colonel James E. Ash, M.C., Curator of the Army Medical Museum. To the late Mr. Archie Woods of the John and Mary R. Markle Foundation a special debt of gratitude is owed for the initial suggestion that these surveys be prepared for publication and for material assistance in the preparation of the volume. The Mayo Clinic and the office of the American Medical Association have likewise assisted in the final preparation of the manuscript. The authors are indebted to all of these for their assistance but can attribute to them none of the shortcomings of the volume. Finally, special mention should be made of our colleagues, both professional and clerical in the Preventive Medicine Service who have rendered invaluable service throughout this undertaking.

James S. Simmons
Tom F. Whayne
Gaylord W. Anderson
Harold M. Horack

Introduction

As the gathering clouds of war began to cast their ominous shadows on the United States, the country found itself faced with the need of sending military forces outside of its territorial limits as part of a vast program of hemispheric defense. To do so meant that American troops would be stationed in areas that presented health problems different from those with which they were experienced—health problems of a very diverse character, as units were stationed in widely scattered posts from the arctic to the equator. Later, as the die was cast, the Army found itself faced with the task of military operations in every corner of the globe, in the frigid north and the sunbaked arid desert, in the humid fever-ridden jungle and on the barren coral atoll, in countries where sanitation was an unknown concept and where for centuries disease had blocked the inroads of commerce and civilization.

History was replete with proof that the maintenance of health was essential to the success of military operations. From the earliest recorded period, disease had caused more casualties than had the sword, the rifle, or the cannon. Typhus, plague, cholera and malaria had shared with the generals and politicians in shaping the destiny of the nations and had all too frequently determined the success or failure of a military venture. The history of military operations in the Balkans during the last war had born striking testimony to the importance of typhus and malaria.

But in 1941 "conditions were different." Yes, they were different, for they were potentially more serious, at least from the standpoint of American troops. During 1917 and 1918 our forces had been stationed in areas, the sanitary culture of which closely resembled that of our own country and therefore presented few hazards to which our Army was not accustomed. Furthermore, the combat area of Northern France had been fought over for almost three years, during which our allies had gathered valuable experience which they might share with us. There was therefore little need for additional medical information to meet unusual health hazards.

By contrast, 1941 presented problems of operation in some of the most disease-ridden areas of the world. Had we deliberately selected the battle ground that presented the worst hazards to health, we would have departed little from the areas in which our enemies have so far forced us to do battle or to operate our supply lines. These areas presented diseases unknown to the United States; and in them diseases with which we were familiar occurred under unfamiliar circumstances. The epidemiology of a familiar disease might be vastly different in a far off land. Obviously, unless the hazards peculiar to a given area were known in advance, effective planning for medical care and health protection would be impossible.

To meet this situation, there was established in the Preventive Medicine Service of the Office of The Surgeon General a special unit known as the Medical Intelligence Division. To this unit was entrusted the task of collecting and assembling data regarding medical, health, and sanitary conditions in all areas to which troops might conceivably be sent, whether in a belligerent or a friendly capacity. The rapid expansion of the conflict to assume a truly global character meant in substance that no one might foresee today the exact area to which troops might go tomorrow. The scope of the surveys therefore quickly spread to cover all corners of the globe and all countries, both friendly and belligerent.

It became the task of the division to be able to furnish exact information about the health conditions of any country at any time. Surveys of over 190 areas were prepared and frequently were revised as conditions changed or new data became available.

The information assembled has been primarily that which would be valuable in planning for the health protection and medical care of troops. Secondarily, information of essentially civil value has been included, as the military force so often must furnish care to the civil population. Moreover, it must be recognized that the health of a military force is vitally affected by the health of the civil community in which it is stationed, whether stationed on a belligerent or a friendly basis. In many respects, the friendly basis favors closer contact with the civil population than does the belligerent so that the health problems of the civil community may be more readily reflected in military experiences.

The need for the collection of exact information is well illustrated by the problem of malaria. It is common knowledge that military operations of 1942 and 1943 were located in some of the most malarious sections of the globe, areas in which malaria occurred under the most diverse conditions. The most significant lesson of malaria research of the past twenty-five years has been to emphasize the highly specific character of the malaria problem of a given locality. It has taught us that the old concept of association of malaria with swamps was a very dangerous half-truth applicable to only certain areas. We have had to learn that different species of anopheles mosquitoes carry malaria in different areas, that in some places malarial vectors might breed in running water rather than in swamps, in shade in one spot but in sunshine a few miles distant. We have learned from bitter experience that control measures effective in one locality may actually increase the magnitude of the malaria problem if applied in a nearby area where the vector is different or where it breeds under greatly different conditions. We have learned to appreciate the differences in seasonal distribution that make malaria a summer disease in one spot, a disease of the autumn a short distance away. In brief, we have learned that the epidemiology of malaria is highly localized and that the only permissible generalization is to state that generalization is impossible. It is obvious that a malaria control unit operating in a given area should be aware of all available information regarding the factors governing the occurrence of malaria in that area if the most effective plans are to be made to combat the disease. To supply precisely this information was the purpose of the Medical Intelligence Division so far as concerns malaria. Similar considerations governed the preparation of other parts of these surveys.

Information contained in the surveys was collected from all possible sources. Much of it could obviously be gathered through library research; the extensive collections of the Libraries of Congress, the Army Medical Library and the libraries of other governmental departments were drawn on freely. Access was also had to libraries in other parts of the country. Governmental departments gave freely of their information, especially the Bureau of Entomology and Plant Quarantine of the Department of Agriculture. Many private agencies that had had contacts with foreign areas opened their files to representatives of the Medical Intelligence Division. Persons who had lived abroad gave much valuable information through personal interviews. In short, every source was tapped that appeared to offer reliable information.

Data so obtained were evaluated and assembled into formal surveys covering a wide variety of topics. Attention was first paid to the form of local health administration so that the military medical unit might be familiar with the structure of the governmental agencies with which it would have to deal. A second section contained information as to the sanitary conditions of water supplies and facilities for disposal of sewage. In the former, emphasis was placed on sanitary quality and treatment facilities rather than on the problem of supplies, as the Army delegates to the Corps of Engineers the responsibility for obtaining an adequate quantity of water and to the Medical Department that of making certain that the water is safe to drink. Special attention was given to insects and other animals that might serve as vectors of disease or as pests or might otherwise jeopardize the safety of troops. Information was collected as to poisonous plants or foods and in some instances, regarding pollens that might precipitate allergic conditions.

A third section of the survey was devoted to medical and hospital facilities of the areas under study. This involved information regarding location, size, and equipment of hospitals, availability of medical supplies including drugs, vaccines and serums, location of laboratories and provisions for medical, dental, nursing and veterinary service to the civil population. A further section was devoted to a discussion of the occurrence of various diseases. Here were presented data regarding prevalence, seasonal distribution, etiological agents, local vectors, control programs, and other factors governing the occurrence of the diseases in the locality under study. The importance of various diseases was evaluated from the standpoint of significance to American troops stationed locally. Maps showing geographical distribution within a country were prepared for many diseases.

These parts of the surveys were written for the use of technically trained personnel and therefore contained technical data. A final section was designed for the use of the non-medically trained line officer. Here were summarized in non-technical language the most significant points of the survey. Specific recommendations were presented as to measures to be taken to avoid the health hazards peculiar to the area in question.

The primary purpose of these surveys was to permit intelligent planning for the equipment of troops for overseas areas and for the orientation of medical units in foreign lands. They have also been of value in training for foreign service as they have pointed out the hazards against which troops must be warned and the preventive measures to be included in the training program. Time has accorded further value to these reports as they have been utilized by other governmental bureaus in planning for both the period of war and for postwar reconstruction.

The surveys have been unique in that they have brought together for the first time much information that has heretofore been widely scattered. Had similar reports been available before the war, there would have been less need for their preparation. Other agencies had obvious need for information of this character. There has thus been the satisfaction that such information gathered incidental to the destructive processes of war, might be equally effective in the reconstruction of peace. At that time public health will inevitably take on a more international character as airplane travel shortens the effective distance between countries and introduces to many areas disease hazards that were formerly avoided through mere geographical isolation and the lapse of time required by older methods of water travel.

Unfortunately much of the information so assembled has been of such a character as to preclude its general dissemination to all interested civil agencies. Information of a military nature was included, public release of which might be prejudicial to the best interests of the war effort. Yet the greater part of the surveys was such as could be properly released and would be of potential value to a wide variety of interests as it brought together in one place data otherwise so scattered as to be virtually unobtainable to most persons.

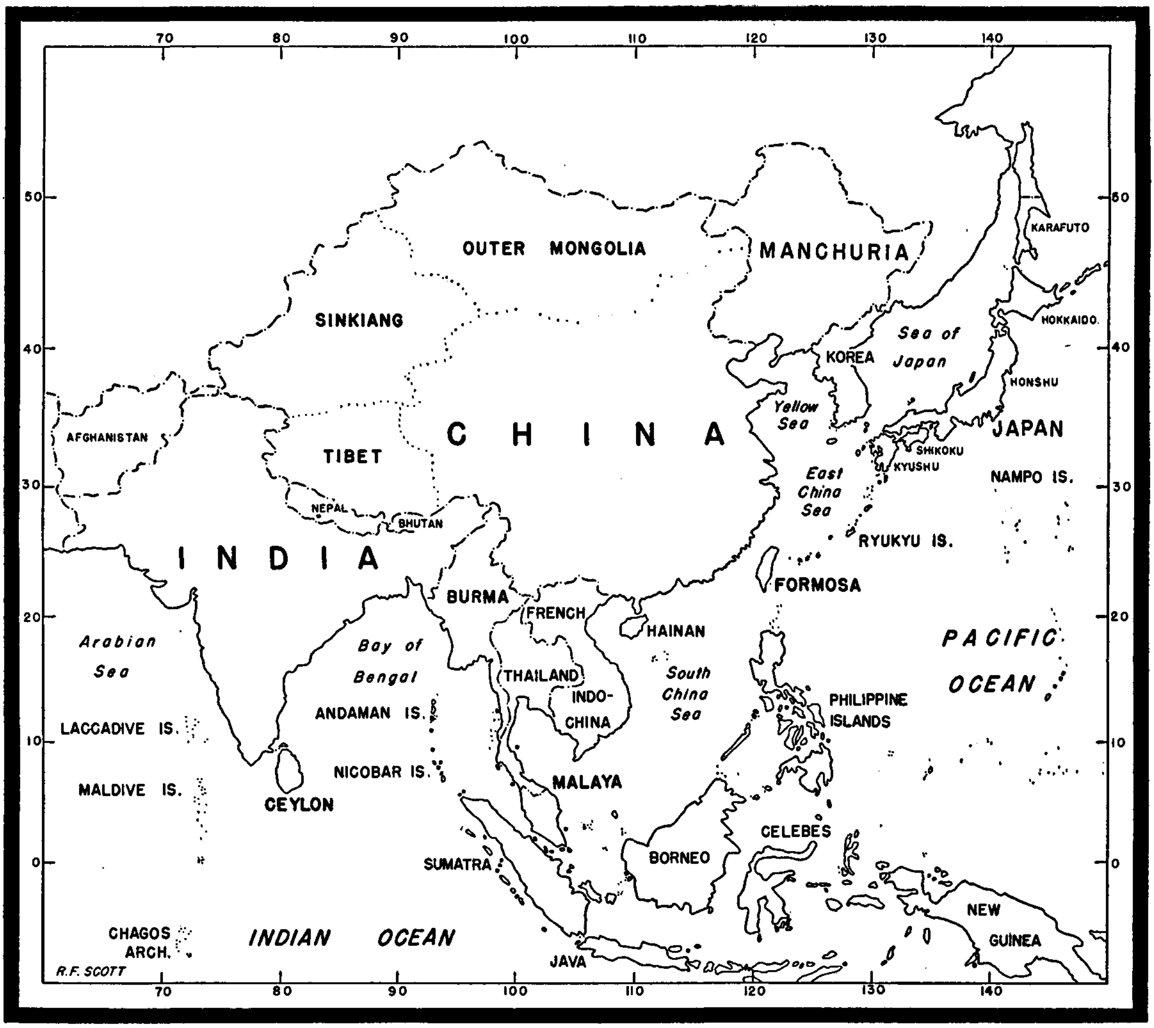
Recognizing the potential value of this material, the Committee on Information of the Division of Medical Sciences of the National Research Council proposed that the original surveys be published after re-editing to remove all material, release of which might be inadvisable at this time. Originally it was proposed that a few sample surveys be so published but as the project developed, it became increasingly apparent that for the volume to have its maximum value to the catholicity of interests concerned with public health an attempt should be made to include material on all the countries studied. The present volume is the initial result of this project.

No one can be as aware of the limitations of such a volume as are those who have labored over it. Much of the material has been gathered under the impelling whiplash of speed. Military operations do not wait for painstaking scholarly research. Information often had to be obtained on short notice and surveys rushed to have information available by certain dates. Some of the reports so completed have been redone, but time has not permitted as careful reanalysis as might be desired in all cases. Sources of information have undoubtedly been overlooked. In a work of this character, errors and omissions are inevitable, especially in the initial stages.

The authors do not present this work as a final or finished task. From the standpoint of scientific accuracy they would have preferred to have delayed it for scrutiny under more leisurely conditions of peace. They have been persuaded, however, to release the material at this time and in this form because it was apparent that so much of the material here assembled was of immediate value to so many interests yet was not readily available elsewhere.

It is obvious that the authors or those who worked on the original surveys could not always have first-hand knowledge of all the areas involved. Wherever possible, interviews have been arranged with persons who have worked in these countries; in many instances it has been the good fortune to have the survey actually prepared by such a person. In the assembly of the information, a vast amount of contradictory data has been encountered. Persons who have carried out public health work in certain areas have violently disagreed with published statements regarding local conditions. In many instances a sense of local pride, an impulse for propaganda or a desire to soften the impact of criticism may have colored scientific writings on which reliance had to be placed. In preparing these surveys and editing them for publication, an attempt has been made to make allowance for such personal elements that color the reliability of original sources. It was inevitable, however, that exact evaluation was not possible in all cases and that certain sources have been overdiscounted and others accorded unmerited credence.

This book is thus released with full knowledge of its many inadequacies but in the hope that the material so contained will be of such value that those who labored on it will be forgiven for their errors, and that it may serve as a basis on which more extensive studies of geomedicine may be built in the reconstruction period to follow the present holocaust.



OUTER MONGOLIA
MANCHURIA
KARAFUTO
SINKIANG
HOKKAIDO
Sea of Japan
KOREA
HONSHU
AFGHANISTAN
Yellow Sea
JAPAN
TIBET
C H I N A
SHIKOKU
KYUSHU
East China Sea
NAMPO IS.
NEPAL
BHUTAN
RYUKYU IS.
I N D I A
FORMOSA
BURMA
FRENCH
HAINAN
Arabian Sea
Bay of Bengal
South China Sea
PACIFIC OCEAN
THAILAND
INDO-CHINA
PHILIPPINE ISLANDS
ANDAMAN IS.
LACCADIVE IS.
NICOBAR IS.
MALAYA
MALDIVE IS.
CEYLON
CELEBES
SUMATRA
BORNEO
NEW GUINEA
CHAGOS ARCH.
INDIAN OCEAN
JAVA
R.F. SCOTT

THE FAR EAST

1

Burma

GEOGRAPHY AND CLIMATE

Burma, formerly a province of the Indian empire, is situated in the tropics between 10 and 28° of north latitude and 92 to 102° of east longitude. Geographically, Burma is a part of Indo-China, but for more than a century has been associated with Great Britain. Upper Burma, for instance, was the former independent kingdom of Burma, annexed to the British Empire in 1886; whereas Lower Burma represented, roughly, the areas won by the British in the two wars of 1826 and 1852. What is now known as Burma has an area of some 262,000 square miles. It is thus about the size of the state of Texas (265,896 square miles). It is bounded on the north by Tibet and China; on the northwest by Assam, the independent state of Manipur, and part of Bengal; on the west by the Bay of Bengal; on the southwest by the Gulf of Martaban; on the east by the Chinese province of Yünnan, French Indo-China and Thailand.

It is thought that the population of Burma is between 14,000,000 and 15,000,000. This population is composed of many races, members of which speak some 26 languages. Generally, it can be said that the majority of the people are of Mongol descent, and that the Burmese, including the related Arakanese, the Tailangs and the Tavoyans, number approximately 11,000,000. The influx of Indians in recent years is known to have been considerable. They were attracted by the relatively high wages available in Burma, a country which is both underpopulated and underdeveloped. Hence, the arrival in Burma of Indians, Chinese and the few English has added to the linguistic difficulties presented by the host of native dialects already existent there.

Physically, Burma is characterized by three great natural divisions: (1) the Arakan Yoma, a series of mountain ranges which form a barrier between Burma and India, (2) the Shan plateau, which occupies the entire eastern section of the country and extends to the south as far as Tenasserim in Lower Burma, and (3) the central basin, situated between the Arakan Yoma and the Shan plateau. Some of the peaks in the Arakan Yoma are 10,000 feet high, and the entire range constitutes a formidable obstacle to easy terrestrial commerce between India and Burma. The Shan plateau actually is a projection of the Yünnan plateau of China, and is said to have an average elevation of 3,000 feet, although it is broken in many places by great troughs. The central basin, conspicuous because it contains the Irrawaddy River, is for the most part a lowland area, although the extinct volcano of Mount Popa, almost 5,000 feet above sea level, is located in the center of it. Most of the hill and mountain country at one time was forested, and huge stands of timber are still standing. The most fertile districts of the country are those parts in or near the alluvial plains of the Irrawaddy delta and those along other river valleys.

Burma is well known for its hydrographic features. The great Salween River, 1,750 miles long, flows from Tibet through Burma to the Gulf of Martaban; the Irrawaddy, 1,350 miles long, originates in the eastern part of India and flows through Burma to the Bay of Bengal. Others are the Tenasserim, An, Sittang, Naaf, Kaladan and Lemru. Indawgyi Lake, in the north of Burma near Mogaung, has an area of about 100 square miles; another lake is Inlé in the Shan States, a lake that is steadily decreasing in size.

It has been said that Burma has three seasons: (1) a cool and rainless period lasting from the end of October through February, (2) a hot and rainless period lasting from March to the end of May, and (3) a rainy period which persists from about June through October. Along the coast line and particularly in the region of Tenasserim the daily and even the annual range of temperature is small, but inland, as the tempering effect of the ocean is dissipated, the range of temperature is extensive; in Mandalay, for instance, the range is as much as 20° F. (11.1° C.). In the southern part of Burma the average temperature is said to be 80° F. (26.6° C.). From October until May, Burma is influenced by the northeastern monsoon; toward the end of May the southwestern monsoon begins. This wind, coming from the Indian Ocean, is the rain-bearing wind; those regions situated along the coastline receive the full force of this monsoon, and hence, have the most rainfall. Most of Arakan receives almost 200 inches (5 meters) of rain annually; Rangoon has about 99 inches (2.5 meters) of rainfall a year; Mandalay, situated in a dry section, has only about 33 inches (0.8 meter) annually.

PUBLIC HEALTH

Health Services *

Organization. There were two separate medical departments in Burma: the Public Health Department and the Department of Civil Hospitals and Dispensaries. The chief of the former department was the Director of Public Health; the chief of the latter department was the Inspector General of Civil Hospitals. Each official had several assistants. Since there never was a sufficient number of public health workers to serve the entire area of Burma, a civil surgeon or an assistant surgeon in charge of a hospital, in a district in which there was no health official, was appointed district public health officer. Such men received a salary from the Department of Civil Hospitals and Dispensaries. The Public Health Department controlled both the district staff and the urban staff. The district staff consisted of five district health officers, five assistant district health officers, and 36 subassistant surgeons who constituted the principal mobile staff and did most of the preventive inoculations in the rural areas, supervised vaccination as carried out by local officers, checked vital statistics, conducted programs of health education, and gave medical and sanitary advice to the head men of the villages. Serving under these 36 subassistant surgeons were 79 public health inspectors, 20 inspectors of vaccination and 317 vaccinators. Members of the urban staff had the supervision of eight towns with eight second-class health officers, 21 medical registrars, 136 public health inspectors and 93 vaccinators.

Special units existed to deal with maternal welfare, inspection or examination of school children, and the promotion of education in the form of lectures, exhibition of motion pictures and lantern slides, and similar endeavors. Public health of the port of Rangoon was supervised by the port health officer who was responsible to a port commission. Patients on incoming ships who had infectious diseases were transferred from the vessels by boat to the town hospital. The port commission of Rangoon operated a launch which was equipped with a Clayton deratization apparatus.

Relative Effectiveness. In the larger towns and along the railways and rivers the Public Health Department of Burma dealt effectively with all health emergencies. Only in those towns or places sufficiently important to have a hospital or

* Unless otherwise indicated, governmental organization, medical facilities, and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

dispensary was it possible to maintain any reasonable degree of sanitation. For the securing of vital statistics from most of the villages it was necessary to rely on the head men of the places, so that the stated causes of sickness or death in such reports probably were of slight value. Most villages, particularly in the interior, had no physicians; days would be required to reach a physician in the mountainous and plateau regions of Burma. The problems presented by the existence of some 26 native dialects aggravated the difficulty of dissemination of health propaganda. Gradually, however, more and more of the native dialects were being reduced to writing, and by means of instruction in health as carried out in public schools valuable information was penetrating to the native tribes.

Water Supplies

In 1935 it was reported that only seven of those Burmese cities with a population of more than 20,000 had a water-supply system in which pipes were employed. This number doubtless had been increased since that year, but even so, it is likely that new installations served only parts of the cities in which they were built. Many smaller towns, such as Tawnggyi, the capital of the Federated Shan States, had excellent water supplies. Others had limited supplies of good water. With the aforementioned exceptions, water for a large part of the various urban communities in Burma was obtained from wells or adjacent ponds or rivers. In 1940 it was reported that the system in Rangoon was capable of delivering 25,000,000 gallons of water a day. Water was not piped to every house, but it was so distributed that residents could secure water from public spigots, for purposes of drinking or bathing. The water of Rangoon was said to be excellent, although it is understood that daily bacterial examinations were not carried out. In almost any area in Burma in which water is drawn from a river or lake, the probability that the source itself may be contaminated should be borne in mind. This is particularly true in rural districts, where deep wells and reservoirs are rare. As in India, it is the custom in Burma for the natives to wash their clothes and bathe themselves in the same streams or bodies of water from which they secure water for drinking.

Sewage Disposal

Only the city of Rangoon had what could be called a "satisfactory" water-borne system for sewage disposal, but even here, in certain sections, the pail system of collection of night soil and outside latrines were employed. In other cities the pail system was used almost entirely. Sometimes night soil was collected by a native who had a contract to carry out such work, but this practice was discouraged by the Public Health Department, which advocated a system in which night soil was removed under municipal supervision. This resulted in a concomitant scheme of taxation to support the service, with the result that many persons resorted to the use of outside latrines to avoid taxation. These latrines were likely to be most insanitary. In rural districts the disposal of excreta was achieved either by the use of poorly constructed latrines or by resort to jungle areas or fields. In a few rural sections the pail system of collection was employed, but such places were exceedingly few. Refuse and manure were removed only when it was convenient to do so, and constituted excellent sites for the breeding of flies. Most villages in Burma become veritable quagmires during the rainy season.

Insects and Animals

Vectors of Disease. Mosquitoes. Seven anopheline mosquitoes known to be vectors of malaria have been recorded as occurring in Burma. Listed in order of importance these are: *Anopheles minimus,* in both Upper and Lower Burma; *A. maculatus maculatus, A. fluviatilis* and *A. hyrcanus nigerrimus* in the same regions; *A. stephensi stephensi* in Upper and Lower Burma but also in cities; *A. culicifacies* in Upper Burma; and *A. sundaicus* in Lower Burma. *A. minimus* is the chief vector of malaria throughout Burma, and especially so in the Shan States, the northern part of Burma, along the old Burma Road and in Assam in India.

Aedes aegypti apparently is very prevalent in Burma, and it is known that dengue fever, spread by this mosquito, occurs in all parts of the country. *A. albopictus* has been reported from Rangoon, but no other species of Aedes are known to exist in Burma.

Eighteen species of Culex mosquitoes occur in or near Burma: *Culex bitaeniorhynchus, C. fuscanus, C. fuscocephalus, C. gelidus, C. malayi, C. mammilifer, C. mimulus, C. minor, C. mimeticus, C. pallidothorax, C. raptor, C. rubithoracis, C. sinensis, C. sitiens, C. theileri, C. tritaeniorhynchus, C. vishnui* and *C. whitmorei.* Four of the aforementioned mosquitoes are not known definitely to occur in Burma, but they exist in contiguous areas of Asia, and are thought to be present in at least some parts of Burma.

Lice. The three types of lice commonly associated with human beings are found in Burma: *Pediculus capitis,* the head louse; *P. corporis,* the body louse; and *Phthirus pubis,* the pubic or crab louse. The rat louse, *Polyplax spinulosa,* is an agent in the maintenance of a reservoir of typhus fever in rats; but this louse will not bite human beings.

Flies. The common housefly, *Musca domestica,* occurs everywhere in Burma. Tabanid flies, such as the horse fly or deer fly, exist chiefly in the jungles, where from May through October they plague the traveler, inflicting bites of such severity that temporary incapacitation may ensue. The horse fly is a vector of *Trypanosoma evansi,* thought to cause surra, from which numbers of horses die in Burma from June through August.

Sand flies of the family Psychodidae are found throughout Burma. *Phlebotomus sylvestris, P. argentipes* and *P. barraudi* have thus far been identified. *Phlebotomus argentipes* is a vector of kala-azar in other countries; doubtless it is such in Burma.

Ticks. Tick-borne typhus fever has been reported from the district of Thayetmyo in Lower Burma, but the tick which causes the disease has not been identified. Yet it has been well established that many ticks exist throughout Burma. *Rhipicephalus sanguineus,* the dog tick, appears to be present on nearly all dogs.

Mites. Mites of the genus Trombicula are present in the jungles and fields of Burma. The larval forms of certain species of Trombicula carry scrub typhus fever.

Fleas. *Xenopsylla cheopis,* the flea of rats, is the chief vector of plague in Burma. *X. astia,* which likewise afflicts rats, is found in most of the port cities. The dog flea, *Ctenocephalus canis,* infests almost all dogs.

Rodents. Considerable numbers of different kinds of rats have been identified in Burma. In a survey of rodents occurring around the docks of Rangoon the incidence by species was: *Rattus concolor,* the indoor rat, 31 per cent; *Bandicota bengalensis,* the outdoor rat, 30 per cent; *Rattus rattus,* 9 per cent; *M. musculus,* 13 per cent; *R. norvegicus,* 12 per cent; and others, 4 per cent. In addition to the foregoing rats, which are essentially pests which infest civilized places, the bamboo rat inhabits the jungles and does not invade human habitations until the roots of the bamboo plants, on which it feeds, die. At such a time hordes of bamboo rats, members of the genus Rhizomys, swarm into the rice fields and consume the crops because they have lost their normal supply of food. The rice famines thus precipitated can be predicted a year in advance, because the flowering of the bamboo precedes by that period the death of the roots.

Snakes and Other Dangerous Animals. The poisonous snakes of Burma are particularly numerous. *Bungarus flaviceps* is a yellow-headed krait, not common, which has a venom that may be neurotoxic. *Bungarus fasciatus* is a banded krait, common and dangerous, which has a venom that is neurotoxic. Another reptile, very rare, is the Burmese krait, a possibly dangerous snake which seems to exist only in the basin of the Irrawaddy River. *Bungarus candidus* is an uncommon reptile, called the "many-banded krait," which has a venom that may or may not be neurotoxic. *Naja naja* is the cobra, exceedingly dangerous and rather common, which has a neurotoxic venom. *Naja hannah* is the king cobra, a deadly and common snake with a neurotoxic venom. *Vipera russellii,* or *Daboia russellii,* is a deadly snake with a hemotoxin; it is found in the valley of the Irrawaddy River. A large, spotted pit viper, *Trimeresurus monticola,* is neither very common nor very dangerous, although it does have a hemotoxin. *Trimeresurus gramineus,* a green tree viper, likewise is comparatively rare, but has a hemotoxin. To these terrestrial snakes can be added about 20 species of marine snakes, which thus far are poorly defined.

Wild elephants appear occasionally in the extreme eastern and western parts of Burma. Tigers, leopards, boars, and wild cows and dogs are dangerous, but apparently are not often encountered.

Pests. Terrestrial leeches, such as *Haemadipsa zeylanica,* are found in all parts of Burma during the rainy season, and particularly in the mountainous and plateau country. About 1 inch (2.5 cm.) long before ingestion of a blood meal, these leeches cling to leaves and twigs to await the approach of a man or animal, and attach themselves to the skin and engorge themselves. The bites they inflict are not in themselves dangerous, but men and animals, in exceptional cases, have been known to die of the excessive loss of blood that is sometimes produced. Moreover, the bites have a peculiar susceptibility to infection.

Cockroaches are ubiquitous in Burma. They contaminate foodstuffs and consume paper and clothing when other foods are not available to them.

Scorpions occasionally occur in droves in Burma, but are not dangerous except in unusual circumstances. The stings they inflict are locally painful, but do not cause death.

Bedbugs infest almost every native dwelling in the hill country, and have been noted in the valleys as well.

Food and Dairy Products

The Burmese generally obtained their food in bazaars, which were uncommonly dirty. Rats, flies and cockroaches were present in abundance, and the rats often made these bazaars the centers of plague. The government exercised some degree of supervision over the bazaars, and there was an improvement in sanitation generally, but much remained to be done in this respect.

Rice was the chief article of food. More rice was exported by Burma than by any other country in the world. Small quantities of fruits and vegetables were obtainable in some regions. Potatoes were grown extensively, but were also exported, because the Burmese preferred to eat rice. Fruits were cultivated carefully, and were consumed at the points of production. In 1940 about $200,000 worth of various fruits was imported. It was said that in normal times the supply of beef, pork and poultry in Burma was adequate. Milk was of poor quality, and was not much used by the Burmese. It was produced and sold chiefly by emigrants from India.

Miscellaneous Problems of Sanitation

The topography of Burma in itself presents distinct problems in sanitation. In Lower Burma the vast rice fields and many of the villages are inundated during the rainy season, so that ideal conditions are produced for the development of the intestinal diseases. The central section of Upper Burma in the vicinity of Meiktila, on the other hand, is a dry region, perhaps the most healthful district in all Burma. In the great plateau areas of the Shan States and the mountainous parts of the east, north and west, malaria arises during the rainy season and the enteric diseases seem to follow the appearance of the great hordes of flies after the rains begin. In mountainous districts more than 4,000 feet high the environment apparently is healthful for Europeans; but native Burmese at such an altitude seem to acquire intestinal parasitism and malnutrition, for reasons that have not been advanced. When Burmese of the mountains go down into the lower areas they often acquire malaria. Yet, in ordinary times, the possibility of maintaining adequate nutrition and controlling disease, perhaps excepting malaria, doubtless could be achieved by the institution of a good health program.

MEDICAL FACILITIES

Hospitals

Number of Beds. In 1935 there were 9,364 beds located in 315 government hospitals, in which almost 4,000,000 patients were treated during that year. Excellent hospital buildings were situated at Rangoon, Maymyo, Mandalay, Moulmein and Namhkam.

Equipment. All the larger hospitals possessed equipment with which to carry out major surgical procedures, and roentgenologic apparatus was available at Akyab, Syriam, Pegu, Bassein, Tavoy, Tawnggyi, Mergui, Moulmein, Namhkam, Mandalay, Maymyo, Toungoo and Rangoon. Most of the more important hospitals had facilities for routine laboratory work, and had microscopes.

Supplies. There were no facilities for the preparation of drugs in Burma; hence, drugs and most other supplies were imported. All the important medical and surgical supply houses were situated in Rangoon, including four dental supply companies.

Medical Personnel

Physicians. Two classes of physicians practiced medicine in Burma. The first consisted of those who had the degree of either doctor of medicine or bachelor of medicine. The second was composed of those who were graduates of the Burma Government Medical School (not the College) or a similar institution in India. Graduates of the Rangoon school and similar institutions received the diploma of licensed medical practitioner, and usually were given the post of subassistant surgeon. In 1937 the Premedical Council, with which are registered physicians with the degree of doctor of medicine and those with the diploma of licensed medical practitioner, had 1,521 on its register. Others, not registered, were practicing medicine in Burma, and were thought to have been unqualified. Most of the physicians in Burma were appointed by the government to work in government hospitals and dispensaries. More than 95 per cent of all treatments administered outside the largest cities were given free of charge. In 1939 physicians and other medical personnel were in the employ of the government to this extent: Indian Medical Service, 22; Indian Medical Department, 101 salaried assistant surgeons, 370 salaried subassistant surgeons, 48 honorary graduates or licentiates, 636 nurses, 139 midwives and 326 compounders.

Nurses. There never were enough nurses to meet the demand in Burma. Roman Catholic sisters were engaged in a few hospitals; some of these women were well trained before they entered the hospitals and others were trained after they had begun such work. Private nurses were exceedingly rare.

Dentists. Ten dentists were listed. They practiced in Moulmein, Rangoon and Maymyo. There were many unregistered dentists, most of whom received their training by serving as an assistant to a dentist for only a few months. In most cases the dentist under whom they had served had gained his training in the same way.

Others. The demand for midwives was very great in Burma, but there were less than 200 of them. Compounders, similar to the *infirmiers* in French Indo-China, assisted in surgical operations, served as interpreters, and aided the physician in his business affairs. There were more than 300 compounders in Burma, and it is believed that most of them came from India.

Medical Institutions

The Medical College at Rangoon was part of the University of Rangoon. It was coeducational and conferred the degree of bachelor of medicine at the completion of four years of work. From 10 to 20 persons were graduated each year, and these graduates as a rule were appointed to government service as assistant surgeons. In 1936 there were 117 men and 28 women at this school, and about half of them were Burmese. The Government Medical School accepted persons who had only a high-school education. Those who were graduated received the diploma of licensed medical practitioner, and became subassistant surgeons in the government service. In 1940 there were 178 students at this school: Burmese, Indians, Chinese and others. From 30 to 50 students were graduated from this school each year. Nurses were trained at three hospitals: the Rangoon General Hospital, the Ellen Mitchell Memorial Hospital at Moulmein, and the Harper Memorial Hospital at Namhkam in the northern part of Burma. In Rangoon there was a proprietary dental school of questionable standards; there were no others. Midwives were trained at the Dufferin Maternity Hospital in Rangoon, the Ellen Mitchell Memorial Hospital at Moulmein, and the Harper Memorial Hospital at Namhkam. At the Civil Hospital at Tawnggyi in the Shan States a training center for midwives was maintained for the women of the area. Compounders were trained at a very few of the civil hospitals, but less than 10 compounders were graduated annually. Some compounders learned the necessary routines by virtue of several years of work as ward servants.

The Peabody-Montgomery Rest Haven at Tawnggyi received patients who had inactive tuberculosis. A government hospital for the treatment of nervous and mental diseases was maintained at Rangoon, and another was located at Minbu. Large asylums for lepers were maintained at Rangoon and at Moulmein, and two were in operation at Mandalay. Some 16 leper colonies were in existence in 1940, and 10 of them were in the state of Kengtung.

A Pasteur institute and bacteriologic laboratory at Rangoon served all the hospitals in the country. This institute had two divisions, a rabies section and a bacteriologic section. In 1933 the rabies section produced 181,472 c.c. of vaccine. It was said that in the same year the number of patients treated at the institute, its three centers and district hospitals, was 3,143. In the bacteriologic section specimens of blood were accepted and examined for evidences of syphilis and malaria; Widal and Weil-Felix tests were conducted, agglutination tests were carried out for dysentery and undulant fever, and studies in blood chemistry were made. Examinations of sputum, urine, feces, cerebrospinal fluid, material from wounds and pathologic specimens were done. Material for use in the treatment of leprosy, and especially oil of *Hydnocarpus wightiana* and sodium hydnocarpate, was prepared and sent to leper colonies. Serums, vaccines and antivenins were stocked and sent out as they were needed. At Meiktila in Upper Burma a vaccine depot was maintained at which smallpox vaccine was produced and distributed. A tuberculosis dispensary was situated in Rangoon, and the Harcourt-Butler Institute of Public Health carried on instruction in certain fields and also possessed facilities for various types of examinations.

Social Services. In the largest cities local chapters of the Red Cross carried on work in association with the Burmese Red Cross Society. The Burma branch of the British Empire Leper Relief Association provided funds with which work was carried out among lepers in Burma. The Burma Tuberculosis and Leprosy Relief Association worked in close relationship to the former organization. Various organizations devoted to child welfare and maternal care functioned in the larger centers. The American Baptist Mission maintained three hospitals and several dispensaries, and did work in the control and treatment of leprosy. The Seventh-Day Adventists had two nursing homes and one clinic. The Roman Catholic Mission in Burma supplied many nurses for government hospitals and also did work among lepers. The Methodist Episcopal Church maintained an asylum for lepers in Mandalay.

DISEASES

Diseases Spread Chiefly Through Intestinal Tract

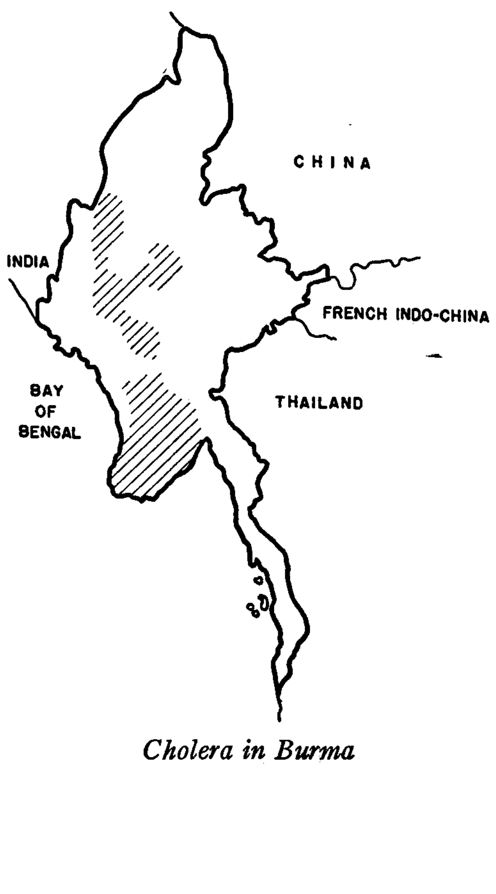
Dysentery and Diarrhea. During the rainy season intestinal diseases were serious throughout Burma. As has been intimated, flies breed in abundance and sanitation was almost nonexistent in the villages, so that it was virtually impossible to prevent the transference of pathogenic organisms or parasites from sewage and refuse to food. Hospitals in 1939 admitted 91,328 patients with diarrhea and dysentery, and 647 of them died. The incidence of these two diseases was highest in June and July. In the public health reports for 1939, in those areas in which registration was carried out, 1,572 deaths were recorded as having been caused by diarrhea.

Amebic Dysentery. Hospitals of Burma reported in 1939 that 24,115 patients had been admitted for amebic dysentery, and that 189 had died. It is likely that among the 54,067 patients admitted to Burmese hospitals for diarrhea in 1939, many had amebic dysentery.

Bacillary Dysentery. In 1939 the hospitals of Burma reported that 13,146 patients were admitted for bacillary dysentery, and that 182 had died. In addition, it seems probable that many of the 54,067 patients admitted to hospitals for diarrhea alone actually had bacillary dysentery. It is probable that the real number of cases of bacillary dysentery in Burma annually surpasses 100,000.

Typhoid Fever. In Burma typhoid fever was a common disease, much more than the statistics would indicate. In the hospitals of all Burma in 1939 only 1,896 patients were treated for typhoid fever; only 184 of these died of the disease. In the public health report for that year only 383 deaths were reported as having been caused by typhoid fever. These figures cannot be otherwise than exceedingly incomplete, for typhoid fever was known to occur in the length and breadth of the land.

Cholera. Cholera was one of the principal endemic diseases of Burma. It was most prevalent in the latter part of the dry sea-



Cholera in Burma

son and during the early part of the rainy season, although in 1939 it occurred most often in December. Most of the patients, it was said, did not reach a hospital. In 1939 there were only 330 patients and 74 deaths in hospitals, whereas the Public Health Department reported that 1,468 persons in Burma died of the disease in that year—1,252 in villages and 216 in larger places. Anticholera measures were carried out in all districts in which the disease appeared. Water supplies were guarded, inoculation against cholera was performed and means were taken to educate the people through lectures and pamphlets.

Intestinal Parasitism. Throughout almost all the rural areas of Burma infection with various types of intestinal parasites actually was the rule rather than the exception. Ascariasis seemed to be most common, and in certain areas infection with hookworm was second in importance. In other sections infection with the beef tapeworm, *Taenia saginata,* was frequent. Infection with the pork tapeworm, *T. solium,* was rare. Hospital reports for 1939 indicated that 277,559 persons had been treated for infection with roundworm. Eleven hundred persons were treated for taeniasis in which the species of Taenia was not stated. Treatment was administered to 1,623 persons for ancylostomiasis (infection with hookworm), and 56 of these persons died. Intestinal parasites, as might be surmised, were most prevalent in those regions in which night soil was disposed of in fields or jungle areas near villages.

Diseases Spread Chiefly Through Respiratory Tract

Pneumonia. In 1939 in the larger towns of Burma 4,461 deaths were ascribed to pneumonia. In the same year deaths from all forms of respiratory diseases in the towns of Burma totaled 10,300. For the rural areas in which reports were returned, slightly less than 3,000 deaths were listed as being caused by respiratory diseases, a figure which doubtless is less than the true number, since in the villages the head man generally determined the cause of death and made the report, and he was likely to ascribe any death in the presence of fever to "fever," regardless of its cause. Some conception of the importance of respiratory diseases in Burma can be gained from the fact that 347,245 patients with diseases of the respiratory system other than pneumonia were treated in the hospitals of Burma in 1939.

Influenza. Each year, at the beginning of the cold season, epidemics of influenza-like infections broke out in Burma. The spread of such epidemics was especially favored by the Buddhist practice of holding a festival to which thousands of adherents came; in all Burma perhaps half the population were accustomed to attend such gatherings. It had been noticed that such festivals invariably were followed by a general epidemic of colds or influenza.

Pulmonary Tuberculosis. In the towns of Burma 2,520 deaths, or 178 per 100,000 of population, were recorded as caused by pulmonary tuberculosis in 1939. All other forms of tuberculosis caused 246 deaths. In the hospitals of Burma in that year 9,714 patients with pulmonary tuberculosis were cared for in Burmese hospitals, and 817 patients died of the disease. Patients who had other forms of tuberculosis treated in hospitals numbered 2,237, and 123 of them died. It should be said that the reporting of cases of, or deaths from, tuberculosis in Burma was inadequate; in many reports such terms as "fever" or "respiratory disease" appeared. Rather high rates for tuberculosis were reported from the towns of Danubyu, Myaungmya and Mergui. A dispensary devoted to tuberculosis was maintained at Rangoon, at which the attendance was 34,206 in 1938 and 38,039 in 1939.

Smallpox. Smallpox occurred every year in the mountains of Burma, and was often encountered in the jungles. In Burmese reports a relatively high morbidity or mortality rate in a single area was likely to be misleading, because the disease occurred most heavily in areas in which reporting was poorest. As a matter of fact, however, despite the large numbers of cases of this disease that have been reported, the program of the Public Health Department in which corps of vaccinators were sent out to villages had succeeded in very nearly controlling this scourge. In 1939 in the whole of Burma vaccination against smallpox was carried out 1,525,238 times, and in that year only 125 deaths from this disease were reported. Although it seems probable that many more deaths actually occurred than were reported, the figure for 1939 was the lowest for deaths from smallpox since records were first kept in Burma (1872).

Diphtheria. Hospitals of Burma reported that 646 persons had been treated for diphtheria in 1939, and that 22 patients had died. The form of diphtheria which occurred in Burma seemingly was mild.

Measles. In the past measles occurred in two-year cycles in Burma. The disease was especially noticeable in areas in which school children came together, and was of the same severity as measles in the United States.

Cerebrospinal Meningitis. Only 28 deaths from cerebrospinal meningitis were recorded in 1939. Most had occurred in Rangoon.

Poliomyelitis. Poliomyelitis apparently was so rare in Burma that it never was listed in the records.

Chickenpox and Mumps. Chickenpox and mumps were found all over Burma. They never were serious. Chickenpox, in particular, was regarded by many Burmese as being smallpox, and this resulted in a demand for vaccination against smallpox on the part of such natives.

Psittacosis. Since parrots, pigeons and parakeets are very numerous in the jungles, it may be that psittacosis is encountered in Burma.

Diseases Spread Chiefly by Contact

Venereal Diseases. Venereal disease was common in both the urban and rural areas of Burma. In 1939 there were seen in hospitals 39,791 patients with syphilis, 29,458 with gonorrhea, 8,128 with chancroid and 6,831 with other forms of venereal diseases such as lymphogranuloma venereum and granuloma inguinale. In one study 80 per cent of the natives of the Kachin Hills near Bhamo, 60 per cent of the Indians at Rangoon and 32 per cent of the male students at the University of Rangoon were found to have venereal disease. Twenty-seven special centers for the treatment of venereal disease were established in Burma.

Yaws. Yaws was reported from Upper Chindwin district, certain sections of Lower Chindwin district and Katha district. Special therapeutic campaigns were initiated in the vicinity of Mandalay and Tavoy. Yaws was endemic in Bhamo district along the Kaukkwe River, and small foci of infection were reported from other sections. Wherever many natives were found to be suffering from the disease, special therapeutic campaigns were carried out with what were said to be satisfactory results.

Trachoma. Trachoma was frequent in Thayetmyo, Magwe, Upper and Lower Chindwin, the Shan States, Bhamo, Shwebo, Minbu and Myingyan districts. In 1939 Burmese hospitals treated 23,196 patients who had trachoma. Arrangements had been completed for the storage of tablets, from which an eye lotion could be made, in 23 treasuries in Burma (in outlying districts of Burma it was the practice of branches of the government treasury to maintain supplies of such drugs as quinine, cinchona febrifuge and others, for either free distribution or sale to the public).

Leprosy. Leprosy was common throughout the central and eastern portions of Burma. In certain sections of the Shan States, such as those adjoining Thailand and China, the incidence of leprosy probably was as high as it is anywhere else in the world. For a considerable period the government exhibited a very keen interest in the prevention of leprosy, and many colonies were established for the treatment of lepers. Almost 2,000 lepers were cared for in such colonies. In addition, perhaps 2,000 more lepers were treated in the various asylums of Burma. It is thought that there were 30,000 to 50,000 lepers in Burma.

Diseases of the Skin. Fungous conditions were common. Trichophytous and epidermophytous infections were particularly likely to develop in those parts of the body covered by clothing, and especially the axillae and groins. Many Chinese in Burma were infected with favus. In 1939, hospitals in Burma treated 289,507 persons who had cutaneous diseases which were not classified, except for ulcers and inflammation of the skin. Scabies was found throughout Burma, but was more prevalent in the rural districts than elsewhere. In 1939 persons with scabies admitted to the hospitals of Burma numbered 102,840.

Rabies. Rabies is encountered at times in Burma. Natives in most of the villages keep dogs for protection, and since the movements of these animals are almost never restricted, a dog is free to spread the infection if it becomes rabid. In 1939 the Pasteur institute at Rangoon treated 1,536 persons who had been bitten by dogs. From 1915 to 1933 persons treated for bites of various animals numbered 13,860, and 75 died. The 75 who died, however, had been bitten by dogs.

Tetanus. Tetanus among the newborn and the mothers of newborn had been encountered fairly frequently in the rural parts of Burma. The condition, in general, occurred rather evenly throughout Burma. One hundred and forty-nine cases were recorded in 1939, with 52 deaths.

Weil's Disease. Weil's disease or infectious jaundice or leptospiral jaundice was said to be frequent in Burma. The rat is the natural reservoir of the causative organism, *Leptospira icterohaemorrhagiae,* although other rodents and also dogs have been shown to be vectors. The disease is ordinarily transmitted by the contamination of food and water with the urine or feces of infected rodents, but it is also true that the causative organisms can pass through breaks in the skin or be absorbed through the mucous membranes. When this disease occurs in epidemics the mortality rate may be high.

Epizootic Stomatitis. Foot-and-mouth disease occurred almost every year among the cattle in Burma. In the majority of cases nothing was done to stamp out the disease. The possibility that this disease, in the form of epidemic stomatitis, might be transmitted to human beings should be borne in mind.

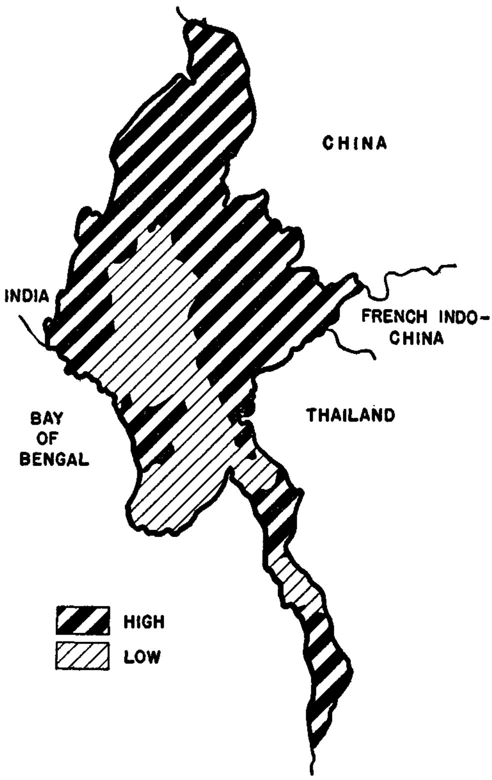
Rat-bite Fever. Rat-bite fever is rare, but does occur throughout Burma.

Diseases Spread by Arthropods

Malaria. In Burma the morbidity and mortality of malaria were greater than those caused by any other disease. The incidence of malaria, as judged by the number of malarious patients admitted to hospitals in Burma, is increasing. In 1937 this number was 469,074; in 1938 it was 516,379; in 1939 it was 604,049. In the latter year 3,029 persons died of this disease, a rate of 214 per 100,000 of population. These figures, however, include only the cities and towns of Burma, with a combined population of 1,412,601. For the districts of Burma, not including the Shan States, deaths caused by "fever" in 1939 amounted to 120,904. It can be assumed that at least half this number resulted from malaria. As a rule, the greatest mortality from malaria was recorded in December. All three forms of the disease occurred: tertian, quartan and estivo-autumnal. It seems likely that malaria is endemic in every part of Burma excepting the dry zone in the vicinity of Meiktila, mentioned previously herein, the larger cities, and the mountainous regions of altitudes of more than 4,000 feet. During the dry season new infection with malaria is rare.

It is important to remember, also, that in many districts in which the prevalence of malaria was greatest the hospital facilities were either meager or nonexistent.

Hence, many malarious patients were never hospitalized at all. In such regions infant mortality was between 300 and 500 per 1,000 live births, and was caused largely by malaria. At Lashio in North Hsenwi state, which represented the starting point of the old Burma Road, the death rate from



Incidence of Malaria in Burma

malaria has been as high as 38.2 per 1,000 of population—the highest rate for any given cause of any place in Burma.

Blackwater Fever. Two hundred patients who had blackwater fever were admitted to hospitals in Burma in 1939. Thirty of them died. Of the total of 200 patients, 119 were from the Northern Shan States, in which Lashio is situated. Many cases of blackwater fever were never reported, since death occurred at the homes of the victims, who had no medical attention. The greatest number of cases, excepting those from the Northern Shan States, was recorded from Myitkyina in north Sagaing district, in Upper Chindwin and in the Southern Shan States.

Measures of Control. The malaria bureau of the Harcourt-Butler Institute of Public Health conducted many surveys of malaria in Burma. Results of these surveys were not available at the time of writing of this chapter, but it is known that antimalarial measures were carried out systematically at Akyab, Kyaukpyu, Lashio and Maymyo. Cinchona febrifuge tablets were distributed free of charge to those in need of them. Larvivorous fish were distributed from the central hatchery at the Harcourt-Butler Institute to subsidiary hatcheries at many places.

Filariasis. Filariasis has been reported from Burma. Most of the cases are recorded in Tenasserim and Mandalay and along the Arakan coast. Treatment was administered to 587 patients with filariasis and 795 patients with elephantiasis in 1939. No information was obtainable concerning the relative importance of *Wuchereria bancrofti* and *W. malayi*, but it is probable that in most instances the disease was caused by *W. malayi.*

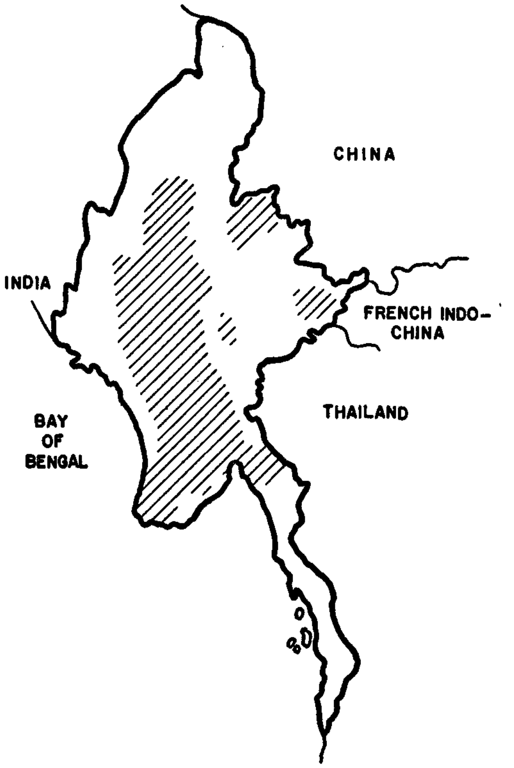
Dengue Fever. Dengue fever was very important in Lower Burma. In 1939 it was reported that 1,242 persons had the disease and that four of them died. This figure doubtless represents only a very small proportion of the actual number of cases. Dengue fever has not been reported in the Shan States and along the Burma Road and it is likely that it does not occur there.

Yellow Fever. *Aedes aegypti* is found in all parts of Burma, but yellow fever never has been reported from the country. Yet the fact that transportation by airplane from Africa and South America may in the future be extensive should emphasize the possibility of the introduction of this disease.

Typhus Fever. Since 1932 the possibility that typhus fever might occur in Burma had been investigated increasingly, and it was discovered that the disease was being diagnosed more and more often each year.

In the hospitals of Burma in 1939 there were admitted 56 patients with louse-borne typhus fever, four with tick-borne typhus fever and 76 with typhus fever of which the vector was unknown. Perhaps the 76 had mite-borne typhus fever. It is obvious, on the basis of available reports, that typhus fever of all kinds is present in Burma, and that the true number of cases is greater than was ever reported.

Plague. Plague was endemic in Burma. The rat flea, *Xenopsylla cheopis,* usually



Plague in Burma

was the vector. In the central part of Burma the seasonal peak of infection usually was reached in January and February, and a secondary increase as a rule followed in July and August. These two periods coincide, approximately, with the periods in which biologic conditions for fleas are optimal. In 1939 in Burma proper 3,266 deaths from plague were recorded, and 2,282 of them were reported from rural areas. Considerable effort was expended by the Public Health Department in deratization in the more important villages, and inoculation against plague was carried out whenever an outbreak of the disease occurred. A few cases of the pneumonic form of plague were recorded, but serious epidemics of it apparently did not take place. From August, 1940, to July, 1941, 996 deaths from plague were reported from rural areas in Burma. In 1939-1940, for the same period of months, 724 deaths were reported.

Sandfly Fever. Sandfly fever is found in certain sections of Burma, and when this disease does appear it occurs in epidemics. One hundred and sixteen patients were treated for sandfly fever in the hospitals of Burma in 1939, and 113 of the patients were from Upper Chindwin. The disease also has been reported from the vicinity of Rangoon, Mandalay and along the Salween River. The vector of the disease is a sand fly of the genus Phlebotomus.

Relapsing Fever. In 1939 cases of relapsing fever reported in the hospitals of Burma amounted to 181. The patients lived chiefly in the districts of Prome, Mandalay and the Northern Shan States. Details as to the vectors of the disease were not available.

Leishmaniasis. Leishmaniasis or kala-azar, caused by *Leishmania donovani,* and spread by a sand fly of the genus Phlebotomus, has been reported from Lower Burma; it would appear that the majority of the patients were people from India. Ninety-two patients with kala-azar were treated in Burmese hospitals in 1939, and seven died. Most of the patients came from the vicinity of Rangoon. Dermal leishmaniasis, or tropical ulcer or Oriental sore, was known to occur, but information concerning the condition was not available because it was generally included in reports of skin diseases.

Dracontiasis. Infection with guinea-worm has been noticed. Twenty-five cases were reported in 1939.

Nutritional Diseases

Beriberi. In 1939, in urban areas, 243 deaths were caused by beriberi, a figure which was lower than that for the preceding year. In 1939, likewise, 3,916 patients were treated in the hospitals of Burma. Beriberi was reported from Bhamo; Upper Chindwin, where many of the camps of the Bombay-Burma Trading Corporation were located; the Pyapon district, where Madrasi and Burmese coolies were chiefly affected; the Mergui district, where laborers of the Thai, Telugu and Malay peoples subsisted on unsatisfactory diets; and from Maubin, Mawlaik, Nyaunglebin, Kyaukse, Yandoon and Syriam.

Goiter. Goiter, found in many mountainous areas of Burma, was so serious a problem that a physician was designated to carry out a special survey of the condition in the Chin Hills in 1940. Results of this survey were not available, but the hospitals treated 32,048 patients with goiter in 1939. A third of the patients came from the Chin Hills; another third came from the Northern Shan States. Most of the remaining patients came from the northwestern part of Burma.

Miscellaneous Conditions

Injuries Caused by Heat. The intense heat and humidity, notably in Lower Burma, are apt to cause heat injuries. Sunstroke and heat exhaustion occurred most often during March and May, but they rarely affected native Burmese. They afflicted chiefly those Europeans who had not become accustomed to the intense humidity and heat.

Snake Bite. In 1935 snake bite was responsible for the deaths of 2,186 people in Burma. Seventy-six of the victims were from urban areas and 2,110 of them were from rural districts. It was said that the bite of *Vipera russellii* was the most common cause of death from snake bite. Mortality rates were highest in the districts of Tharrawaddy, Pegu, Maubin, Magwe, Sagaing and Insein. In 1936 a pamphlet printed in Burmese, in which advice on the prevention and treatment of snake bite was set forth, was circulated widely.

Alcoholism and Addiction to Drugs. Alcoholism was not a formidable problem in Burma. Many Burmese drank a native type of alcohol which was weak, but true alcoholism was limited chiefly to foreigners in Burma or those natives who used imported liquor. On the other hand, it is known that among the tribes in the hill country along the borders of Burma the smoking of opium was rather prevalent. In the hospitals of Burma 601 persons were treated for poisoning by opium in 1939. Addiction to morphine was reported from Rangoon, and marihuana was known to have been used by the Indians.

Allergic Conditions. On the basis of results of various studies of the pollens of bamboo and sugar cane, it is evident that persons subject to hay fever probably experienced distress from pollinosis in Burma. Bamboo is cultivated in Burmese villages and it also grows extensively in the jungles. Sugar cane was one of the important crops of Burma. The pollen of these two plants resembles in allergic effect the pollen of the common grasses of the Occident.

Melioidosis. The "glanders-like disease of Rangoon," melioidosis, which is caused by *Malleomyces pseudomallëi,* was reported from Rangoon. The reservoir of infection is the rat. The clinical manifestations of the disease may resemble those of plague, cholera, malaria or typhoid fever. Patients with melioidosis usually die within 10 days. Prevention is maintained by careful attention to food which is likely to become contaminated with the urine or feces of rats.

Plumbism. Lead poisoning was mentioned frequently in public health reports. Apparently, the condition developed chiefly among workers in the Namtu-Bawdwin mines. Careful supervision of the workers and routine examination of the blood were said to have resulted in early detection of the condition, before symptoms became severe.

SUMMARY

Responsibility for the programs of public health and medical care in Burma was divided between the Public Health Department and the Department of Civil Hospitals and Dispensaries. These two departments were able to promote an effective program that did much to improve the health of the country in general, even though it could not be said that what had been accomplished was adequate. Few other countries had so many serious problems of health as those which confronted Burma. Hospital and medical facilities were inadequate, and almost all supplies had to be imported. In most areas water was plentiful, but because sanitary methods of disposal of wastes were lacking, it probably was unsafe for human consumption before it had been treated. The larger cities had systems in which sewage was water-borne; in the rural areas promiscuous defecation was the usual method of disposal, so that pollution of the soil was widespread. In some areas night soil was used as fertilizer. Insects and animals dangerous to man abounded in Burma, and included mosquitoes, various kinds of flies, rats, fleas, mites, lice, scorpions, leeches, poisonous snakes and predatory animals.

The major problem of public health in Burma was malaria. The disease was widespread over the country and the incidence was highest in the northwestern provinces and those in the eastern half of the country. Other diseases of importance were the enteric diseases, such as typhoid fever, paratyphoid fevers, bacillary dysentery, amebic dysentery and the common diarrheas; venereal diseases, such as syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale; plague; cholera; dengue fever; sandfly fever; diseases of the skin; typhus fever; and pneumonia. Injuries caused by heat might be considered of importance to unacclimated persons. Leishmaniasis, filariasis and rabies at times present serious problems.

BIBLIOGRAPHY

Burma: Report on the Administration of Burma. Rangoon 1867-1936.

——: Educational Dept.; Report on Public Instruction in Burma 1939/40.

——: Government Medical School, Rangoon: Annual Report for 1933/34. Rangoon, Supt. Govt. Print., 1934.

——: Medical Dept.: Annual Report on Hospitals and Dispensaries in Burma for the year 1934 and Triennial Review for the Years 1932-1934. Rangoon, Supt. Govt. Print., 1935.

——: Pasteur Institute and Bacteriological Laboratory, Rangoon: Report for the Year Ending 31st December 1933. Rangoon, Supt. Govt. Print., 1935.

——: Public Health Dept.: Report on the State of Public Health in Burma during 1939. 2 pts. Rangoon, Supt. Govt. Print., 1940.

Christian, J. L.: Burma Between Two Wars. Asia, **41**:446-449 (Aug.) 1941.

——: Modern Burma. Berkeley, University of California Press, 1942.

Christophers, S. R.: Family *Culicidae*. Tribe *Anophelini*. London, Taylor and Francis, 1933 (The Fauna of British India, including Ceylon and Burma, *Diptera,* vol. 4).

Covell, G.: The Distribution of Anopheline Mosquitoes in India, 2d ed., by I. M. Puri. Delhi, Govt. of India Press, 1936 (Health Bull. No. 17. Malaria Bureau No. 8).

Denham, A. A.: Report of a Malaria Survey on [Pt. 1] The Pyinmana-Taungdwingyi Railway. [Pt. 2] The Anngban-Hepo Section of the Southern Shan States Railway. Rangoon, British Burma Press, 1925.

Feegrade, E. S.: A Malarial Survey of Bhamo Town with a Note by Col. E. Bissett. Rangoon, Supt. Govt. Print., 1926.

Fink, L. G.: Blackwater Fever in Burma. Indian M. Gaz., **42**:328-331 (Sept.) 1907; **47**:137-141 (Apr.) 1912.

Grewal, R. S.: Notes on the Anopheline Mosquitoes of Villages on the Arakan Coast of Burma. Records of the Malaria Survey of India, **7**:267-268, 1937.

Hirst, L. S.: Rat-flea Survey of Ceylon, with a Brief Discussion of Recent Work on the Rat Flea Species Distribution in Relation to the Spread of Bubonic Plague in the East Indies. Ceylon J. Sc., sect. D. **3(1)**:51-113, 1933.

——: Researches on the Parasitology of Plague. Ceylon J. Sc., sect. D. **1(4)**:155-455, 1927.

Huard, P., and Lond, M.: Mélioidose et chirurgie en Extrême-Orient, Rev. de chir. Paris, **75**: 773-793 (Dec.) 1937.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Jafar, M., and Singh, J. B.: Dengue Fever in the Rangoon-Mingaladon Area. Indian M. Gaz., **67**:674-675 (Dec.) 1932.

Jolly, G., Fenn, V. W., and Dorai, R.: A Rat-Flea Survey of Rangoon; the Port Area. Indian J. M. Research, **18**:1231-1244 (Apr.) 1931.

Kapila, C. C., and Maitra, G. C.: A Severe Case of Scrub Typhus. Indian M. Gaz., **72**:417-418 (July) 1937.

Kundu, M. L.: A Case of Typhus Fever in Rangoon. Indian M. Gaz., **67**:390 (July) 1932.

Lalor, N. P. O'G.: Spleen Census of the Province of Burma with a Malarial Map of the Province and a Preliminary Note on Blackwater Fever. Rangoon, Supt. Govt. Print., 1912.

——: Report on the Investigation of Malaria in the District of Katha, Burma. Rangoon, Supt. Govt. Print., 1913.

League of Nations: The Prevalence of Epidemic Disease and Port Health Organization and Procedure in the Far East. Geneva, 1923.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

Maitra, G. C., and Sen Gupta, P. N.: Note on Cases of Typhus Fever in Burma and their Distribution. Indian M. Gaz., **71**:572-574 (Oct.) 1936.

Maplestone, P. A., and Sundar, R. S.: Dracontiasis or Guinea Worm Disease. Indian Health Bull., No. 7, 1939.

Martin, C. C., and Anderson, L. A. P.: A Case of Tropical Typhus Serologically Related to Scrub Typhus of Federated Malay States. Indian M. Gaz., **68**:432-435 (Aug.) 1933.

Megaw, J. W. D., and Sundar, R. S.: Tick Typhus and Other Sporadic Fevers of the Typhus Group. Indian M. Gaz., **63**:306-318 (June) 1928.

Meyer, K. F.: Ecology of Psittacosis and Ornithosis. Medicine, **21**:175-206 (May) 1942.

Sinton, J. A.: A Bibliography of Malaria in India. Records of Malaria Survey of India, **1**:1-200 (Oct.) 1929.

Singh, A.: The Rebel Premier of Burma. Asia, **42**:17-19 (Jan.) 1942.

Soni, R. L.: Typhus Fever in Burma. Indian M. Gaz., **77**:79-81 (Feb.) 1942.

Stott, H.: Studies in Malaria. Indian M. Gaz., **49**:462-471 (Dec.) 1914; **50**:7-10; 47-52 (Feb.); 85-91 (Mar.); 131-135 (Apr.) 1915.

U. S. Bureau of Foreign and Domestic Commerce (Dept. of Commerce): Physicians and Surgeons, Burma, 1938; Dental Supply Houses, Burma, 1931; Hospitals, Burma, 1940 (Commercial Intelligence Division Reports).

Williams, L. L.: Malaria on the China-Burma Highway. Am. J. Trop. Med., **21**:1-11 (Jan.) 1941.

2

Ceylon

GEOGRAPHY AND CLIMATE

The British Crown Colony of Ceylon is situated in the Indian Ocean between 5 and 10° of north latitude and 79 and 82° of east longitude. It is separated from India by the Gulf of Mannar on the east and by Palk Strait on the northeast. The entire island of Ceylon has an area of only 25,481 square miles, or approximately the area of West Virginia (24,170 square miles). The maximal length of the island is 272 miles. It is 137 miles wide at the greatest lateral (east to west) extension.

An incomplete census carried out in 1931 indicated that the population was approximately 5,352,000. More recent figures are not obtainable.* Of that total some 3,500,000 were Singhalese, an Aryo-Dravidian stock the members of which are taken to be the original inhabitants of the island because their name derives from *Siṁhala*, the Sanskrit designation from which the word "Ceylon" evolved. There were also, in 1931, about 790,000 Tamils, chiefly immigrants from the southern part of India. Indian Tamils on estates numbered 692,000. There were 325,000 Moors, 35,000 burghers of Dutch and Portuguese strains, and perhaps 10,000 Europeans.

The physical aspects of the southern part of Ceylon are dominated by a principal mountain mass which occupies more than 4,000 square miles. Approaching this mass, at about 50 to 70 miles from the coast line, are the foothills. These culminate in several impressive peaks, such as Pedrutalagala, which is more than 8,000 feet high, and Adam's Peak, more than 7,000 feet high.

* The estimated population in 1940 was 5,981,000.

Another notable physical configuration is the plateau of Nuwara Eliya, which has an elevation in excess of 6,000 feet. The western coastal plains for a considerable expanse are covered with coconut palms; the eastern coast is rocky and comparatively lacking in vegetation. In the northwest, sandbanks and rocky declivities feature the coastline.

The Mahavili Ganga is the largest stream on the island. It empties into the Indian Ocean on the eastern coast of Ceylon south of the seaport of Trincomalee. It is navigable only in the lower parts. The Kala Ganga discharges near Kalutara on the southwestern coast, and the Kelani Ganga enters the sea near Colombo on the western coast. Neither of these two rivers is an important waterway. The northern part of Ceylon is notable for its many lakes, some of which were created artificially.

The climate of Ceylon is variable because of the different elevations of the island. On the plateau of Nuwara Eliya the climate is said to be nearly perfect from September to April, although rain falls almost daily from May to August. Rainfall in general is more extended, so far as area is concerned, in the northeastern portions of the island because in those regions the terrain is lower than elsewhere, presenting no great eminences which would intercept rain-bringing winds from the sea. Ceylon is swept by the southwestern monsoon from May to the end of October, at which time the northeastern monsoon begins to blow. The southwestern monsoon brings rain to the western and southern coasts but does not penetrate to the eastern and northern parts of the island. Along the coast line the annual mean temperature is about 80° F. (26.6° C.); for each 300 feet in excess of sea level the temperature recedes approximately 1° F. (0.55° C.). The range of temperature throughout the year is very small.

PUBLIC HEALTH

Health Services

Organization. Public health work in Ceylon is administered by the Executive Committee of Health. Members of this committee are elected by the State Council and are responsible to that body. The State Council is composed of eight members nominated by the Governor of Ceylon, 50 elected members and three members *ex officiis*. The latter three are the Chief Secretary, the Legal Secretary and the Financial Secretary of the island government. When a new State Council meets for the first time the members, by secret ballot, form seven Executive Committees. The Executive Committee of Health is one of these seven committees. The chairman of each committee becomes, by appointment from the Governor, a minister of the island government. The Executive Committee of Health has four separate divisions.

The first of these divisions, the Department of Medical and Sanitary Services, has control of all curative and preventive medical work in Ceylon. The staff of this department consists of a director, an assistant director of medical services, two senior medical officers, two medical officers, and an assistant director of sanitary services who is also director of the Quarantine Department. The assistant director of sanitary services has one senior medical officer and two medical officers as assistants. The Department of Medical and Sanitary Services has three branches: (1) the medical branch, (2) the sanitary branch and (3) the laboratory branch. The first limits its activities to curative medicine; such persons as the medical superintendents of government hospitals and asylums, and medical officers and provincial surgeons are responsible to it. This branch also supervises government hospitals and dispensaries, the Dental Institute and the Anti-Tuberculosis Institute. The sanitary branch supervises work in preventive medicine. Field officers and medical officers of health help carry out the manifold functions of this branch, which will be considered *infra* in the appropriate sections of this chapter. The laboratory branch administers the Bacteriological Institute at Colombo and the laboratories utilized by the office of the superintendent of the antimalarial campaign.

The second division of the Executive Committee of Health is the Quarantine Department. This department furnishes quarantine services to seaports and operates quarantine camps in the southern part of India, where laborers are detained before they are permitted to enter Ceylon. This branch also is concerned with deratization of vessels coming into seaports from other countries. Measures against the introduction of mosquitoes at seaports are carried out by this branch. Inspection of passengers arriving in Ceylon by airplane is performed by a port health officer at the Ratmalana airport, but disinsectization or fumigation of airplanes is not done, so far as is known.

The third division of the Executive Committee of Health is the Ceylon Medical College at Colombo. This institution will be considered in the section devoted to medical institutions.

The fourth division of the aforementioned committee is the College of Indigenous Medicine.

Relative Effectiveness. The problems confronting the Executive Committee of Health of Ceylon are complicated by unusual climatic, topographic, social and racial factors. Measures for the control of malaria are undertaken, but the disease continues to afflict most of the population. The department has succeeded in reducing the incidence of the enteric diseases, but dysentery, typhoid fever and cholera are still prevalent. Progress in the development of good water supplies has been slow. Education of the people with the objective of causing them to seek better sanitation has been difficult and largely ineffective. The quantity of medical personnel in Ceylon is insufficient; hence physicians in government service must serve the needs of persons who might otherwise be attended by private physicians. The laboratory facilities at Colombo are adequate.

Water Supplies

Responsibility for water supplies in Ceylon is divided between the Department of Medical and Sanitary Services and the Department of Public Works. Methods employed to ensure the purity of water in Ceylon do not conform to the accepted procedures in the United States. In some places surface water is consumed without treatment. Approximately 40 of the 130 towns in Ceylon have piped supply systems. Ten additional systems were either under construction or planned in 1938. Only about 650,000 of the population of perhaps 5,981,000 are served by piped water supply systems.

In the cities water is obtained from shallow wells, impounding reservoirs, irrigation tanks and streams. Only a few of these sources have adequate quantities of water throughout the year, so that at times the supply must be supplemented by water from springs or rivers. All water may be subject to gross contamination at intervals, but chlorination as a rule is initiated only after results of bacteriologic examination have disclosed actual contamination. Such treatment as is secured usually is sedimentation. Filtration is carried out at Colombo, Chilaw and Diyatalawa. In some places it is necessary for trucks with tanks to haul water in during the dry season.

In most rural areas water is taken chiefly from wells, but it is obtained also from springs, rivers and irrigation tanks. Only 73 of 8,322 villages in Ceylon had piped water supplies in 1938. Shortage of water occurs seasonally in certain regions, when the southwestern monsoon is blowing.

On the basis of available information, all water in Ceylon must be considered unsafe until it has been either treated chemically or boiled.

Sewage Disposal

Systems in which sewage is water-borne are found only in a few towns, such as Colombo and Nuwara Eliya. A few private homes, hotels and institutions have such systems. In rural areas the latrine, either the deep-pit type or the bored-hole type, is employed; the first is more prevalent. In certain places where the water table is close to the surface of the ground a mound type of latrine is utilized. Excreta of human beings ordinarily are not employed for fertilizer, but have been so used on a few rubber or coconut estates. Some natives defecate promiscuously on the ground.

Insects and Animals

Vectors of Disease. Mosquitoes. It has been said that about 80 species of mosquitoes are found in Ceylon. The chief vector of malaria is *Anopheles culicifacies*, and experimental evidence as well as epidemiologic experience would indicate that this anopheline is in fact the only important vector of malaria in the island. *Anopheles hyrcanus nigerrimus*, *A. maculatus*, *A. minimus*, and *A. varuna*, all of which are important carriers in other countries, are also found but there is no evidence that they are of any importance as vectors of malaria in Ceylon. *Anopheles aconitus*, *A. barbirostris barbirostris*, *A. jamesii*, *A. pallidus*, *A. subpictus subpictus*, and *A. vagus vagus* are found; some of them have been found capable of acting as intermediate hosts of *Wuchereria bancrofti* or *W. malayi* or both.

The favored breeding places of *A. culicifacies* are collections of clear, fresh water, particularly if the water is situated in sandy or rocky formations. It can breed in the small pools remaining when a river or stream dries up. A major factor in the serious epidemic of malaria in Ceylon in 1934-1935 was an unusually prolonged drought during which, as dryness became more intense, great numbers of small pools were formed in which *A. culicifacies* could breed readily. This species invades houses to rest and to feed, has a range of flight of about a mile, and bites at night. Female adult mosquitoes will feed on the blood of man, but prefer that of cattle.

Three species of Aedes which are potential vectors of yellow fever exist in Ceylon. They are *Aedes aegypti, A. albopictus* and *A. vittatus. A. aegypti* is, in addition, a vector of dengue fever and filariasis. *A. pipersalatus* has been found to be naturally infected with the larval forms of filariae in Ceylon, but the species of the parasites in question has not been determined.

Culex quinquefasciatus (*fatigans*), a vector of dengue fever and a carrier of *Wuchereria bancrofti,* is common in most towns and villages of Ceylon. This mosquito bites at night. It can breed in a variety of places, but prefers water containing organic matter. *C. bitaeniorhynchus* and *C. tritaeniorhynchus* have been found to be naturally infected with the larval forms of filariae in Ceylon.

Other mosquitoes are *Mansonia annulifera, M. indiana* and *M. uniformis.* These mosquitoes carry the larval forms of *Wuchereria malayi.* They are widely distributed in Ceylon. The first two mosquitoes occur in association with water lettuce, *Pistia stratiotes;* the third is found on or in the vicinity of more than 20 species of plants. It is especially prevalent in the swampy grasslands near Colombo.

Lice. The head louse, *Pediculus capitis,* is the only louse prevalent in Ceylon. It was estimated that 50 per cent of the people of Colombo are infested with this louse. It is true that *P. corporis* and *Phthirus pubis* exist in Ceylon, but are not so numerous as is *P. capitis.*

Flies. At least 16 species of Musca have been identified in Ceylon, but only two of them appear to frequent human habitations. The others are attracted to cattle, buffaloes and other animals. The two species of this genus which are common in homes, markets, bazaars and bakeries are *Musca sorbens* and *M. vicina.* Flies of the genera Chrysomyia, Lucilia and Sarcophaga, which potentially can cause myiasis, often are numerous. Unsatisfactory or nonexistent measures for the removal of human, animal and kitchen wastes are largely responsible for the extensive distribution of flies in Ceylon.

Sand flies of the genus Phlebotomus are abundant in many parts of Ceylon. Those identified are *Phlebotomus argentipes, P. arboris, P. babu, P. sylvestris* and *P. zeylandicus. P. argentipes* is known to transmit visceral leishmaniasis and sandfly fever in India. Cutaneous leishmaniasis is reported from Ceylon, but sandfly fever has never been reported.

Siphunculina funicola is an "eye" fly of India, Ceylon and Java which should not be confused with the so-called eye gnats of the genus Lasiohelea. *Siphunculina funicola* apparently cannot bite, but is particularly annoying because it hovers near the eyes, where it feeds on lachrymal secretions. Some observers in India, for example, have suspected *Siphunculina funicola,* among others of the family Chloropidae, as perhaps having some relationship to the epidemic conjunctivitis which arises in that country in certain seasons.

Ticks. Many ticks occur in Ceylon. The fowl tick, *Argas persicus,* is found in the eastern part of Ceylon, and the sand tick, *Ornithodorus savignyi,* in the Jaffna district of Ceylon. Some investigators have suggested that the sand tick transmits relapsing fever in Africa. Thousands of so-called hard ticks develop in the jungles of the northeast and south in Ceylon, where the larval forms will affix themselves to man or animal. Secondary infection can follow the bites of these larval ticks, and the infection does not subside readily.

FLEAS. *Xenopsylla cheopis,* the flea of rats, has been imported into Ceylon. It is thought to comprise 75 per cent of the species taken in surveys. This flea, which can transmit bubonic plague, has established itself among rats in such seaports as Colombo and Galle, and in towns of the interior such as Kandy, Hatton and Talawakelle. *X. astia* also has been taken from rats in Colombo.

Pulex irritans, the flea of human beings, *Ctenocephalus felis,* the flea of cats, and *C. canis,* the flea of dogs, are known to be present in Ceylon.

MITES. Workers who handle copra in Ceylon are attacked by a form of dermatitis of obscure origin. *Tyroglyphus longior,* a mite about 0.5 mm. long, is known to subsist on copra, flour, cereals and similar products. It has been said that this mite has a relationship to the aforementioned type of dermatitis. Species of Trombicula, of which *T. akamushi* is known to carry tsutsugamushi disease, occur in the grasslands. The common itch mite, *Sarcoptes scabiei,* is widely distributed.

RODENTS. *Rattus kandianus,* the common house rat of Ceylon, is identified as the chief vector of plague. *R. rattus,* the black rat, is found. *R. norvegicus* occurs only in seaports. *R. alexandrinus* has been encountered in the wharf areas of Colombo. Other rodents present are *R. rufescens, R. montanus, R. blanfordi, R. kelaarti* and *Anteliomys chinensis.*

Some of the 12 species of squirrels in Ceylon may be infected with plague. Some rodents on the island may transmit *Spirillum minus,* the etiologic agent of rat-bite fever, by their bites.

Snakes and Other Dangerous Animals. The eight important poisonous snakes which are found in Ceylon are members of three main groups: (1) the true vipers or Viperidae, (2) the pit vipers or Crotalidae, and (3) the cobras and kraits or Colubridae. Nine other species of snakes in Ceylon have fangs in the rear of the upper jaw; they are only mildly poisonous. Many species of sea snakes, or Hydrophidae, are found in the Indian Ocean, and some of them are poisonous. Snake bite is not often reported.

Some of the most dangerous snakes in Ceylon are Russell's viper or *Vipera russellii,* the cobra or *Naja naja,* and the Indian krait or *Bungarus candidus.* Antivenin is not prepared by the government of Ceylon. Most of the natives depend upon their own folk remedies if they are bitten by snakes. Some of these remedies have been tested scientifically, but none has been found to be of value.

Tigers, sloth bears, leopards, panthers, elephants, wild buffaloes and wild boars may be dangerous to human beings under certain circumstances. The Ceylon jackal may be infected with rabies. The mugger or common crocodile, *Crocodilus palustris,* is found on the island.

Pests. A species of biting midge of the family Ceratopogonidae occurs in great numbers. This midge will bite human beings or cattle. The bite is not immediately painful, but within a few hours intensely irritating localized eruptions arise and persist for several days. The cone-nosed bug, *Triatoma rubrofasciata,* is common in the huts of the people. Trypanosomiasis, which bugs of this genus transmit in other countries, does not occur in Ceylon. The biting "eye" fly, *Lasiohelea stimulans,* is common in the foothills and hill country. It is not known definitely to carry disease, but it is one of the most viciously biting insects in the island. *Haemadipsa zeylanica,* a land leech, is abundant in the tropical forests near waterways. This leech lies in wait, so to speak, for human beings and animals. It affixes itself to the skin of a victim and withdraws blood until it is engorged. The puncture made by this leech is painless, but the wound may bleed for a long time. Healing is delayed and the possibilities of secondary infection are many. Blister beetles of the genus Paederus are numerous in certain seasons. Beetles of this genus seem to be harmless under ordinary conditions, but if they are crushed on the skin the body juices may produce blisters. The active principle of the vesicant is cantharidin, the lactone of cantharidic acid. The body juices of these beetles can cause conjunctivitis if they reach the eyes.

Poisonous Plants

There are numerous poisonous plants to be found in Ceylon. *Alyxia ceylanica* is a shrub of semi-dry regions which has a milky juice that is poisonous. *Cerbera odallam* is a small tree which grows in lowlands along the sea; it has an acrid, milky juice and seeds which contain an irritant poison. A type of oleander, *Nerium oleander,* has poisonous roots and milky juice. *Ochrosia borbonica* is a small tree which has poisonous red fruit. A tropical tree, *Hydnocarpus venenata,* common in the lowlands, has fruit which is poisonous. The poisonous principle is used to poison fish. *Lobelia nicotianaefolia* is called the "wild tobacco" in Ceylon; it is a large perennial plant found in open country at altitudes of from 4,000 to 6,000 feet. The leaves and seeds of this plant are acrid and poisonous. The four o'clock or marvel-of-Peru, *Mirabilis jalapa,* is an annual plant cultivated for ornament; it has poisonous roots and seeds. Other poisonous plants abound.

Ragweed is either very rare or absent in Ceylon. The pollen of the bamboo tree, when tested on persons known definitely to have hay fever, produced positive reactions. The pollen of maize, which is grown in Ceylon, produced similar reactions in comparable cases.

Food and Dairy Products

As a general statement, it can be said that the food supply of Ceylon is poor. The diet of the natives is limited. They eat largely rice and curry. Milk and meat are rarely consumed. Polished rice, from which most of the vitamin B complex has been removed in processing, is preferred to unpolished rice. Normally, about 90 per cent of the rice eaten in Ceylon was imported from Burma. Other foods or food products which must be imported are sugar, fish, curry, vegetables and wheat flour. It is believed that the total diet in Ceylon is deficient in vitamins A and B, and in calcium and other minerals.

The supply of milk in Ceylon is limited and the milk itself is of questionable purity. In Colombo and other towns milk which is to be sold must be produced and handled in premises that have been inspected by officials of the municipal health department. This does not mean that pasteurization is carried out. So far as is known, this process is utilized in only one place in the island. Most consumers of milk in Ceylon, therefore, boil milk before it is used. It is possible, however, that boiling is resorted to, not for purposes of safety, but to ensure preservation of the milk. Milk, with few exceptions, is produced by individual dairymen, many of whom are Tamil cowmen with rudimentary conceptions of sanitation. There is no so-called pure food and drug statute in Ceylon, as there is in other components of the British Empire; hence, it is most difficult for authorities to control the quality of milk excepting when it does not comply with basic standards for the content of fats and solids. Butter and cheese are not produced in Ceylon. They are imported, normally from Australia.

In Colombo and other towns establishments in which food is handled are inspected by the health authorities; this control extends also to the examination of food handlers and vendors of milk. The standard of this particular aspect of sanitation has been low. Food and drink can still be purchased along the curbs in many cities and towns in Ceylon.

Poultry and eggs in normal times were produced in quantities sufficient to meet the local demands. They are produced on government farms in some regions; the supply of eggs is limited. Meat is supplied by the slaughter of cattle and goats. The meat as a rule is of a poor quality. By regulation all animals are subject to inspection before they can be slaughtered, the inspection being carried out by either a veterinary surgeon or a medical officer of health. In remote areas a sanitary inspector performs this service. Pork seems to be available in fairly large quantities, and as a rule is sold in a fresh state. Facilities for cold storage are not impressive. About 32,000 tons of fish are taken from the Indian Ocean annually. Fresh and canned fish can be purchased in most markets, and this is true, likewise, of canned meat.

Locally produced fruits and vegetables are offered for sale in markets. Plantains, pawpaws, mangoes, mangosteens, citrus fruits, pineapples, gourds, pumpkins, beans, tomatoes and brinjals (eggplants) are some of the native produce. Cabbages, cauliflowers, lettuce, carrots, turnips and beetroots are not indigenous but are grown in some quantities. A certain quantity is imported.

There are three ice plants in Colombo, and one each in Galle, Kandy, Matara, Negombo and Trincomalee. In Colombo and Kandy water used for the manufacture of ice is obtained from the local supply.

Miscellaneous Problems of Sanitation

In 1915 an ordinance was passed in which minimal sanitary standards were outlined for all new houses. New construction work must be inspected and approved by the health authorities, but thousands of old structures exist which are in bad condition from many standpoints. Since 1920 in a few cities or towns attempts have been made to eliminate slums, and some degree of progress has been attained. In those municipalities subject to the jurisdiction of so-called urban district councils or district sanitary boards control of sanitation can be exercised, to some extent; in rural areas such control is not possible. Sanitary conditions in the large estates (the word as used in Ceylon means an enterprise somewhat similar to a plantation) usually are better than those in the mud-walled, thatched dwellings of the surrounding countryside.

MEDICAL FACILITIES

Hospitals

Number of Beds. Most hospital facilities in Ceylon are provided by the government. There are, however, a few private hospitals and nursing homes in addition to the 99 small hospitals maintained on estates. The 115 government hospitals provide a total of about 10,282 beds, or 1.7 beds per 1,000 of population. Colombo has 19 hospitals with 3,511 beds.

There are 267 central and 178 branch dispensaries and 375 visiting stations, all operated by the government, in Ceylon. The central dispensaries are supervised by medical officers; the branch dispensaries are under the direction of either medical officers or pharmacists from near-by hospitals or from central dispensaries. In the larger towns a few dispensaries are maintained by private practitioners of medicine. There are also about 602 dispensaries on the estates throughout Ceylon.

At the Dental Institute in Colombo clinics are held daily for persons who need dental care. Ophthalmic clinics are held at Jaffna, Kandy, Galle and other towns. Special clinics in maternal and child care are held in hospitals and dispensaries. Medical supervision and obstetric assistance as well as educational work form part of the program.

Equipment. The 115 government hospitals are equipped from government stores. Operating rooms are found in all but the smallest of these hospitals. Roentgenologic equipment is present in the Colombo General Hospital, the King Edward VII Memorial Anti-Tuberculosis Institute and the Dental Institute in Colombo. This type of equipment is found, also, in hospitals in Kandy, Galle, Jaffna, Trincomalee, Angoda and Ragama. Most of the larger cities are equipped with electric power, the voltage of which is usually 230.

Supplies. Few medical supplies are manufactured in Ceylon. Almost all must be imported, and only a limited supply is maintained. Most of the time the government has a supply of quinine.

Medical Personnel

Physicians. A total of 928 physicians are in practice in Ceylon. About 405 of them are in government service. Private practitioners seem to be limited to towns. Medical missionaries are to be found in some sections. In 1938 the ratio of physicians-to-population was one per 6,500. In the same year there were about 3,500 registered native physicians who practiced medicine according to the precepts of the *Ayur-Veda,* the Hindu book of the science of health and medicine.

Dentists. There are 29 dentists in Ceylon, eight of whom are Europeans. Seven native dentists are employed by the government. Unqualified Chinese dental mechanics practice dentistry widely in Ceylon.

Nurses. The total number of nurses in Ceylon is not reported. The government employs 580 nurses, of whom 162 actually carry out the duties of nurses. There are also 144 religious sisters who act as nurses in the government service. Because the need for nurses in hospitals is so great, it has been impossible to recruit nurses for public health work. In 1938 there were only 47 public health nurses in Ceylon.

Others. In 1943 the total number of midwives was reported as 1,284. Of these, 567 were in government service. In 1938 registered midwives numbered 884, of whom 271 were in government service (78 in hospitals, 96 in health units and 97 in the program for control of malaria and that of public health). Of the remaining 613, it was reported, 298 were employed by local authorities and 170 were employed on estates. The rest were engaged privately.

Apothecaries and pharmacists in Ceylon are comparable to surgical dressers in other countries. There are 521 permanent apothecaries and 17 acting officers in government service, but the total number in the island is not known. Of the 761 registered pharmacists 35 are European. The latter are not employed by the government excepting as acting officers.

In 1941 there were 46 veterinary surgeons in Ceylon. In 1943 there were 55 laboratory assistants and 20 laboratory attendants in government service.

Medical Institutions

At the Ceylon University College in Colombo a premedical course is offered which prepares students for the Ceylon Medical College in Colombo. The Ceylon Medical College itself offers a complete course of instruction for the modern practice of medicine, surgery and midwifery. A two-year course of instruction for apothecaries is provided which includes anatomy, physiology, chemistry, pharmacology and dispensing, elementary medicine, theoretical and clinical surgery and midwifery, surgical dressing and public health. The Ceylon Medical College retains control over the standards of teaching for midwives and conducts examinations for those trained by the Department of Medical and Sanitary Services. A dental school attached to the Ceylon Medical College offers a two-year course in dental surgery for graduates in medicine of the former college only. It is planned, at some time in the future, to offer a complete course in dentistry which will be available to those who do not have the doctor's degree in medicine. A School of Indigenous Medicine, mentioned earlier herein, apparently is conducted in Ceylon, but information concerning it is not available.

Nurses are trained at the Colombo General Hospital, the Willard F. Pierce School of Nursing of the Green Memorial Hospital at Mandipay, the Kandy Hospital, the Lady Havelock Hospital for Women, the Lady Ridgeway Memorial Hospital for

Children, and the DeSoysa Lying-in Home at Colombo.

Laboratory facilities in Colombo include the Bacteriologic Institute, the department of pathology at the General Hospital and the laboratories at the headquarters of the antimalarial campaign. The latter are supervised by a medical entomologist. Smaller laboratories exist in government hospitals at Kandy, Galle, Jaffna, Ratnapura and Trincomalee. Laboratories are maintained at the hospital for lepers at Hendala, the lying-in home at Colombo, and at various health centers where examination of blood, stools and urine is done. The laboratories of the Bacteriologic Institute are well equipped for the performance of such work as agglutination tests for the diagnosis of typhus fever and typhoid fever, Wassermann and Kahn tests, examination of rats for evidences of plague, and of human sputum for *Mycobacterium tuberculosis,* and various other procedures requisite to the diagnosis or treatment of pneumonia, gonorrhea, leprosy, dysentery and the like. Smallpox vaccine is produced and a supply of 150,000 doses is maintained. Vaccine for use against paratyphoid fever A and C is produced; paratyphoid fever B does not exist in Ceylon, so that an agent against this form is not needed. Cholera and plague vaccines are prepared. Solutions of sodium chloride, glucose and sucrose are made. Ampules of sodium thiosulfate, quinine, camphor, calcium and calcium gluconate are produced. Serums and insulin are not prepared. A department of nutrition was opened in the Bacteriologic Institute in 1938; research in nutrition is carried out and work is carried out in examination of school children for malnutrition. Study is made of special diets for patients in hospitals. A Pasteur institute, at which antirabies vaccine is made, is associated with the Bacteriologic Institute. Ten private veterinary institutes were reported from Ceylon in 1941.

Social Services. Social services are carried on by the medical missionaries mentioned previously, by social service leagues, child welfare groups and other organizations.

DISEASES

General Considerations. In 1941 the general death rate for all causes was 19 per 1,000 of population. In the same year in the United States this rate was 10 per 1,000 of population. The average annual death rate per 1,000 of population from 1929 through 1937 was 24 per 1,000 of population. In 1938 the infant mortality rate was 161 per 1,000 live births.

Death rates in Ceylon are of limited value because among a large part of the population certification of death is not required. Furthermore, the ratio of physicians-to-population is small. There is some degree of resentment against Occidental methods of medical practice.

Diseases Spread Chiefly Through Intestinal Tract

Enteric Diseases. Typhoid fever and paratyphoid fevers in 1942 caused 982 deaths in Ceylon. In 1941, throughout the island, 1,123 deaths were attributed to these diseases; in 1938 the figure was 920. In the first nine months of 1943, at Colombo, 193 cases and 63 deaths were reported.

Typhoid fever, caused by *Eberthella typhosa,* is encountered most often in hospitals. Paratyphoid fever A, caused by *S. paratyphi,* and a form of fever caused by *S. columbensis,* also are reported. The true incidence of typhoid fever and paratyphoid fever probably cannot be ascertained, because many patients are never seen by physicians. It can be said that the incidence of typhoid fever in Ceylon appears to be fairly constant, and that the disease seldom appears in epidemic form.

Dysentery in Ceylon in 1942 accounted for 2,275 deaths, a mortality rate of 38 per 100,000 of population. In 1941 deaths from this disease amounted to 2,546; in 1938, to 2,228. A total of 6,052 patients with dysentery were treated in the government hospitals of Ceylon in 1942; 2,799 had bacillary dysentery; 1,833 had amebic dysentery; and 1,420 had dysentery of undetermined origin. In the outpatient departments of government hospitals and dispensaries 59,180 patients were treated for dysentery in the same year. There is much variation in the incidence of the disease from year to year, but within recent years over 30,000 patients with dysentery have been treated annually; more than 2,000 of these cases died each year. The chief causative agent of bacillary dysentery in Ceylon seems to be the Flexner type of *Shigella paradysenteriae*. Diarrhea and enteritis in 1942 afflicted 6,374 hospitalized patients. Of these, 1,675 were children less than two years old.

Cholera. Cholera, commonplace in India, is relatively rare in Ceylon. Yet in Ceylon cholera is a potential menace that could be expected to spread rapidly, once it was introduced into the rural areas. In 1942 two outbreaks of cholera occurred. One consisted of 45 cases and 31 deaths; the other consisted of 15 cases and 10 deaths. In 1936 there were 49 cases and 44 deaths; in 1935 there were 30 cases and 22 deaths.

Intestinal Parasitism. Many helminthic diseases are common in Ceylon, infection with hookworm being the most common. In 1937 more than 2,000,000 treatments were administered for this disease. Estimates of the extent of infection in the native population vary from 90 to 99 per cent. Surveys of the condition have been made, and mass treatments are carried out by medical officers in certain areas. All natives who appear at government hospitals for any kind of treatment are routinely treated also for infection with hookworm, unless such therapy is specifically contraindicated. Children in schools are treated for infection with hookworm at least twice during their period of instruction, and coolies in India who plan to enter Ceylon to work are treated for this type of infection before they leave the former country. *Necator americanus* is the hookworm usually recovered, but *Ancylostoma braziliense*, usually parasitic in dogs and cats but sometimes infecting man, has been reported. *A. duodenale* has not been reported. Pollution of the soil in the vicinity of dwellings doubtless is a major factor in maintenance of the infection.

The roundworm, *Ascaris lumbricoides*, is of common occurrence. Infection with this parasite is second only to infection with *Necator americanus* in the frequency with which it is encountered among hospitalized patients in Ceylon. The cestodes, *Taenia saginata*, *T. solium* and *Hymenolepis nana* have been found, but apparently are not of major importance. *Trichuris trichiura* is widespread, but infection with it is not an important cause of morbidity.

Diseases Spread Chiefly Through Respiratory Tract

Tuberculosis. Tuberculosis caused 3,343 deaths in Ceylon in 1941 and 3,228 in 1938, according to reports. It is thought that the mortality rate of tuberculosis in Ceylon is approximately 55 per 100,000 of population. It seems probable that tuberculosis is a serious problem in Colombo, and that the incidence of the disease is also high in the rural areas. During the eleven-month period for which recent reports are available (October 25, 1942, to September 25, 1943), 734 new cases and 316 deaths were recorded. About 18,000 persons were treated for tuberculosis in Ceylon in 1942. Most patients when seen by physicians have an advanced form of the disease, which is more rapidly fatal in Ceylon than in most European countries. Among the 5,499 patients with pulmonary tuberculosis treated in hospitals in 1938 there were 1,363 deaths.

Smallpox. Smallpox in 1942 attacked seven persons, but it is believed that the patients were infected outside of Ceylon. The greatest epidemic recorded in years broke out in 1941, when 114 cases were reported. Only seven were reported from 1936 through 1940. Vaccination is carried out by trained personnel in Ceylon. Although primary immunization is supposed to be required before a child can enter a school, 6,000 children who had not been vaccinated were admitted to schools in 1938, indicating that many actually are not reached by vaccinators.

Diphtheria. In 1942, for the whole of Ceylon, 59 deaths were caused by diphtheria. In 1941 there were 125 cases of this disease and 39 deaths. Seventy-three of the patients were from Colombo. Forty-seven cases and five deaths had been reported from the city of Colombo up to September 25, 1943.

Scarlet Fever. Scarlet fever is rare in Ceylon. Only one case was reported in 1942, and only one in 1940.

Meningitis. Hospitals of Ceylon reported 236 cases of meningitis in 1942.

Poliomyelitis. Twelve persons were attacked by poliomyelitis in 1942. Sixteen persons were treated for poliomyelitis in the hospitals in 1938; one of them died.

Measles. Nine persons in Ceylon died of measles in 1942, and 5,494 persons had the disease.

Whooping Cough. In 1940 in the city of Colombo 310 children had whooping cough and seven of them died. In 1939 there were 143 cases of this disease.

Parotitis. In 1942 there were 366 patients with mumps in hospitals of the islands; in 1938 such patients numbered 948.

Rheumatic Fever. In 1942 there were 318 patients with acute rheumatic fever.

Diseases Spread Chiefly Through Contact

Venereal Diseases. Syphilis, gonorrhea, chancroid (soft chancre) and "granuloma venereum" are reported. The incidence of venereal disease, to judge by data from public clinics and hospitals, decreased considerably in the island in 1942. Figures obtained from government hospitals in 1938 indicate that 2,527 persons were treated for syphilis, 250 for soft chancre, 5,055 for gonococcic infection and nine for "granuloma venereum." In addition, 43,430 outpatients were treated in the clinics and dispensaries of the island.

Yaws. Yaws at one time was an exceedingly prevalent disease, but the incidence was greatly reduced by mass treatment of the population. In 1938 about 8,000 persons were known to have the disease. These persons lived chiefly in the rural areas. In 1942 it was reported that about 3,000 patients with yaws were known to health authorities; 1,051 had the infectious stage of the disease.

Leprosy. It was reported, at the end of 1938, that 2,519 lepers in the island were known to the authorities, and that 1,329 lepers were receiving treatment in government hospitals. Seventy-six died of the disease in 1938.

Diseases of the Skin. Many dermatologic conditions, varying in importance from large chronic ulcers to minor irritating lesions, are common among the natives of Ceylon. These conditions are distinct hazards to nonindigenous persons. About 15 per cent of all the beds in military hospitals in Ceylon are set aside for the treatment of patients with cutaneous diseases. The most frequent types of dermatologic lesions encountered in the hospitals of Ceylon are tropical ulcers, infection with some species of Trichophyton, prickly heat and scabies. In government hospitals of the island 116 persons were treated for tinea infection in 1938; 4,307 persons were treated for scabies; and 8,015 patients with cutaneous ulcers were treated. Infection with the tropical sand flea, *Tunga penetrans*, afflicted 635 persons in 1938.

Fungous infections, such as tinea cruris, tinea imbricata and Madura foot, are of frequent occurrence under certain conditions. Other fungous diseases which are reported include rhinosporidiosis, trichosporosis, mossy foot, blastomycosis and infection with *Microsporon scolaceous*, *Cladosporium mansonia* and *Microsporon furfur.*

Scabies appears to be very common. It is often severe. Copra itch, caused by a mite of the genus Tyroglyphus, also is reported. A chronic dyschromic type of dermatitis characterized by the presence of colored spots on the skin is reported as occurring rarely.

Diseases of the Eyes. The incidence of gonorrheal ophthalmia in Ceylon is said to be high, although only 15 patients with this disease were treated in government hospitals in 1938. Trachoma and other infections of the eyes also are reported, but the incidence of these diseases cannot be determined.

Tetanus. Tetanus was the cause of 381 admissions to government hospitals in 1942.

Rabies. Eleven persons died of rabies in 1938. About 2,000 persons were treated prophylactically at the Pasteur institute of the Bacteriologic Institute in Colombo. Of 478 brains of dogs examined at the institute in that year, 212 were found to contain Negri inclusion bodies.

Brucellosis. Twenty-eight persons died of undulant fever in government hospitals in 1938, among 190 persons who had the disease.

Rat-bite Fever. Rat-bite fever has been reported, but is not an important cause of morbidity.

Diseases Spread by Arthropods

Malaria. It is difficult to state the number of patients with malaria in Ceylon at any one time. In 1942, it was said, 2,933,074 persons were treated for the disease, and of these, 47,309 were hospitalized patients and 2,885,765 were outpatients. In those sections of Ceylon in which the incidence of malaria is generally high it is probable that all persons, and especially children, have one attack or more of malaria each year. In 1939 a survey was made of the types of Plasmodium encountered in a dry zone, an intermediate zone and a wet zone. Results were as follows: dry zone: *P. malariae*, 55 per cent; *P. falciparum*, 26 per cent; *P. vivax*, 19 per cent; intermediate zone: *P. malariae*, 52 per cent; *P. falciparum*, 29 per cent; *P. vivax*, 19 per cent; wet zone: *P. malariae*, 30 per cent; *P. falciparum*, 33 per cent; *P. vivax*, 37 per cent.

It can be said that malaria is always present, but that in years of normal rainfall the distribution of the disease is uneven. Incidence is highest in the north, but in other sections the disease is only slightly less prevalent. In the central hill country and in the southwest the incidence as a rule is low. The disease occurs most frequently in areas of an elevation of less than 500 feet and with rainfall of less than 100 inches (2.6 meters) annually. At Trincomalee the incidence of malaria is greater than anywhere else on the island.

In years of epidemics of malaria, the type most frequently reported in hospitals is benign tertian. This was the form most often encountered in the great epidemic of 1934-1935. On the other hand, during one period of that epidemic the percentage of malignant tertian malaria was as high as 43, much higher than that of preceding years. Quartan malaria occurs, but is rarely reported in hospital statistics. In a recent survey carried out among school children, however, quartan malaria was the type most often noted.

Blackwater Fever. Blackwater fever is reported regularly, but seemingly does not occur extensively.

Measures of Control. An antimalaria campaign is carried out by a committee of the Department of Medical and Sanitary Services, with the assistant director of sanitary services as chairman. This campaign is conducted by a superintendent who has as assistants a medical entomologist, a sanitary engineer and a senior medical officer, all of whom are members of the committee. The superintendent of the campaign has charge of the campaign centers; the sanitary engineer supervises drainage projects; the senior medical entomologist investigates problems in respect to insect vectors and determines the efficiency of antilarval measures. Intensive work has been done in malarious areas. Quinine is available at various places throughout the island. A trained entomologist is stationed at each control center. Breeding places of *Anopheles culicifacies* have been oiled; but the amount of this work which would have to be done before the species could be controlled is enormous.

Filariasis. Filariasis is endemic in Ceylon. The chief etiologic agent is *Wuchereria malayi*. Filariasis caused by this parasite is prevalent in the south and in the vicinity of Trincomalee. Filariasis caused by *Wuchereria bancrofti* likewise occurs, particularly in the urban centers. In 1942 there were known to be 1,422 patients with filariasis scattered through 302 villages. In 1938, in government hospitals, 107 patients with filariasis were treated.

Dengue Fever. In Ceylon dengue fever is not a reportable disease, but it occurs frequently. The vectors of dengue fever, *Aedes aegypti* and *A. albopictus,* are widespread in Ceylon.

Yellow Fever. Yellow fever does not occur in Ceylon or India, but the mosquito vector of it, *Aedes aegypti,* is abundant in Ceylon. Stringent measures of control are exercised to prevent the introduction of yellow fever or of infected mosquitoes which might be brought in by air from infected areas.

Plague. Plague has not been reported in Ceylon since 1938. It is endemic among the rats in the island, and it is thought that the squirrels may be infected. In 1938 only nine cases and eight deaths were reported from Colombo. This was the lowest figure that had been reported from this city since 1914. In 1938, of 31,239 rodents examined for evidences of plague, only 15 were found to be infected. Twenty-nine persons had plague in 1937, and all died. Twenty-seven of these patients had lived in Colombo. In 1936 there were 57 cases and 46 deaths.

Typhus Fever. Two cases of typhus fever were reported from Colombo in 1940. The real disease in these two cases may have been tsutsugamushi disease. Only seven persons were admitted to the hospitals of Ceylon in 1938 for typhus fever. Both louse-borne typhus fever and flea-borne typhus fever occur throughout India.

Tsutsugamushi Disease. Tsutsugamushi disease, a mite-borne rickettsial disease, frequently called "mite-borne typhus fever," occurs sporadically. The serum of patients with typhus fever in Ceylon agglutinates *Proteus vulgaris,* strain OXK. Tsutsugamushi disease is reported from the Maldive Islands, southwest of Ceylon.

Relapsing Fever. Twenty-eight patients with relapsing fever were treated in the hospitals of Ceylon in 1938. Four patients died. Whether the disease was louse-borne or tick-borne was not stated.

Leishmaniasis. Seventeen deaths were caused by leishmaniasis in the government hospitals of Ceylon in 1938, among 6,578 patients hospitalized for the disease. Potential vectors of this disease are abundant in Ceylon. In 1937 about 4,000 cases of Oriental sore were recorded. Kala-azar was not found in the investigation made in that year.

Dracontiasis. Infection with guinea-worm or *Dracunculus medinensis* has been reported from Ceylon, but apparently is not common. This type of parasitic infection was not encountered in government hospitals in 1938.

Myiasis. Infections caused by the larvae of certain flies occur in Ceylon, but do not seem to be common.

Nutritional Diseases

Deficiency Diseases. Beriberi, pellagra, scurvy and rickets are reported from Ceylon, but pellagra and beriberi apparently are not common. In 1938 Ceylonese natives treated in government hospitals for rickets numbered 308; of these 77 died. In the same year 52 patients were treated in hospitals for scurvy; nine of them died. Keratomalacia and xerophthalmia seem to be fairly common among the natives, and dental defects are numerous. Malnutrition is encountered more often than not, and it doubtless contributes to the high fatality rates associated with other diseases.

Goiter. Enlargement of the thyroid gland occurs in Ceylon, but does not appear to be serious. Thirty-nine patients with goiter were treated in government hospitals in 1938; three of them died.

Miscellaneous

Allergic States. Copra dust and tea dust are common allergens in the island. Certain parts of the cinnamon tree, *Cinnamomum zeylanicum*, have been said to produce an allergic reaction in susceptible persons. Some observers have written that it is not the tea dust or copra dust *per se* which provokes a reaction, but rather, emanations from parasites which attack the tea plant, *Thea sinensis*, and the coconut palm, *Cocos nucifera*. Some fungi likewise have been suspected. Infected kapok, the silky fibers which invest the seeds of the silk-cotton tree, *Ceiba pentandra* or *Eriodendron anfractuosum*, has been said to cause an allergic state similar to hay fever, as well as an asthmatic condition. These two conditions are produced only when the kapok is infected by bacteria or fungi. Uninfected kapok seems to be entirely harmless. Since a type of allergic state is common among workers who handle spices in Ceylon, it may be that certain spices are allergens. In 1938 persons with asthma treated in government hospitals numbered 2,976.

Addiction to Drugs. In 1937 about 2,000 persons in Ceylon were registered as being addicted to the use of opium.

SUMMARY

The public health program of Ceylon is supervised by the Executive Committee of Health, which is a part of the State Council of Ceylon. This committee in turn controls the Department of Medical and Sanitary Services, the Quarantine Department, the Ceylon Medical College and the College of Indigenous Medicine. The medical branch and the sanitary branch of the Department of Medical and Sanitary Services carry out most of the work in preventive and curative medicine in the island. Most of this work is done in government hospitals, dispensaries, clinics, health units and other groups. Epidemiologic studies and control programs, maternity and child welfare, school health, sanitation and sanitary engineering, health education, control of malaria and infection with hookworm, estate sanitation, vaccination for smallpox, and control of leprosy and yaws, are some of the endeavors which are prosecuted by the health organization. Various private organizations assist, and the International Health Division of the Rockefeller Foundation has co-operated actively with the government in the establishment of health units and in campaigns against malaria, yaws, leprosy and infection with hookworm.

All sources of water in Ceylon are subject to contamination at various times. Treatment as a rule is nothing more than sedimentation in a reservoir, tank or well. Systems in which sewage is water-borne exist only in Colombo and a few other towns, and in a small number of private homes or estates. In most rural areas deep-pit latrines are employed; in urban districts the bucket latrine is common. Pollution of the soil is frequently practiced by the natives.

Insects constitute a major problem. Some 80 species of mosquitoes exist, 20 of which are anophelines. Lice, flies, ticks, fleas and mites abound. Rodents infest seaports. Poisonous snakes and poisonous plants are numerous. Dangerous animals are still to be found in some parts of the island.

The disease of greatest importance is malaria. Enteric diseases, such as typhoid fever and paratyphoid fever, amebic and bacillary dysentery, diarrhea and enteritis, are prevalent. Pneumonia, dengue fever and venereal diseases occur. Cholera, plague, typhus fever and filariasis are endemic and potentially important. Tuberculosis, intestinal parasitism, diseases of the skin and yaws cause much illness and many deaths among the natives.

BIBLIOGRAPHY

Bogert, C.: Dentitional Phenomena in Cobras and Elapids with Notes on Adaptive Modifications of Fangs. Bull. Am. Mus. Nat. Hist., **81**: 285-360 (July 14) 1943.

Bose, P. N.: Anti-malarial Operations in India. Indian M. Gaz., **76**:690-695 (Nov.) 1941.

Carter, H. F.: Further Observations on the Transmission of Malaria by Anopheline Mosquitoes in Ceylon. Ceylon J. Sci., Sect. D, **2**:159-176 (Nov. 7) 1930.

Castellani, A.: Rhinitis Spastica Tropicalis (Tropical Hay Fever). Sind. M. J., **11**:7-13 (June) 1938.

Ceylon. Dept. of Medical and Sanitary Services: The Ceylon Malaria Epidemic, 1934-35. Colombo, Ceylon Govt. Press, 1935.

——: Administration Report of the Director, 1934-1938. Colombo, Ceylon Govt. Press, 1935-1939.

——. ——: Dept. of Public Works. Administration Report, 1934-38. Colombo, Ceylon Govt. Press, 1935-1939.

Ceylon Veterinary Association, Brief History of Its Formation. Indian Veterinary J., **18**:40-52 (July) 1941.

Chellappah, S. F.: Malaria Control in Ceylon. J. Ceylon Br., Brit. M. A., **36**:293-312 (Sept.) 1939.

——: Progress of Public Health in Ceylon. J. Ceylon Br., Brit. M. A., **35**:303-318 (July) 1938.

——: Public Health Aspects of Ankylostomiasis. J. Ceylon Br., Brit. M. A., **35**:419-445 (Nov.) 1938.

——, and Jacocks, W. P.: A Guide to Health Unit Procedure in Ceylon. Colombo, Ceylon Govt. Press, 1937.

Clemesha, W. W.: Brief Account of the Natural History of Malaria in Ceylon. Ceylon J. Sci., Sect. D, **3**:157-172 (Dec. 8) 1934.

Cochran, D. M.: Poisonous Reptiles of the World: A Wartime Handbook. Washington, Smithsonian Institution, 1943. (Smithsonian Institution War Background Studies No. 10.)

Colombo, Ceylon: Report of the Chief Medical Officer of Health for the Years 1939-1940. Colombo Municipal Print. Office, 1940-1942.

Covell, G.: The Distribution of Anopheline Mosquitoes in India, 2d ed., revised by I. M. Puri. Delhi, Govt. of India Press, 1936. (Health Bulletin No. 17; Malaria Bureau No. 8.)

Covell, G.: The Distribution of Anopheline Mosquitoes in India and Ceylon. Indian J. M. Research (Memoir No. 5), p. 1-85 (Feb.) 1927.

——: The Distribution of Anopheline Mosquitoes in India and Ceylon. Additional Records, 1926-1930. Rec. Malaria Survey, India, **2**:225-268, 1931.

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 3d ed. Philadelphia, Lea and Febiger, 1943.

Dassanayake, W. L. P.: Early Manifestations of Filariasis. J. Ceylon Br., Brit. M. A., **35**:469-478 (Nov.) 1938.

——: Filariasis Survey in Galle Town. J. Trop. Med. and Hyg., **43**:133-135 (May 15) 1940.

De Livera, P. L. F.: An Investigation to Determine the Degree of Anophelism in Rambukpotha Oya, Badulla and Its Vicinity and Some Remarks about the Epidemiology of Malaria in Ceylon. J. Ceylon Br., Brit. M. A., **36**:343-365 (Sept.) 1939.

De Silva, K. J. L.: Problem of Trachoma in Ceylon with Plea for Its Suppression. J. Ceylon Br., Brit. M. A., **38**:346-361 (Dec.) 1941.

——: A Study of an Epidemic of Muco-purulent Conjunctivitis at the Eye Institute Civil Hospital, Kandy. J. Ceylon Br., Brit. M. A., **37**: 159-170 (Sept.) 1940.

De Silva, S.: "Pseudo-Typhoid," a Ten Day Fever Which Is Commonly Mistaken for Typhoid Fever. J. Ceylon Br., Brit. M. A., **38**: 319-323 (Sept.) 1941.

De Simon, D. S.: Leprosy and Its Control in Ceylon. J. Ceylon Br., Brit. M. A., **37**:171-191 (Sept.) 1940.

Dickson, R. M.: The Malaria Epidemic in Ceylon, 1934-1935. J. Roy. Army M. Corps, **65**: 85-90 (Aug.) 1935.

Dockerty, J. F.: Hookworm Infestation and Reinfestation in Ceylon, A Study of High Incidence with a Moderate Degree of Infestation. Am. J. Hyg., Supp. **6**:160-171 (Mar.) 1926.

Doresamy, A. O. D.: Beetle Disease among Children in Ceylon. J. Ceylon Br., Brit. M. A., **39**: 54-60 (June) 1942.

Encyclopaedia Britannica, 14th ed. London, Chicago, Encyclopaedia Britannica, Inc., 1939.

Farrell, E.: Symposium on Tropical Medicine, III, Malaria. Bull. M. Library A., **30**:13-16 (July) 1942.

Fernando, C. F.: Tropical Typhus. J. Ceylon Br., Brit. M. A., **35**:463-466 (Nov.) 1938.

Fernando, P. B.: Ancylostomiasis in Ceylon. J. Ceylon Br., Brit. M. A., **35**:365-376 (Sept.) 1938.

Freeman, J., Oxon, D. M., and Hughes, W. H.: Biological Polyvalency of Antigens with Special Reference to Hay Fever. Lancet, **1**:941 (April) 1938.

Gill, C. A.: The Influence of Malaria on Natality with Special Reference to Ceylon. J. Malaria Inst. India, **3**:201-252 (Sept.) 1940.

——: Report on the Malaria Epidemic in Ceylon in 1934-35. Together with a Scheme for the Control of Malaria in the Island. Colombo, Ceylon Govt. Press, 1935.

——: Some Points in the Epidemiology of Malaria Arising out of the Study of the Malaria Epidemic in Ceylon in 1934-1935. Tr. Roy. Soc. Trop. Med. & Hyg., **29**:427-466 (Feb.) 1936.

Graham-Smith, G. S.: The Oscinidae (Diptera) as Vectors of Conjunctivitis and the Anatomy of Their Mouthparts. Parasitology **22**:457-467 (Nov.) 1930.

Gt. Brit. Colonial Office: Ceylon 1938, Annual Report on the Social and Economic Progress of the People. London, H. M. Stationery Off., 1939. (Colonial Reports, Annual No. 1922.)

Gunasekara, S. T.: Progress of Public Health in Ceylon. J. Ceylon Br., Brit. M. A., **27**:121 (June) 1930.

Herms, W. B.: Medical Entomology, 3d ed. New York, The Macmillan Co., 1939.

Hill, W. C. O.: Revised Check-List of the Mammals of Ceylon. Ceylon J. Science, Sect. B, **21**:139-184 (Feb. 10) 1939.

Hirst, L. F.: Report of the City Microbiologist for 1931. In: Colombo, Ceylon, Medical Off. Health Report (1931) **26**:38-41, 1932.

Hutson, J. C.: Report of the Entomological Division, Insect Pests, Technical Reports, 1927, Dept. of Agriculture. Ceylon, Colombo, 1928, p. 1-8.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Isaac, P. V.: Notes on *Paederus fuscipes* Curt., a Beetle Which Causes Vesicular Dermatitis in Man. Agriculture and Livestock in India, **3**:33-36 (Jan.) 1933.

Jacocks, W. P.: Ceylon Health Units. Indian M. Gaz., **68**:332-338 (June) 1933.

——: A Note on a Type of Latrine Suitable for Use in Ceylon Villages. Ceylon J. Science, Sect. D, **2**:87-95 (Feb. 13) 1929.

Jayaram, T. K.: Malnutrition. J. Ceylon Br., Brit. M. A., **36**:119-122 (March) 1939.

Kelaart, H. N. C. V.: Some Aspects of Port Health Work. J. Ceylon Br., Brit. M. A., **36**: 127-134 (Mar.) 1939.

Kodituwakku, D. N.: Folk Medicine in Ceylon. Pharm. J. Lond., 4th ser., **74**:473 (June 11) 1932.

Kumm, H. W.: The Geographical Distribution of Yellow Fever Vectors. Baltimore, American Journal of Hygiene, 1931. (Am. J. Hyg. Monographic Ser. No. 12.)

McCarthy, L.: Tropical Mycoses. J.A.M.A., **123**:449-454 (Oct. 23) 1943.

MacDonald, G.: A Design of Flushing Siphon for Control of Anopheline Breeding. J. Malaria Institute, India, **2**:63-69 (Mar.) 1939.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr, 11th ed. Baltimore, Williams & Wilkins Co., 1941.

Mehta, D. R.: Studies on the Longevity of Some Indian Anophelines, Pt. 1, Survival of *Anopheles subpictus* Grassi under Controlled Conditions of Temperature and Humidity. Rec. Malaria Survey India, **4**:261-272 (Sept.) 1934.

Mumford, E. P.: Mosquitoes, Malaria and the War in the Pacific. J. Trop. Med. & Hyg., **45**: 74-76 (May 15) 1942.

Nicholls, L.: A Case of Tsutsugamushi (Rural Typhus) in Ceylon. Brit. M. J., **2**:490 (Oct. 12) 1940.

——: Rural Typhus in Ceylon. Brit. M. J., **2**: 490 (Oct. 12) 1940.

——: Starting of Nutrition Department. J. Ceylon Br., Brit. M. A., **35**:268-276 (May) 1938.

——, and Nimalasuria, A.: Nutrition and Economic Position of Ceylon. Lancet, **2**:734-735 (Dec. 19) 1942.

Oberdorffer, M.: Moderne Leprabekämpfung in Ceylon. Arch. f. Schiffs- u. Tropen-Hyg., **42**: 550-552 (Dec.) 1938.

Patton, W. S.: Notes on Some Indian Aphiochaetae, *Aphiochaeta xanthina* Speiser. Indian J. M. Research, **9**:683-691 (Apr.) 1922.

Peiris, M. V. P.: Tropical Abscess of Liver. J. Ceylon Br., Brit. M. A., **35**:381-384 (Sept.) 1938.

Phillips, W. W. A.: Manual of the Mammals of Ceylon. London, Dulan and Co., Ltd., 1935.

Puri, I. M.: Synoptic Table for the Identification of the Anopheline Mosquitoes of India, 3d ed. Delhi, Govt. of India Press, 1938. (Health Bull. No. 10, Malaria Bur. No. 2.)

——: Synoptic Tables for the Identification of the Full-grown Larvae of the Indian Anopheline Mosquitoes, 4th ed. Delhi, Govt. of India Press, 1941. (Health Bull. No. 16, Malaria Bur. No. 7.)

Reese, J. M.: Medical Aspects of Trincomalee. J. Roy. Nav. M. Serv., **25**:58-65 (Jan.) 1939.

Rockefeller Foundation International Health Board, 13th Annual Report, 1926. New York, 1927, pp. 34-36.

Ross, Edward S., and Robers, H. R.: Mosquito Atlas, Pt. 2. Philadelphia, American Entomological Society, 1943.

Russell, P. F., and Rao, T. R.: A Study of Density of *Anopheles culicifacies* in Relation to Malaria Endemicity. Am. J. Trop. Med., **22**: 535-558 (Sept.) 1942.

——, Rozeboom, L. E., and Stone, A.: Keys to the Anopheline Mosquitoes of the World, with Notes on Their Identification, Distribution, Biology and Relation to Malaria. Philadelphia, American Entomological Society, Academy of Natural Sciences, 1943. Pp. 152.

Sinton, J. A.: Suggestions with Regard to the Prevention of the Spread of Yellow Fever in India by Air Traffic, with Special Reference to Insect Transmission, 2d ed. New Delhi, Govt. of India Press, 1940. (Health Bull. No. 20.)

Sivalingham, V., and Rustomjee, K. J.: Spleen and Parasite Surveys in Ceylon. J. Malaria Inst. India, **4**:155-173 (Dec.) 1941.

Smith, M. A.: *Reptilia* and *Amphibia.* London, Taylor and Francis, 1931, 3 vols. (The Fauna of British India including Ceylon and Burma.)

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942, 2 vols.

——: Notes on a Quantitative Hookworm Survey of Ceylon. Tr. Far Eastern A. Trop. Med. Calcutta, 7th Cong., **3**:239-248, 1929.

Stitt, E. R., and Dirckze, H. A.: A Filariasis Survey of the Southern Province of Ceylon. Ceylon J. Sci., Sect. D, **3**:177-182 (Dec. 8) 1934.

Van Rooyen, C. A.: Reflections on the Malaria Epidemic of 1934-1935 with Special Reference to the Kegalle District Where There Is a Mortality from Malaria of Some 71,000. J. Ceylon Br., Brit. M. A., **34**:169-176 (Oct.) 1937.

Wall, F.: *Ophidia taprobanica;* or The Snakes of Ceylon. Colombo, H. R. Cottle, Govt. Printer, 1921.

Wickramasinghe, W. G.: Care of Childhood in Ceylon. J. Ceylon Br., Brit. M. A., **35**:337-341 (July) 1938.

Wickramasuriya, G. A. W.: Maternal Mortality and Morbidity in Ceylon. J. Ceylon Br., Brit. M. A., **36**: 79-106 (Mar.) 1939.

Wijerama, E. M.: Ancylostomiasis in Ceylon. J. Ceylon Br., Brit. M. A., **36**:193-196 (May) 1939.

——: The Mode of Onset of the Malaria Epidemic in Ceylon, 1934-1935. J. Ceylon Br., Brit. M. A., **34**:55-64 (Apr.) 1937.

——: Notes on Two Cases of Tropical Typhus. J. Ceylon Br., Brit. M. A., **35**:467-468 (Nov.) 1938.

——: Tropical Abscess of the Liver. J. Ceylon Br., Brit. M. A., **35**:263-267 (May) 1938.

Willis, J. C.: Ceylon, A Handbook for the Resident and the Traveller. London, Dulan & Co., 1907.

Worth, H. N.: The Control of Anopheline Breeding in River Beds. Tr. Roy. Soc. Trop. Med. and Hyg., **30**:521-530 (Mar.) 1937.

3

China

GEOGRAPHY AND CLIMATE

China, like India, is so vast a country that it might almost be treated as a separate continent. Hence, any consideration of the geographic and climatic aspects of China, in a space as restricted as that allotted to this chapter, can be presented only in the broadest outlines. As a general statement, it can be said that China consists of (1) China proper, a region which includes 24 great provinces; (2) Mongolia, a misleading designation which more correctly should be "Inner Mongolia" and "Outer Mongolia"; (3) Sinkiang, or the so-called New Dominion; and (4) Tibet.

It must be remembered that four provinces—Liaoning, Jehol, Kirin and Heilungkiang—of the 18 constituting China proper were incorporated into the new state of Manchukuo in 1932. It must be realized, further, that whereas Inner Mongolia is becoming increasingly bound to the Republic of China which claims it, Outer Mongolia has proclaimed its independence. Sinkiang, consisting of Chinese Turkestan, Kulja and Dzungaria, is administered by Chinese officials, but is populated chiefly by non-Chinese. Finally, China exercises technical sovereignty in all Tibet, as recognized by England and Russia (1907), but the southwestern portion of Tibet, under the Lhasa government, claims to be independent.

In 1936 the Ministry of the Interior of the republic estimated that the population of the 24 provinces constituting China proper was 422,708,000. The four provinces of Heilungkiang, Jehol, Kirin and Liaoning in Manchukuo in the same year had a population of 29,328,000. Mongolia was said to have a population of 2,077,000. The population of Tibet was estimated at 3,722,000. The population of all the territory claimed by the Republic of China, therefore, was 457,835,000 in 1936. Eighty per cent of the people are farmers. It has been said that there must be at least 100,000 farm villages with a population of perhaps 100,000,000; and it was thought that there are no less than 1,000,000 farm hamlets, with a population of some 200,000,000. The population as a whole is Mongoloid. Three religions prevail—Confucianism, Buddhism and Taoism. There are, however, about 48,000,000 Mohammedans. In 1934 there were 2,623,560 Roman Catholic Chinese, and in 1932 there were 488,539 Protestant Chinese.

If China is accepted as consisting of all the four main sections mentioned in the first paragraph, it has an area of about 4,480,992 square miles. It is thus much larger than any other country in the world with the exception of the Union of Soviet Socialist Republics (8,241,921 square miles).

Physically, China consists essentially of the middle and lower basins of the Hwang Ho, Yangtze and Si rivers east of the great natural boundaries of the Tibetan and Mongolian plateaux. Actually, however, it is only in the middle and southeastern parts of this tremendous area that a well-defined system of river valleys is evident. The northern part of China is formed largely of plain country and uplands. The uplands extend, north of the Tsinling mountain range, from Jehol in Manchukuo to the province of Kansu in the west. To the north is the great plateau of Mongolia and to the west is Sinkiang. The plain country of north China, on the other hand, stretches from the plains of Manchukuo southeast to the delta of the Yangtze River. This region encloses the Shantung uplands.

South of the Yangtze River are the highlands of southern China. In the east the highlands overlook the irregular terrain of the provinces of Chekiang, Fukien and Kwangtung; in the southern and southwestern parts of these highlands high plateaux arise. Separate from the highlands is the great area in the south of China that is drained by the Si River. The western reaches of this region extend to the plateau country in Yünnan and Kweichow provinces; to the south and east are the maritime provinces of Chekiang, Fukien and Kwangtung, from the mouth of the Yangtze to the mouth of the Si at Canton. The plateau land in the provinces of Yünnan and Kweichow, in the southwestern part of China, is a distinct physical entity, entirely separate from the great river basins that have been mentioned thus far. This plateau is lowest in Kweichow province. The western edges of the plateau are serrated by deep gorges and high ranges, so that in the extreme west Yünnan province is almost inaccessible from Burma.

The hydrographic features of China are intimately associated with the geographic facies of the country. The Yangtze River, which means the "yang kingdom river," is the longest in China and the fifth longest in the world. It arises in Tibet and flows for more than 3,000 miles through the southern central part of China to empty into the East China Sea. The Hwang Ho or Yellow River, second longest stream in China, originates near the lake called Koko Nor in Chinghai province and flows for about 2,700 miles through the middle part of China to the Gulf of Pohai. The Si River, or "west river," arises in the southern part of China and after a course of about 1,000 miles enters the South China Sea near Canton. Other rivers, such as the Salween, Ili, Mekong, Selenga and Brahmaputra, originate in China but traverse other countries.

The climate of China is characterized by a marked difference in frequency and amount of rainfall according to season, and a reversal of the direction of winds typical of monsoonal regions. China is essentially a warm temperate country. Only in the extreme southern parts, near the boundaries of Burma and French Indo-China, is the country below the Tropic of Cancer. Moreover, China is open to the strong and intensely cold winds of Siberia by way of Mongolia, so that winter in the north of the country is the coldest in the world in respect to comparable latitudes. Every part of China north of the Hwai River, for instance, has at least one month in which the mean temperature is less than the freezing point (32° F. or 0° C.). It is not until the valley of the Yangtze River is reached that the climate, in general, is comparable to that of the British Isles. Snow has fallen in Canton, which is located almost at the Tropic of Cancer. Usually, however, the winter in most parts of China is comparatively short. In the southern part of China a temperature in excess of 60° F. (15.6° C.) is common for most of the year. Such a situation obtains in the valley of the Yangtze River for about seven to eight months a year, and in the northern part of China for approximately five months of the year.

Rainfall in China as a whole is most abundant when the southeastern monsoon is blowing. It is least abundant when the northwestern monsoon prevails, or in midwinter. Cyclones occur at times along the valley of the Yangtze River. Since it is impossible adequately to present the climatic picture of China in so compressed a space as this brief résumé, additional details may be found in Table 1 (see p. 51).

PUBLIC HEALTH

Health Services

Organization. Unoccupied China. Public health under the National Government of China was first established as a Ministry of Health at Nanking in 1928. Two years later it became a part of the Ministry of the Interior. After the outbreak of war in 1937, a Ministry of Health with two divisions, the Army Medical Administration and a National Health Administration, was established. A reorganization in the next year placed the Army Medical Administration under the Ministry of War, whereas the National Health Administration was again placed under the jurisdiction of the Ministry of the Interior. In 1940 the National Health Administration was removed from the Ministry of the Interior and placed directly under the Executive *Yuan.* The Director General is the executive head of the National Health Administration. This organization has four chief duties: prevention and control of epidemics, provision of facilities for the protection of the health of persons traveling the principal highways, provision of medical relief, and the development of provincial and local health centers.

To carry out this program, the National Health Administration in June, 1942, had the following administrative branches: general administration, medical administration, health services, epidemic prevention, an accountant's office, the statistician's office, and the commission on native medicine. It functioned through several subsidiary organizations which included a National Institute of Health, four central and numerous other hospitals, a National Central Epidemic Prevention Bureau (for the manufacture of serums and vaccines) with headquarters at Kweiyang in Kweichow province, a National Northwestern Epidemic Prevention Bureau with offices at Pingliang in Kansu province, Sian in Shensi province, and Chengtu in Szechwan province (at which vaccines and serums were produced, and at which anti-epizootic work was carried out), a national quarantine service, an anti-epidemic corps, various health centers, numerous highway health stations for the treatment of venereal diseases, a central narcotics bureau, and a central factory for the manufacture of surgical instruments and equipment.

The National Institute of Health was established in 1941 with the amalgamation of the Central Field Health Station and the Public Health Personnel Training Institute. It had charge of the research and surveys necessary for the planning of the public health program and also of the training of the public health personnel needed for that program. Two institutes were controlled by the National Institute of Health: the Epidemiologic Institute and the Nutritional Research Institute. In addition, there were eight departments as follows: public health administration, experimental medicine, chemistry and materia medica, sanitary engineering, maternity and child health, health education, nursing, and health statistics. The Public Health Personnel Training Institute was established in 1935 to train candidates sent by the provincial and municipal health administrations. Since its establishment it has given training to 512 medical officers, eight sanitary engineers, 758 public health nurses, 181 midwives, 37 laboratory technicians and 128 others. At present there are two regional training schools (for members of the staff) located at Kweiyang in Kweichow province and Lanchow in Kansu province; and some 14 other schools for auxiliary personnel have been opened in the provinces of Kiangsu, Szechwan, Shensi, Fukien, Kwangsi, Hunan and Kweichow. Some of these schools receive support from the American Bureau for Medical Aid to China.

The National Health Administration supervises and co-ordinates the health programs of the provinces. It also appoints the directors of the provincial health administrations. Sixteen of the 24 provinces in

China proper were reported to have provincial health administrations by October of 1942. These provinces are Anhwei, Chekiang, Chinghai, Fukien, Honan, Hunan, Hupeh, Kansu, Kiangsi, Kwangsi, Kwangtung, Kweichow, Ningsia, Shensi, Szechwan and Yünnan. There are also three municipal health bureaus (at Chungking in Szechwan province, Kweiyang in Kweichow province, and Kweilin in Kwangsi province) and three municipal health stations. According to the plan of the public health organization for the entire country, a provincial medical center is to be located in the capital of each province, where there is to be located a first-class hospital having from 500 to 1,000 beds and a medical college with all the facilities necessary for the training of provincial medical and technical personnel. Each *hsien* or county is to have a *hsien* health center where a small hospital (25 to 50 beds) would be located for the treatment of less serious diseases. Patients are to be sent into these health centers from four or five subcenters which are to be located in each of the counties. Each subcenter in turn is to be served by health stations located in the villages of the county. By October, 1942, fully 783 of the 1,775 *hsiens* of the 24 provinces of China proper had *hsien* health centers. When all aspects of the problem are considered, these represent extraordinary achievements. The National Health Administration also coordinates the activities of the various organizations working in China for the improvement of the medical services. The names of these organizations are listed in the section on Social and Medical Services (p. 51).

Occupied China. Very little is known concerning public health programs in those parts of China not under the control of the Chinese National Government. In Manchuria, where the Japanese puppet state of Manchukuo exists, public health administration is controlled by the Bureau of Hygiene of the Department of Civil Affairs. Japanese hold most of the responsible positions and their methods are enforced. The four provinces constituting Manchukuo have been divided into 19 provinces and one special municipality. The plan of organization provides for health officers and hospitals in each province. The public health organization of the Nanking Government is similar to that of the National Government, but its program has not been very effective. It is known that there is a great lack of trained personnel. In the areas directly controlled by the Japanese military forces, measures of public health have consisted largely of attempts at the control of epidemic diseases, particularly cholera, plague and smallpox. In the larger port cities, such as Tientsin, Shanghai, Amoy, Hong Kong, Macao (a Portuguese colony), Canton and Kwangchowan (leased by France), the health organizations probably are similar to those existing before the onset of military occupation, but are now functioning under Japanese supervision.

Relative Effectiveness. The task of providing medical and public health care to so large a population distributed over such a vast area as China is tremendous. Social and religious customs, illiteracy, low economic levels and wars have interfered with the development of this program. In spite of these difficulties, health work under the National Health Administration of the Republic of China has made remarkable progress. Plans for present and future work are especially commendable. The leaders of this work are well trained, many of them having received their training in American medical schools located in either China or the United States. There is, however, a great lack of trained personnel. Although the National Health Administration has been cognizant of this need and has developed training schools, the number of graduates of these schools is still relatively small. Supplies and funds have been limited and difficult to obtain, but in spite of these handicaps the work has advanced. Aid obtained chiefly from America has made it possible for the program to be as extensive and effective as it has been, but until more trained personnel, supplies and funds are available, only a small part of China's immense population can be aided by its public health program. In the occupied areas, including Manchukuo, the public health program is concerned largely with assistance to Japanese nationals. Under such conditions, the masses of the Chinese people in these particular areas can expect little or no help.

Water Supplies

In the rural areas of China, where 80 per cent of the people live, rain water collected in *kongs* (large vitrified tile or crockery containers), cisterns, ponds, canals and rivers forms the principal supply. Water obtained from open wells also is used. In the hill and mountainous country spring water is available. A survey of a typical rural area near Nanking revealed that 74 per cent of the water used was taken from ponds and canals, 17 per cent from rivers and 9 per cent from wells. During the periods of scanty rainfall, the cisterns, wells and ponds dry up, and more people use canal and river water. All water obtained from these sources is grossly contaminated by the washing of clothes and containers of night soil, as well as by refuse and night soil from near-by houses and boats. Wells are contaminated through the open top and by seepage from near-by cisterns which contain night soil. In the towns and cities of China the situation is little different. Only a few of the larger cities, including Changchun, Mukden, Dairen, Tientsin, Peiping, Tsingtao, Shanghai, Nanking, Canton and Hong Kong, have public water systems, but not all have plants for the treatment of water. Usually, such systems do not serve the entire area of the city concerned, and some systems, even before the onset of the war, were run inefficiently. Under present conditions it is probable that they are even less efficient than formerly. The Shanghai water works (formerly operated by a London-registered company) in recent years has been well operated, but not more than eight years ago cases of typhoid fever were reported in which the disease was due to the drinking of water. Fortunately, the habit of drinking hot water or tea has resulted in the boiling of most water before ingestion, but under certain circumstances and in certain areas untreated or unboiled water is consumed. Dishes ordinarily are washed in unboiled water. In some districts local water supplies contain the cercariae of blood flukes. The use of contaminated water has been a factor in the high incidence of cholera and the enteric diseases throughout most sections of China. All water in China, regardless of its source, must be considered unsafe and fit for use only after proper treatment or after results of repeated bacteriologic tests have proved it to be safe.

Sewage Disposal

Throughout China night soil is used as a fertilizer. The majority of the insanitary conditions are associated with the deposition, collection, storage and distribution of this material. In some rural areas crude pit latrines or latrines constructed over brick-lined cisterns or pigpens are used. In rural homes bucket commodes are common. The contents of these are emptied daily into the outside latrine or the uncovered storage cistern. Sometimes animal manure also is stored in these cisterns. Likewise, in the villages, larger towns and cities the bucket commode and pit latrines are in common use. The bucket commodes are emptied daily into a storage *kong* and every few days the *kong* is emptied by a collector who carries the material in buckets, wheelbarrow or boat to the country, where it is sold for use as fertilizer. The buckets and dippers used in the handling of this material customarily are washed in a canal or pond. It is not uncommon to see cooks clean vegetables or women do the family washing in the same canal or pond and near the same spot as that where the collectors are washing their equipment for the collection of sewage. Twice a year the night soil, after being diluted with water, is distributed on the land. This night soil may have remained in the storage cistern for only two or three days, or it may have been there for some five or six months. In some districts in the southern part of China night soil is dried and made into cakes for convenience in storage before it is used. All night soil in China, whether it is used in the form of a liquid from the storage cistern or in the form of dried cakes, usually contains many living ova and cysts. A few of the larger cities have systems in which sewage is water-borne; these systems empty sewage directly into the near-by stream or into the ocean. On the outskirts of such a city night soil is collected and disposed of as in other parts of China. In most villages, towns and cities ill-kept and insanitary public latrines are found. In many areas the younger children and males defecate somewhat promiscuously, but if a latrine is available it is usually utilized. Children frequently are allowed to defecate in the yards and courts about the homes. Such indiscriminate and insanitary disposal of excrement has led to the increased prevalence of flies, insects, animals and other carriers of disease and to the widespread incidence of helminthic infections, cholera and the various enteric diseases.

Insects and Animals

Vectors of Disease. Mosquitoes. By 1938 at least 100 species and varieties of mosquitoes had been reported from 21 provinces of China. Of these, 76 species and one variety were Oriental, 14 were Palaearctic, one was Central Asiatic, and eight were reported as being cosmopolitan in distribution because they were found universally throughout China.

By 1938 no less than 26 species and varieties of anopheline mosquitoes had been reported from China and since then six additional types have been found. The names and distribution, along with the breeding habits of the five most important vectors of malaria found in China, are given below.

Anopheles minimus minimus occurs from the southern part of China to approximately 30° of north latitude. It has been reported from the provinces of Chekiang, Kiangsi, Fukien, Kwangtung, Kwangsi, Kweichow, Hunan, Yünnan, Hainan Island and from the city of Hong Kong. This mosquito breeds in clear, sunlit, slow-running streams and springs with grassy margins, and in irrigation ditches, at low to moderate altitudes. Adult mosquitoes of this species commonly are found in large numbers in houses and cattle sheds in China. This species is the most important vector of malaria in the southern part of China.

A. hyrcanus var. *sinensis* has been reported from the middle, northern and southern parts of China: from the provinces of Hopeh, Honan, Kiangsi, Chekiang, Heilungkiang, Fukien, Kwangtung, Kweichow, Yünnan, Szechwan, Hainan Island, Shantung and from Hong Kong. This species breeds in stagnant water of pools, swamps and ponds, and sometimes along the shores of streams and lakes and in rice fields, at elevations ranging to 6,000 feet. This mosquito is a vector of malaria and is found in most parts of China; in areas between 30 and 40° of north latitude it is in fact the most important vector of malaria.

A. maculatus maculatus occurs in the southern part of China. It has been reported from the provinces of Hunan, Kiangsi, Fukien, Kwangtung, Kweichow, Yünnan and from Hong Kong. This mosquito breeds essentially in streams, but it has a preference for seepage. It can also breed in small pools, rice fields and the margins of lakes and ditches.

A. jeyporiensis var. *candidiensis* likewise occurs in the southern part of China. It has been reported from the provinces of Fukien and Yünnan and from Hong Kong. It breeds in slow-running water, such as that near the margins of streams with grassy edges, and in ditches, swamps and rice fields.

A. maculipennis has become known as *A. labranchiae* var. *atroparvus*. It is found in the northern part of Manchuria, in the province of Heilungkiang. It can breed in either fresh or brackish water, and sometimes semihibernates in houses. It is an important vector in Manchuria and the northeastern section of China.

In the northern part of China, in addition to *Anopheles hyrcanus* var. *sinensis*, two other anopheline mosquitoes are found: *A. pattoni* and *A. lindesayi* var. *japonicus*. They occur in the hilly districts, but are not efficient vectors of malaria. In the western part of China, in Sinkiang province, *Anopheles sacharovi* occurs, and it probably also is found in other sections of northwestern China. In the mountainous areas of southern and western China, at altitudes ranging from 10,000 to 11,000 feet, *Anopheles gigas* var. *baileyi*, *A. gigis* var. *simlensis*, and *A. lindesayi* occur, but are not important vectors of malaria. There are twenty other species of anopheline mosquitoes, the distribution of which is not specifically given above, that are found in various parts of southern China. The largest number is reported from Yünnan province, probably because more work in control has been done in that area. In China *A. hyrcanus* var. *sinensis* is a most important vector of *Wuchereria bancrofti* and *Wuchereria malayi*. *Anopheles minimus* and *A. jeyporiensis* var. *candidiensis* also have been found to be naturally infected with *Wuchereria bancrofti* in the vicinity of Hong Kong.

Twenty-six species of Aedes mosquitoes have been reported from various parts of China. *Aedes aegypti* has been recorded from the region of the delta of the Canton River, from the Amoy section of Fukien province and from the western part of Sinkiang. *Aedes albopictus* occurs along the coast of China as far north as Peiping and southern Manchuria, and probably is found in most parts of the eastern and southern sections of China. These two mosquitoes are the important vectors of dengue fever, which occurs sporadically and occasionally in epidemic form along coastal China; dengue also has been reported from Kashgar in the province of Sinkiang. They are also potential vectors of yellow fever, which disease, however, has not been reported from China or other parts of the Orient. Some of these mosquitoes may be involved in the transmission of encephalitis, but to date no evidence of it is available in Chinese reports.

Twenty-eight species of Culex mosquitoes have been recorded from China. The most important ones are *Culex fatigans*, *C. pipiens* and *C. pipiens* var. *pallens*, all of which are vectors of *Wuchereria bancrofti*. In the area of Hong Kong *Culex fatigans* is reported to be the most important culicine vector of *Wuchereria bancrofti*, whereas in the Woosung-Shanghai area and in northern Kiangsu *C. pipiens* is the principal culicine vector of *W. bancrofti*. *Culex tritaeniorhynchus* has been proved experimentally to be a vector of *Wuchereria bancrofti*, but has not been found to be naturally infected. The other culicine mosquitoes are not known to be vectors of disease among human beings in China. *Culex bitaeniorhynchus* and *C. tritaeniorhynchus* are reported to be the most widely distributed of any of the culicine mosquitoes found in China.

Twenty other species of mosquitoes are reported from China, the most important being *Mansonia uniformis*, a vector of *Wuchereria malayi*. This type of filariasis has been reported chiefly from Chekiang province, with occasional instances of it from Fukien province and the northern part of Hunan province. *Mansonia uniformis* is capable also of transmitting yellow fever. *Lutzia fuscana*, sometimes also known as *Culex fuscanus*, has been proved experimentally to be capable of harboring the living microfilariae of *Wuchereria malayi*, but its rôle as a vector in nature is not determined. Other mosquitoes of this group have not been identified as vectors of disease in China.

In some sections of the southern part of China mosquitoes breed throughout most of the year, but breeding is increased during the summer and fall. In northern China the breeding season of mosquitoes is limited to the summer and early fall. It is of interest to note that the larvae of *Anopheles pattoni* have been found hibernating in the water under the ice. Only a small amount of work in control of mosquitoes has been done, and this has been carried out principally in and about a few of the port cities. From 1939 to 1941 the United States Public Health Service and the Rockefeller Foundation, co-operating with the Chinese National Health Administration, carried out some control work along the Burma Road, but since the closing of the road the field work in Yünnan province has been abandoned. Control of mosquitoes is one of the most important problems of public health in China, and especially in southern China.

LICE. Louse infestation is extremely common among the lower classes of people. All three species are present; namely, the body louse, *Pediculus corporis,* the head louse, *P. capitis* and the pubic louse, *Phthirus pubis.* The first two are vectors of *Rickettsia prowazeki* and *R. quintana,* the causative agents of epidemic typhus fever and trench fever, respectively. They are also vectors of the spirochete, *Borrelia recurrentis,* which causes relapsing fever. This spirochete and *Rickettsia prowazeki* can enter the human body through the intact skin; thus, infection can result if an infected louse is crushed upon the skin. Scratching increases the chances of infection. The rat louse, *Polyplax spinulosa,* which is an important vector of typhus fever among rats, also may be present. In addition, a species of mouse louse has been found to be a vector of *Rickettsia prowazeki.* Lice also are capable of carrying bacteria of the genus Salmonella. Lice and the diseases which they carry, especially typhus fever and relapsing fever, are widespread throughout China.

FLIES. Flies of China which frequent houses are *Musca domestica* in Manchuria and the northern part of China; *M. vicina,* common in northern China and replacing *M. domestica* in central and southern China; *M. sorbens* and *Chrysomyia megacephala.* These flies commonly breed in either human feces or manure, but *Chrysomyia megacephala* breeds almost entirely in liquid human feces. *Musca vicina* usually breeds in solid human feces. Other species which sometimes frequent houses are *Musca hervei, M. tempestiva, M. autumnalis* and *M. stabulans;* the stable flies, such as *Stomoxys calcitrans;* the flesh flies of the genus Sarcophaga; bluebottle flies of the genus Calliphora; and members of the genus Tuberifa. Other members of the family Muscidae reported from northern China, and perhaps also found in other parts of China, are members of the genera Haematobia, Haematobosca and Siphona. These flies ordinarily bite cattle and horses rather than man. *Gasterophilus intestinalis* and other species, capable of causing intestinal myiasis in horses and occasionally in man, occur in the north of China. *Oestrus ovis,* the common nasal bot fly of sheep and a similar fly, *Cephalopsis titillator,* found on the camel in the northern and western parts of China, are reported. Both cause nasal myiasis, usually of animals rather than of human beings. A member of the family Phoridae, *Megaselia scalaris,* which causes myiasis of wounds, is found in the south of China.

Some of these flies are active, even in the northern part of China, until November and December. In 1940 in Peiping 100 per cent of *Chrysomyia megacephala* caught in the vicinity of public latrines were found to carry *Escherichia coli* externally, and from 8 to 30 per cent were found to carry mannite-fermenting organisms causative of dysentery. None of them carried causative organisms of typhoid fever. Eighty per cent of *Chrysomyia megacephala* caught in vegetable and fruit shops carried *Escherichia coli,* but not the causative organisms of dysentery or typhoid fever. Experimentally, it was proved that *Shigella dysen-*

teriae and *Eberthella typhosa* could survive on or inside these flies for as long as five to six days. Some of them, and especially *Chrysomyia megacephala,* have been found to be capable of transmitting flagellate and ciliate forms, ova of various helminths and cysts of amebae. Various flies of the families Oestridae and Gasterophylidae are specific producers of myiasis. In addition to being mechanical vectors of cholera and the enteric diseases, most of the flies mentioned above also serve as mechanical vectors of infections of the eyes.

Six species of sand flies are reported from China. They are *Phlebotomus chinensis, P. sergenti* var. *mongolensis, P. squamirostris, P. barraudi, P. khawi* and *P. kiangsuensis.* These sand flies are found widely distributed throughout China from southern Manchuria to north, central and south China, and extending westward into the provinces of Shensi, Kansu, Szechwan and Yünnan. *Phlebotomus chinensis* is the principal vector of *Leishmania donovani,* the etiologic agent of kala-azar, and is widespread throughout China. *P. chinensis* is also the vector of *Leishmania tropica,* the agent of Oriental sore, which is reported from an area of southern Hunan, and of a member of the genus Leishmania which causes canine leishmaniasis (in China considered to be the same as leishmaniasis of human beings). Sand flies are most prevalent in the provinces of Hopeh, Honan, Shantung, Kiangsu and Anhwei. In these provinces the breeding season of sand flies is longer and the incidence of kala-azar is higher than in areas in which there is a short breeding season. In 1935 and 1936, 958 sand flies were dissected and examined for flagellate forms of *Leishmania donovani* at Tsingkiangpu in the northern part of Kiangsu province; of 904 *Phlebotomus chinensis* examined, 1.85 per cent were found to have the parasites in question. Results of other investigations, however, have indicated that flagellates soon die in *Phlebotomus sergenti* var. *mongolensis,* and for this reason, this particular species of sand fly is a poor vector of kala-azar. Sand flies also are vectors of sandfly fever, which has been reported on a few occasions from different parts of China, but the presence of the disease has not been fully authenticated.

Flies of the genus Culicoides, or punkies, which are members of the family Chironomidae; buffalo gnats, *Simulium equinum* and others; horse flies, which are members of the family Tabanidae; and dog flies, which are members of the family Hippoboscidae (the common one being the *Hippobosca longipennis*), are believed by some to be possible vectors of canine kala-azar. In China the aforementioned flies may act as mechanical vectors of disease, but they have not been proved to be true vectors of any specific disease.

Ticks. The common dog tick, *Rhipicephalus sanguineus,* and several other varieties are present. Tick-borne typhus fever is not known definitely to occur in China, but tick-borne relapsing fever has been reported from the province of Sinkiang in the western part of China.

Fleas. Fleas of several types are common in China. The most important one and the one which is most widely distributed over China is the tropical rat flea, *Xenopsylla cheopis.* It is the principal vector of *Pasteurella pestis* from rat to man as well as from rat to rat. It is also the principal vector of *Rickettsia mooseri,* the causative agent of endemic typhus fever. The rat flea, *Ceratophyllus anisus,* is the second important vector of plague in China. Other fleas found in China, all of which may at times transmit plague, include the mouse flea, *Leptopsylla musculi* (*segnis*); the dog flea, *Ctenocephalus canis;* the cat flea, *Ctenocephalus felis;* and the flea of human beings, *Pulex irritans.*

Rodents and Marsupials. Rodents of various kinds are numerous, and constitute the reservoir for plague. In north Manchuria the Siberian marmot or tarabagan (*Arctomys bobac*), which hibernates from October to April, and the small sisel or suslik (*Citellus pygmaeus*), which hibernates from July, August or September to April, are reservoirs of sylvatic plague. The semi-wild mouse, *Mus wagneri*, also has been suspected of being a reservoir of this disease. The predominating rat of Manchuria and the northern part of China is the brown rat, *Rattus norvegicus*, whereas the most prevalent species found in central and southern China is the black rat, *R. rattus*. In other parts of China, in addition to the brown rat and the black rat, there are the roof rat, *Rattus alexandrinus*, and *R. frugivorus*. The mouse, *Mus musculus*, is found in most parts of China. The bandicoot, *Nesokia bandicota*, which is a marsupial and not a rodent, is capable of becoming infected with plague and is a host for the vectors of plague and mite typhus fever. The storage of grains in homes and shops has led to the increased prevalence of mice and rats in those places. Rodents serve as hosts of lice, fleas and mites, which are vectors of plague, typhus fever and other diseases. The excreta of rodents may contain such organisms as those of the genus Salmonella or *Leptospira icterohaemorrhagiae* and a wide variety of ova and cysts. *Spirillum minus*, which causes rat-bite fever, is transmitted by the bites of rodents. Some work in the control of rats has been done in areas when epidemics have occurred and in some of the port cities, but otherwise very little such control has been carried out.

Mites. Mites found in China are the scabies or itch mite, *Sarcoptes scabiei*, and the harvest mite, *Trombicula akamushi*. The larval mites of the genus Trombicula, parasitic on various rodents, are vectors of *Rickettsia orientalis*, causative agent of mite-borne typhus fever or tsutsugamushi disease. The adult mites and nymphs are reported to feed only on plants and do not act as vectors of mite-borne typhus fever. All forms of these mites are likely to be encountered in cutover grasslands and in areas that are subject to flood. In China mite-borne typhus fever occurs in the middle and lower parts of the Yangtze River valley and may also occur in Manchuria.

Bedbugs. The bedbug of the temperate zone, *Cimex lectularius*, is a common species in Manchuria and northern China, and the tropical bedbug, *Cimex hemipterus*, is the common species in the southern part of China. Bedbugs are not commonly involved in the spread of any disease. The ability of the bedbug to transmit disease by biting is not definitely established, but it is possible that the crushing of infected bedbugs on the skin or the ingestion of infected bugs may at times result in disease.

Snakes and Other Dangerous Animals. Poisonous snakes, although found in most sections of China, are not common, and a physician may practice medicine in almost any part of China without ever having seen or heard of a patient with snake bite. The snakes found in China are members of three families; namely, Viperidae, Hydrophidae and Elapidae. Members of the Viperidae include those of the genus Agkistrodon. *Agkistrodon intermedius* is found in Mongolia, Manchuria and the northern parts of China, and *A. blomhoffi* is found in Mongolia, Manchuria and northern China; it also has been found near Kiukiang and Nanking. These two snakes are not especially vicious nor is their poison extremely toxic. *Agkistrodon acutus* or the crested adder, called the "cockscomb snake" by the Chinese, is still less common and occurs in the central part of China in the Kwangsi Mountains, and also near Ichang in Hupeh province and in Fukien province. In the southern part of China in the Himalayan mountain districts *Agkistrodon himalayanus* is found at elevations of from 5,000 to 10,000 feet. The small viper, *Azemiops feae*, has been reported from the provinces of Szechwan, Kiangsi and Yünnan; and the Russell viper has been found in southern Yünnan. *Trimeresurus gramineus*, which is known as the "green bamboo" or "tree" viper, has been recorded from Ningpo in Chekiang province, Hong Kong, Hainan Island and other parts of the southern China coast. A few poisonous sea snakes, members of the family Hydrophidae, are found along the southern coast of China. Near the junction of the Whangpoo and Yangtze rivers and in the vicinity of Ningpo sea snakes are seen frequently. Although all the sea snakes are very poisonous they have never constituted a great hazard to man, for they are quiet and nonaggressive if they are not actually annoyed or restrained. Members of the family Elapidae found in China include the hooded cobra, *Naja tripudians,* reported from parts of the central and southern parts of China including Kiukiang, the province of Fukien and Hainan Island, and the king cobra, *Naja hannah,* recorded from a few areas of the southern part of China. In addition, three kraits, namely, *Calliophis macclellandi* found in Kiangsi and Fukien; *Bungarus candidus* var. *multicinctus,* common in the mountains south of the Yangtze River; and *B. fasciatus,* found only in the southern part of China, particularly about Canton, are reported. Kraits are nocturnal in habit and sometimes enter houses or lie in the dust on roads. In such places they may be stepped on and will retaliate by biting. Pythons, found in the jungles of Hainan Island and other districts in the southern part of China, may inflict dangerous wounds and sometimes cause death. Snake antivenin is not produced in China.

Poisonous and Dangerous Fish. Members of the genus Tetraodon, commonly called "puffer fish," are found in the seas about China. In Canton this fish is given the name *kuai-hu,* whereas in Shanghai it is known as the *wu-dung*. Each year several deaths occur as the result of the victims' eating these fish. In Shanghai the sale of the *wu-dung* is forbidden in the municipal markets, but the fish, and especially the roe, nevertheless are eaten because they are considered to be "food for the gods." The poisonous principle seems to exist chiefly in the ovaries and testes, and the eating of even one roe of such fish causes serious illness in a few minutes or death in a few hours. The poison has a physiologic action somewhat like that of curare and is thermostable. These fish can be recognized by their large head, absence of scales and the prevalence of small spines. When removed from the water they swallow air and dilate a resonant air pouch; expulsion of the air causes a loud noise. To avoid such fish a good rule to follow would be abstinence from the eating of fish which have no scales. The sting ray, of the family Trygonidae, also is found in the ocean waters, especially near the southern part of China. The wounds which are made by the spines on the tails of such fish are very slow in healing because of the poison which is deposited when the wound is made. Jellyfish are common in some ocean waters of southern China. Contact with them causes intense irritation of the skin. Man-eating sharks live in the seas off the southern coast of China.

Scorpions and Centipedes. Scorpions found in China are of the species *Buthus martensii*. They are most numerous in Manchuria and the northern part of China. They are reported to be absent from Shanghai and Ningpo, and probably are not found in the provinces of Kiangsu and Chekiang. Poisonous centipedes are plentiful throughout China. They are from 1 to 6 or 8 inches (2.5 to 15 or 20 cm.) in length. They usually are found under old buildings or under stones. The bites or stings of both scorpions and centipedes are extremely painful, but are rarely fatal except to children. Ordinarily, the scorpion and the centipede do not sting unless disturbed.

Dangerous Animals. Tigers are found in southeastern Manchuria and in parts of southern China, especially in Fukien province and the Luichow Peninsula of Kwangtung province; wolves are present in sections of Manchuria and Mongolia; and foxes, bears and wild boars occur in Hainan Island and the southern part of the province of Kwangtung. All these animals may at times attack human beings.

Pests. Stray dogs are plentiful in all parts of China. They are filthy and mangy, and usually harbor many fleas, ticks, mites and worms. They constitute reservoirs for kala-azar, rabies, echinococcosis, amebiasis and clonorchiasis. Campaigns are carried out from time to time to eliminate such dogs, but have little lasting effect. The cockroach, *Blatta orientalis,* found nearly everywhere, is not only a pest but also harbors ova and cysts of parasitic organisms. Ants of various sorts, including termites, are present, especially in the south. Leeches are found in the jungles of the southern part of China. They cause loss of blood, and infections may occur at the site of their bites. If they are present in drinking water they may attach themselves to parts of the nasopharynx or larynx and may cause death by asphyxiation of the victim.

The monkeys and gibbons found in Hainan Island and southern China at times may be pests; however, they usually remain in the jungles and do not come near the settlements.

Poisonous Plants and Foods

The sap of *Rhus vernicifera* or varnish tree is used in lacquer and varnishes. Persons sensitive to this material who come into contact with it will acquire lacquer poisoning. Three species of the arisaema plant, *Arisaema japonicum, A. ringens* and *A. thunbergii,* are present in China. The roots are used in Chinese medicine and occasionally are eaten by mistake or taken with suicidal intent. In northern China *Atriplex serrata,* an herb known as *noong jang-ai,* commonly grows along the roads and in the fields. During famines people sometimes eat this plant and poisoning occurs. Such poisoning is characterized by pain in the fingers, swelling and the formation of bullae on the eyelids, face, hands and arms and some degree of cyanosis. Secondary infection of the bullae is common and if it is not too severe, the patient usually recovers within two or three weeks. Two wild plants common throughout many districts of China are *Datura alba* and *Datura stramonium.* The fruit from such plants, sometimes eaten by children, results in poisoning, which, however, is not serious. Seeds of *Illicium religiosum* sometimes are used for the flavoring of food in place of the nonpoisonous seeds of the Chinese anise, *Illicium anisatum.* Cases of such poisoning are not uncommon in northern China. In some parts of southern China and Hainan Island the deadly nightshade, *Atropa belladonna,* is found. Its leaves and roots sometimes are used by Chinese with homicidal and suicidal intent. Primitive tribesmen of the interior part of Hainan Island use poisonous arrows, and the poison which they employ may be that of *Strychnos colubrina.* This plant also is used for killing dogs, rodents and fish. The poppy, *Papavera somniferum,* from which opium is obtained, is grown in many districts of China. The amount produced depends upon varying social, economic and political conditions existing in the district. By 1937 the production of the poppy and the use of opium, morphine and heroin, except for medicinal purposes, were prohibited by law in most sections of China proper. But the practice has again become widespread in occupied China.

Food and Dairy Products

The majority of the Chinese people live on a diet consisting almost exclusively of cereals and vegetables, to which small amounts of vegetable oil are added in the process of preparation. Rural families derive 90 per cent of their caloric intake from seeds and their by-products; only 1 per cent of the caloric intake is derived from animal products. The Chinese, unlike the Mongols and Tibetans, practically never use dairy products, such as milk, cheese and butter. They like eggs, pork, fowl, fish, crabs and other sea foods, but most of these animal protein foods appear only on the tables of the well-to-do families. The orthodox Buddhists will not eat flesh or any by-product of animals or fowl. The Moslems eat mutton and beef, but will not eat pork. The masses of Chinese, however, eat beef, mutton, pork and fish without discrimination, if opportunity presents itself. In a few areas of the southern part of China and on Hainan Island dogs and monkeys occasionally are eaten. In the north of China horses and donkeys furnish supplies of meat.

The cereals grown and eaten vary in different parts of China. In the north of China and Manchuria wheat, *kaoliang* (Chinese millet), and soybeans are the main products; some corn also is raised. In the Yangtze valley rice, wheat, some soybeans and corn, peanuts and sesame are grown; in the provinces of Fukien, Kwangtung and Yünnan rice is raised; and in the provinces of Chekiang, Hunan and the southern part of Kiangsu, rice and tea are the principal crops. The exclusive use of polished rice in the diets, especially among the southern Chinese, has resulted in the frequent occurrence of beriberi. Many kinds of vegetables are grown, including several varieties of spinach-like vegetables and cabbage, peppers, beans, peas, carrots, turnips, onions, squash, melons, sweet potatoes and other tubers. Many fruits, including persimmons, plums, peaches and small apples, are cultivated in central and northern China. In southern China, and especially Hainan Island and the province of Kwangtung and in some sections of southwestern China, tropical fruits, including papayas, breadfruit, lychees, mangoes, coconuts, bananas, guavas, pineapples, figs, tangerines, oranges and pomelos, are raised. Citrus fruits also are grown in the province of Szechwan. In many parts of China the struggle for existence has crowded out all domestic beasts excepting draft animals, and even these animals in many districts are not common. Nevertheless, yellow oxen are not uncommon, as is shown by the fact that on 52 per cent of the farms in the north and 31 per cent of those in the south, oxen are used for farm work. Water buffaloes, absent in the northern part of China, are employed on 40 per cent of the farms of eastern, central and southern China. Herds of cattle, excepting in Mongolia and parts of coastal Chekiang, are rare. The beef obtained from buffaloes and cattle usually is tough and of poor quality. Sheep are raised chiefly in Mongolia and western China, and goats of poor quality are raised throughout China. Camels, horses and donkeys are common in the north. Hogs and chickens are raised in most areas of China and in southern China hogs formerly were raised in sufficient quantity to be exported to Singapore. Eggs are plentiful in some districts but, due to lack of facilities for storage, their supply is uncertain. In some of the larger cities where there was a large foreign population there were dairies, but milk was pasteurized in only a few of them. Tampering with milk bottles is so common that any or all milk obtained in China, whether it is pasteurized or raw, must be considered to be unsafe for consumption unless it is boiled immediately prior to use.

Diseases take a heavy toll among livestock. Rinderpest, swine fever and fowl cholera are common, especially in the southern part of China. Anthrax and glanders are common in northern China and Manchuria. Beef and pork often are infected with cysts of tapeworms and at times pork may be infected with *Trichinella spiralis*. Vegetables and raw fruits often contain amebic cysts and pathogenic organisms. Fish, crustaceans and water nuts frequently are infected with flukes. The injection of contaminated water into melons in order to increase their weight has resulted in serious outbreaks of cholera.

Supplies of food, under normal conditions, are hardly adequate for local needs. The frequent occurrence of famines indicates that anything which upsets the routine life of the masses results in an insufficient supply of food.

Miscellaneous Problems of Sanitation

Vital statistics provide an unsatisfactory picture of public health in China. The maternal death rate is about 15 per 1,000 births. The infant mortality rate is about 200 per 1,000 births. These rates, which are estimates of the true rates, are from two to five times higher than those of countries in which modern preventive measures are practiced. The estimated mortality rate for all China, including Manchuria, is 25 per 1,000 of population, which means that approximately 11,500,000 persons die each year (based on a population of 458,000,000). Death rates of more than 15 per 1,000 of population are considered to be excessive in most countries. Thus, China has 4,400,000 unnecessary deaths each year. Probably three fourths of these deaths are caused by gastro-intestinal diseases, tuberculosis and the infectious diseases of infancy and childhood, notably tetanus, smallpox, dysenteries and diarrheas. Poverty, ignorance, and social customs are prime factors responsible for the low standards of living and are in part accountable for the high incidence of diseases in China. Crowding in the homes is marked and the custom of preserving the family as a unit has increased this crowding. In north China many people sleep together on a heated couch called the *k'ang*. Spitting is promiscuous and is freely indulged in. Insects and rodents which carry disease are common in the homes. Food is taken from common bowls and sometimes the chopsticks are passed about and used from hand to hand. Yet, in spite of these unfavorable sanitary conditions, the population of China has increased.

MEDICAL FACILITIES

Hospitals

Before the onset of the war, only 370 hospitals were operating in China proper. Of these, 310 were nongovernmental hospitals, of which 235 were Protestant mission institutions. Then, as now, the majority of the hospitals were located in the cities, so that large sections of the country did not have hospital facilities. With the westward movement of the National Chinese Government this situation has been corrected somewhat, but it is still not satisfactory. In unoccupied China the government hospitals consist of four National Central hospitals located at Kweiyang, Chungking, Sian and Lanchow; some 15 provincial and municipal hospitals; seven hospitals for the treatment of communicable diseases; and other hospitals with limited facilities that are operated in connection with dispensaries, first-aid stations and health centers. There also are 151 mission hospitals, of which 119 are Protestant and 32 are Roman Catholic. The majority of the mission hospitals also function as *hsien* hospitals and some of them serve as teaching hospitals for medical schools. In addition, the Roman Catholic missions maintain approximately 290 dispensaries in unoccupied China. There are four International Peace hospitals, three of which are located in the provinces of Shansi and Shensi; the fourth is a small branch hospital in the so-called Shantung-Kiangsu guerrilla area. The largest of these hospitals is the Bethune Memorial Hospital, which is completely housed in caves, at Fushih in the province of Shensi. Four Northwest Border hospitals are located in the northwestern area. Included among them is a maternity and children's hospital. Both the International Peace hospitals and the Northwest Border hospitals treat soldiers as well as civilians. In addition, there are numerous base and field hospitals and dressing stations maintained by the Army Medical Administration and the National Red Cross Society of China to provide care for the Chinese armed forces. In the occupied areas of China proper are 84 mission and numerous government and private hospitals, all of which, if now operating, are doing so under Japanese supervision. Manchuria has more than 200 hospitals, the majority of which are maintained by railroad, government and mining interests. There also are a few private hospitals, among which are 16 hospitals maintained by mission organizations, chiefly British and Danish. These latter institutions, if they are now operating, likewise are under Japanese management. Hong Kong, before the onset of the war, had 32 hospitals; the Portuguese colony of Macao reported four established hospitals and several smaller ones; and the French-leased territory of Kwangchowan in Kwangtung province had three hospitals.

Number of Beds. Before the war hospital facilities in China proper provided 38,000 beds, of which 27,000 were in mission hospitals. An estimate of the hospital beds (including only a few of the Red Cross hospital beds, none of the Army hospital beds nor beds in Highway Health Station Hospitals) now available for the use of civilians in unoccupied China indicates that there are approximately 17,000 beds, or 0.6 bed per 10,000 of population (based on a population of 270,000,000). A similar estimate of the hospital beds in occupied China discloses that there are some 24,000 beds or 1.6 beds per 10,000 of population (based on a population of 150,000,000). In Manchuria there are about 10,000 hospital beds, providing approximately 3.4 beds per 10,000 of population (based on a population of 29,000,000). Before the war began, Hong Kong was reported to have about 3,500 hospital beds, or 17.5 hospital beds per 10,000 of population (based on a population of 2,000,000). On the basis of these figures it is obvious that the number of hospital beds in all parts of China is grossly inadequate. This is more significant when it is realized that the rate of sickness for China is much higher than that for the United States, where hospital beds number 97 per 10,000 of population.

Equipment. Excepting for Manchuria, the equipment of hospitals in China has deteriorated since the onset of the war with Japan. Only a few of the larger hospitals ever had adequately equipped operating rooms, x-ray and laboratory facilities. In the occupied areas, much of the hospital equipment has been confiscated, broken or in other ways damaged. Difficulties of supply and transportation have interfered with the equipping of hospitals, especially in the unoccupied areas.

Supplies. Throughout China, including the unoccupied and the occupied parts of China, and in Manchuria, there is a serious shortage of drugs and hospital supplies. This condition existed before 1937, but since that time it has become an acute problem, especially in the unoccupied areas. Many tons of drugs and supplies have entered China *via* the Burma Road and more recently *via* the airplane route from India, but the majority of such supplies have been for the armed forces. Only recently have such materials reached China in quantities sufficient for civilian use. More than 100 drugs are considered essential by the National Health Administration, but only about 50 per cent of them can be produced locally. The manufacture of these essential drugs is limited, and the quantities produced are inadequate. This work is discussed, *infra,* in the section on medical institutions. Efforts are being made to manufacture these drugs, but the lack of personnel trained in methods of mass production and the lack of essential supplies and equipment make the production of drugs almost impossible at present. Several agencies are endeavoring to meet the problem of medical supplies and equipment. The National Health Administration has a factory for the manufacture of surgical instruments, hospital equipment and artificial limbs, as well as several laboratories which produce serums and vaccines. Two Chinese pharmaceutical laboratories are located at Chungking and Chengtu, and two are situated in the province of Shensi. These laboratories manufacture drugs as well as medical and hospital equipment. In addition, the Chinese Industrial Co-operatives are making certain quantities of these products. The International Relief Committee of the American Red Cross and other charitable organizations help the Chinese to obtain these supplies and also in transportation of them.

Medical Personnel

Physicians. At the end of October, 1942, it has been said, 12,018 physicians were registered with the National Health Administration of China.* About 6,000 of these physicians were practicing in unoccupied China; the others in the occupied areas. Of the physicians in unoccupied China, about a third had not been graduated from accredited medical colleges but had obtained their licenses to practice medicine after they had taken and passed a special examination. Approximately 2,000 of the 6,000 physicians in unoccupied China are in the employ of the National Red Cross of China; many of the others are in the employ of the National Health and the Army Health Administrations. The ratio of physicians-to-population is one per 45,000 people in unoccupied China and one per 25,000 people in the occupied area. At the end of 1939 in Manchukuo 4,100 physicians were reported, or one per 10,000 persons. The majority of the 16,118 physicians in China and Manchukuo are in city districts, so that the large rural areas are without scientifically trained medical personnel. The *hsien* health program is, however, enabling many medical practitioners to go into the rural areas; but as yet the system is not extensive enough to supply an adequate number of physicians for all of the rural districts. The number of scientifically trained physicians is entirely insufficient for the needs of the Chinese people. This inadequacy becomes more apparent when the ratio of physicians-to-population in China is compared with the ratio of about one physician to each 1,000 persons in the United States in 1942.

Nurses. It was said that 5,796 nurses were registered with the National Health Administration of China in 1942. The exact number of nurses in Manchuria is not known. Registration of nurses is required in Manchuria, and it is known that the training courses for nurses have been shortened in an effort to increase the supply of such personnel. A number of Chinese and American nurses recently has been sent to China from the United States to assist in the training of nurses.

Others. At the end of October, 1942, in China proper, 322 dentists, 5,003 midwives, 793 pharmacists and 4,010 dispensers of drugs were registered with the National Health Administration of China. In Manchuria, at the end of 1939, there were 600 dentists, of whom only a third were qualified; there were 700 pharmacists, of whom only about two thirds were qualified; and there were approximately 6,000 untrained midwives and 2,400 trained midwives.

Medical Institutions

Medical education in China was entirely disorganized as a result of the war. The majority of the medical colleges were moved from the eastern parts of China into unoccupied areas in the western regions. Although much equipment was lost by these colleges, they have continued to function. At present, in unoccupied China, there are four national and 18 provincial medical colleges. Several of the colleges are also supported by missions. These medical colleges are doing creditable work, and are graduating about 400 physicians each year. The National Central University Medical College and the West China University Medical College, both situated at Chengtu, provide courses in dentistry. The Bethune Hygiene School, established in the northwestern part of China in 1939, offers a three-year course in medicine and a two-year course in surgery. There are, in addition to these institutions, special schools in China in which persons are trained in the treatment of the ill and wounded members of the Chinese armed forces.

In 1938 the Red Cross Emergency Medical Service Training School was organized at Kweiyang in the province of Kweichow. This school has five branch schools which

* In addition, there are, of course, thousands of practitioners of native medicine scattered throughout all parts of China and Manchuria.

function in different zones of the theater of war. Three-month courses are provided for surgeons, medical officers, nurses and hospital orderlies. A course of six years' duration is planned, and it is contemplated that those students who complete this course will receive the degree of doctor of medicine and will be permitted to practice medicine in China. The Army Medical College, situated at Anshunfu in the province of Kweichow, has sub-units in Sian in Shensi province and at Shaoyang in Hunan province. This college offers a regular course in medicine as well as "refresher" courses, and it also trains pharmacists and other medical assistants. The Eighth Route Army, now known as the "Eighteenth Group Army," has its own medical college, the China Medical College. The Hygienic School of the Kiangsu-Shantung border region is affiliated with this college.

Only a few of the Chinese medical schools in those parts of the country occupied by the Japanese have been permitted to operate. The Peiping Union Medical College, which was supported by the Rockefeller Foundation, was closed after the attack by Japan upon the United States in December of 1941, and has not been opened. One of the other schools in Peiping, the National Peiping University Medical School, and two of the medical colleges in Shanghai, Saint John's Medical College and Aurora Medical School, were known to be operating in August of 1942.

The largest medical school in Manchuria is the Manchuria Medical College at Mukden, which is or was financed by the South Manchuria Railway Company. Most of the medical courses in Manchuria have been shortened to four years by decree of government, with the object of increasing the supply of physicians. The government medical college at Harbin also offers courses in dentistry and pharmacy. It is not known whether or not the Hong Kong Medical School is now in operation.

About 80 per cent of the schools of nursing in China were closed as a result of the war. Fifteen government and 17 private schools of nursing were registered with the Ministry of Education in Chungking by the end of 1942, and 1,497 students were in training. In January, 1939, national examinations of students wishing to become nurses were inaugurated in 12 provinces. These examinations are conducted semiannually, and 631 students have passed them. There is a special army school of nursing at Kweiyang in the province of Kweichow. Little is known concerning the education of nurses in occupied China excepting that at individual hospitals the training of nurses has proceeded as well as conditions permit.

The Central Midwifery School is located at Loshan in the province of Szechwan.

Since 1940 all the physicians, pharmacists, dentists, nurses and midwives recently graduated from schools in China have been conscripted for service in the Chinese Army or in other units of the government. About 40 per cent are assigned to the medical department of the army; 30 per cent are assigned to the National Health Administration; 15 per cent are sent to the Chinese Red Cross; and 15 per cent are detailed to the medical colleges. Those who refuse to accede to such orders are not permitted to be graduated.

A certain quantity of biologic products is produced in various laboratories of China. In unoccupied China, these products are manufactured at the National Central Prevention Bureau at Kunming in Yünnan province, at the Northwest Epidemic Prevention Bureau at Lanchow in Kansu province (with branches at Pingliang in Kansu province, Sian in Shensi province and Chengtu in Szechwan province), and at the Emergency Medical Service Training School at Kweiyang in Kweichow province. Limited supplies of vaccine, chiefly smallpox vaccine, are manufactured at provincial hygiene laboratories situated in the provinces of Fukien, Kiangsu, Kwangtung, Kwangsi and Shensi.

In occupied China proper Pasteur institutes were situated at Shanghai and Tientsin; a radium institute was maintained in Shanghai, as was also the Lester Institute. In Manchukuo the South Manchuria Railway Company operated an institute for the study of diseases of animals at Mukden; an institute of hygiene was maintained by the government. At the former institution, serums and vaccines were produced for use in the treatment of diseases of animals; at the latter institute serums and vaccines for the treatment of human beings were manufactured.

TABLE 1

Salient Climatic Data, Annual Figures, Certain Places in China (Including Manchuria and Mongolia)

Place	Temperature, ° F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Urga	97 *	−48 *	28	8 †	68	NW, ?	4,374
Canton	100	31	71	65.2	80	N, 33	33
Chungking	29	111	66	43	78	NW, 29	755
Hankow	13	106	63	49.3	74	NE, 46	118
Hong Kong	32	97	72	85.4 ‡	79	E, 45	105
Shanghai	104	10	61	44.8	..	SE, 20	23
Tengyueh	85	22	60	58.8	..	....	5,358
Tientsin	109	−3	54	21.1	62	NW, ?	21
Tsinan	108	1	58	24.8	56	....	154
Yünnanfu	91	22	61	41.8	72	SW, ?	6,212
Mukden	103	−27	45	26.6	..	....	144
Darien	96	−3	51	25.4	66	....	45
Hsinking	103	−33	40	26.8	66	....	709

* These two temperatures were recorded at an elevation of 3,773 feet.
† About 75 per cent of precipitation occurs in June, July and August.
‡ In most cases, the heaviest rainfall is associated with typhoons; but rainfall of 28 inches (0.7 meter) has occurred in May, not accompanied by a typhoon.

Social and Medical Services. The Republic of China, as is well known, is assisted in the development of the country by a multitude of Occidental agencies and organizations. In medicine and associated fields nearly 25 separate groups are or were providing aid to China in a variety of ways. One of the most important of such groups is the American Bureau for Medical Aid to China, which supports the training programs of the National Health Administration and the Emergency Medical Service Training Schools. This bureau trains and transports personnel for that program. Another very important group is of course the American Red Cross, the work of which in the sending of supplies for civilian medical care in China is well known. The Associated Boards for Christian Colleges in China maintain three medical schools, with associated schools of nursing and university hospitals.

Two leading British organizations in China are the British Fund for the Relief of Distress in China, which is known as the "Lord Mayor's Fund" devoted to the relief of distress arising from the hostilities in China; and the British Red Cross Base Hospital.

At Chefang in the province of Yünnan the Rockefeller Foundation built and equipped a laboratory for research in malaria, at the request of the National Health Administration of China. At the moment of writing this laboratory is located in Chungking.

The China Aid Council supports the four International Peace hospitals and maintains a drug factory in the northwestern part of China. China Defense Supplies is the name for the lend-lease organization in

China. The China Medical Board is the organization which supports the Peiping Union Medical College. The Chinese Young Men's Christian Association extends emergency services to soldiers in the Chinese Army; and the Church Committee for China Relief is an interdenominational organization which sends funds and supplies to hospitals and clinics for the use of the civilian population.

The Friends Ambulance Unit is a medical transport unit which is supported by money from the United States and England. This unit is employed for the transportation of medical supplies for the National Health Administration, the Medical Relief Corps and the mission hospitals.

"Indusco" is the American Committee for Chinese Industrial Co-operatives. The International Relief Committee at Kweiyang in the province of Kweichow was formerly known as the "International Red Cross Committee." This committee allocates funds and supplies to mission hospitals, and receives funds from the National Health Administration, the National Relief Commission, and the Church Committee for China Relief.

The Japanese Red Cross carries out work in Manchuria and other areas of occupied China. The Health Organisation of the League of Nations in 1938 sent three anti-epidemic units to China. Official cooperation was concluded as of the end of 1940, but some of the experts who served in the units remained as members of the National Health Administration of China. The Medical and Surgical Supplies Committee is an American organization which collects donations of surgical instruments and supplies in the United States and sends them to various members of the United Nations as requested.

The Medical Relief Corps is an organization of the National Red Cross Society of China which works with the Army Medical Service. At the moment of writing this body has seven divisions, 40 groups, and 100 units working in field hospitals, base hospitals and dressing and receiving stations. It provides hospital care for troops and outpatient care for civilians. Personnel of this corps also serve in the Emergency Medical Service Training Schools. The National Red Cross Society of China is the parent organization of the Medical Relief Corps. This society is devoted to civilian relief, and has five groups and 23 units. Local chapters of this organization maintain 31 hospitals, 63 clinics and 37 medical units.

The Rockefeller Foundation, as said previously, supports the central Public Health Personnel Training Institute and the laboratory for research in malariology now situated in Chungking. This foundation has made grants to several medical schools in unoccupied China.

United China Relief is a federation of eight agencies, the purpose of which is relief for China. They are: the American Bureau for Medical Aid to China, the American Friends Service Committee, the Associated Boards for Christian Colleges in China, the China Aid Council, the Church Committee for China Relief, Indusco, the American Committee for Chinese War Orphans and the China Emergency Relief Committee.

The United States Public Health Service has sent experts to China Defense Supplies to work on the problem of malaria.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Asiatic cholera, intestinal helminthiasis, typhoid fever, paratyphoid fevers, amebic dysentery, bacillary dysentery and the common diarrheas are widespread throughout China, from Manchuria and Mongolia on the north to Hainan Island and Yünnan province on the south and westward to the province of Sinkiang. The extensive use of night soil as fertilizer and the prevailing unhygienic conditions and customs probably are the chief factors causing the increased prevalence of these diseases. Human carriers of these diseases are numerous.

Dysentery. The widespread incidence of dysentery is demonstrated by the fact that in 1941 the National Health Administration of China reported 101,686 cases of dysentery (type not specified) in 18 provinces of unoccupied China. Various types of dysentery also are common in Manchuria and other parts of China.

Bacillary dysentery occurs throughout the year, but in areas in which seasonal changes of temperature are common the disease is always more prevalent during the summer. In some years bacillary dysentery actually is pandemic during the hot season. In the northern part of China the mannite-fermenting organisms of paradysentery are more frequent than is *Shigella dysenteriae*. In Peiping, of 315 children who had dysentery, 138 suffered from the Flexner type of infection and 73 had the Shiga type of infection. In Shanghai during the years 1937, 1938 and 1939, the municipal laboratory reported 1,833 positive cultures from the stools of dysenteric patients; of the organisms isolated, 87 per cent were of the Flexner type and 13 per cent were of the Shiga type.

Amebic dysentery, caused by *Endamoeba histolytica,* occurs throughout China. Hepatic abscesses caused by *Endamoeba histolytica* are frequent and occur more commonly in men than in women. The high incidence of amebic dysentery is shown in Table 2. The incidence of amebic dysentery among foreigners in China usually is higher than among the Chinese.

TABLE 2

Incidence of Infection with Endamoeba histolytica in China

Region	Stools examined, no.	Positive results, %
Manchuria	790	15.90
All China	9,338	10.49
Peiping	816	29.50
Peiping (foreigners)	.....	16.50
Peiping	60	20.00
Shansi	.....	18.10
Yangtze valley (general patients)	359	2.50
Yangtze valley (patients with intestinal disease)	57	50.87
Turkestan	1,064	35.00

Typhoid and Paratyphoid Fevers. The prevalence of these diseases is shown by the fact that 11 per cent of 29,468 patients admitted to hospital or outpatient departments in various parts of China in 1935 for communicable disease suffered from typhoid fever or paratyphoid fevers. During 1941 the National Health Administration reported 15,218 cases of typhoid fever from 18 provinces of unoccupied China. In Manchuria from 4,000 to 6,000 cases are recorded yearly, but in 1937 almost 15,000 cases were reported. In Manchuria and the northern part of China these diseases occur chiefly during the late summer and early autumn. At that season hospitals often can admit only a small percentage of the patients who come to the outpatient departments. In the interior (such as the province of Szechwan) and in Hong Kong and other parts of southern China, typhoid fever and paratyphoid fevers occur throughout the year, but there is a maximal incidence during the late summer and autumn. In Table 3, which is based on data from Shanghai

TABLE 3

Reported Typhoid Fever Occurring in Shanghai and Hong Kong

Year	Cases, no.	Deaths, no.	Population
Shanghai			
1937	808	570	3,552,199
1938	3,700	1,400	4,000,000
1939	1,980	1,500	3,500,000
Hong Kong			
1937	296	86	1,300,000
1938	404	152	1,800,000
1939	417	154	2,000,000

and Hong Kong, the high proportion of deaths among reported cases is shown. The table does not, however, show the true incidence of the disease because only a few of the cases are reported.

Paratyphoid fever caused by *Salmonella paratyphi* and paratyphoid fever caused by *S. schottmuelleri* both are frequent. Infections caused by *S. choleraesuis* also are not uncommon, as shown by the agglutinations carried out in Shanghai laboratories during 1937. In the northern part of China septicemia caused by *Salmonella choleraesuis* or by *S. enteriditis* has been frequently observed as a complication of relapsing fever and of typhus fever. Strains of *S. enteriditis* isolated in such cases are intermediate between the *S. enteriditis* of western Europe and the Moscow type isolated in Russia. In the case of relapsing fever, such septicemia is manifested by a febrile rise, accompanied by leukopenia and occurring after the drop of fever that follows neoarsphenamine therapy. It has been reported that the same lice responsible for transmission of the spirochetes of relapsing fever or of the rickettsiae of typhus may also transmit the salmonellae, thus precipitating a dual infection.

Cholera. Cholera is endemic in China and occurs periodically in epidemic outbreaks. Severe epidemics raged in 1909, 1919, 1926 and 1932. Twenty-one provinces and 303 cities were attacked in 1932. At least 100,000 cases were reported, with 34,000 deaths. The epidemic area extended from Canton in the south to Tsitsihar in northern Manchuria and from the port city of Foochow on the eastern coast to the western part of the province of Kansu. Never, excepting in 1919, had such an epidemic been observed in China. In 1932 Nanking had 1,555 cases of cholera with 386 deaths; Hankow had 777 cases with 125 deaths; Amoy had 1,614 cases with 745 deaths; Canton had 1,093 cases with 386 deaths. Even in Tientsin, 2,000 cases were reported. In 1937 cholera was epidemic in the southeastern coastal provinces, and in that year 305 cases with 272 deaths were reported from the French-leased territory of Kwangchowan. With the extension of the Sino-Japanese War in 1938, the disease spread to the interior, resulting in 50,043 cases in nine provinces. In 1938 the disease also occurred in Manchuria. In 1939 the disease became pandemic. It started as usual from an endemic center in the province of Hunan (the cities of Yuanling and Changteh), where 1,087 victims were observed; it reached the neighboring province of Kweichow and spread over 15 provinces, with a total of 34,900 cases. The epidemic reached as far south and west as the provinces of Yünnan, Szechwan and Sikang, and as far north as those of Shensi and Kansu. Kunming, the capital of Yünnan, reported 3,486 cases with a fatality rate of 74 per cent. In 1940 the epidemic was less intense and occurred chiefly in southern Kiangsu, Chekiang, Fukien, Kwangtung, Hunan and northern Szechwan. In 1941 the disease occurred only in Hunan, Fukien and Kwangtung, in which it is well known that the disease is endemic. In 1942 the epidemic spread again. After the Japanese occupation of Hong Kong, the Malay States and Burma, cholera was brought into the country by three different routes: along the Si River into Kwangtung, across the Burmese border into Yünnan and into Kwangsi. In 1942, between January and the end of September, 11,951 cases, spread over 19 provinces, were reported. Even in October and November, 1942, the disease had not entirely disappeared, although in this part of the world epidemics of cholera usually cease in October.

In the northern parts of China, in the vicinity of Peiping and Tientsin, cholera has occurred only sporadically since 1938. In Hainan Island epidemics of cholera occur regularly; the last one was recorded in 1937. The first instances of the disease often are represented by persons who have come into the region from Bangkok in near-by Thailand.

Common Types of Diarrhea. Such types of diarrhea are extremely frequent in China. Some are caused by acute infection with organisms of the genus Salmonella, and others may be caused by the excessive amounts of oil in Chinese food.

Helminthiasis. Helminthic diseases are prevalent throughout China. Widespread pollution of the soil and improper habits of hygiene and sanitation favor the prevalence of these diseases.

INFECTION WITH HOOKWORM. A survey made in 1935 of 29,468 patients admitted to hospital or outpatient departments in various parts of China for a communicable disease showed that 30 per cent were suffering from ancylostomiasis. In Manchuria and the northern part of China the infections are mild. In this area the majority of patients usually do not show evidence of hookworm disease, but act chiefly as carriers. In the southern areas this disease presents serious clinical and public health problems. The infection is especially heavy among the rural populations in the basin of the Yangtze River (southern Kiangsu and northern Chekiang, northern Anhwei, the Hupeh-Hunan areas and Szechwan). In the southern coastal provinces the rates of infection also are high. Approximately 60 per cent of the farming population of the province of Kwangtung have infection with hookworm; 80 to 95 per cent of the people of Hainan Island are reported to be infected. However, in the mountainous provinces of Kweichow and Yünnan the disease is reported to be practically absent. In the province of Szechwan, although the incidence of infection is high, the clinical signs are insignificant. Ancylostomiasis, even in the areas in which it is endemic, has an irregular distribution, and villages free from infection may be found a short distance from heavily infected localities. The incidence of disease in China is associated with the cultivation of mulberry trees, vegetables and flowers, because of the use of night soil for fertilizer. The cultivation of rice is said to be less dangerous because the wet method of utilization of night soil in the fields is unfavorable for the production of infection of the soil. In about 80 per cent of cases, infection with hookworm in China is due to *Ancylostoma duodenale*. In the remaining 20 per cent the parasitic nematode is *Necator americanus*.

INFECTION WITH ROUNDWORM (*Ascaris lumbricoides*). In some areas, and especially in rural districts, from 80 to 95 per cent of the people are infected with roundworms. In the northern part of China, where the climate is dry, the average number of worms per person is reported to be less than that in southern China.

INFECTION WITH *Strongyloides intestinalis*. Little is known concerning the distribution of this particular worm in China, but cases have been reported from Wuhu in the province of Anhwei, and Yungchun in the province of Fukien. In view of the fact that this parasite frequently is associated with infection with hookworm in other parts of the world, the area of distribution in China may be much wider than it appears on the basis of available reports.

INFECTION WITH TAPEWORM. The beef tapeworm, *Taenia saginata*, is found in many areas of northern and western China, being prevalent in the areas in which beef is eaten. It is not common in southern China. The pork tapeworm, *Taenia solium*, has been reported from certain areas of China (such as the cities of Weihaiwei, Soochow, Hankow, Peiping and Siangyangfu), but is rarer than *T. saginata*. In Peiping *T. saginata* is five to six times more frequent than *T. solium*. In the northern part of China *Cysticercus cellulosae*, the larva of *T. solium*, not infrequently is found in human beings; if located in the brain it may cause serious complications. Echinococcosis, or hydatid disease, occurs in northern China (Hopeh and Chahar), and in Mongolia and Manchuria. Sporadic instances of the disease also have been reported from Shansi, Shantung, Kiangsu, Fukien, Szechwan and Kansu. *T. echinococcus* has been found in dogs in Peiping and one such observation was made in Szechwan. Many cases of infection with *Hymenolepis nana* have been reported from northern China (Peiping and Chefoo). Sporadic cases also have been reported from the southern provinces. Seven cases of infection with *Sparganum mansoni,* which is the larval stage of *Diphyllobothrium mansoni,* have been reported from China. Infection with *Diphyllobothrium latum* has been reported from one or two districts in Yünnan province in the southern part of China.

TRICHINIASIS. Infection of human beings with *Trichinella spiralis* rarely has been reported from China, but the parasite has been found in pork in Amoy, among rats in Shahsien in the province of Fukien, among dogs and cats in Mukden in the province of Liaoning, and among hogs in Harbin in the province of Kirin.

INFECTION WITH WHIPWORM (*Trichuris trichiura*) AND PINWORM (*Enterobius vermicularis*). This type of infection occurs in most sections of China. In some areas practically all the inhabitants have trichuriasis.

CLONORCHIASIS. This disease, caused by the fluke, *Clonorchis sinensis,* which inhabits the bile ducts of animals and human beings, is found in many parts of China. It is endemic in all regions in which raw fish are consumed, and is especially common in Canton, Swatow and other parts of the province of Kwangtung. Eighty per cent of the inhabitants of Canton are reported to be infected with these flukes. The disease has spread westward along the Si River to as far as Wuchow in the province of Kwangsi. It is endemic in Hong Kong, and is found in Hainan Island among immigrated Cantonese. Cases have recently been reported from Szechwan. In Peiping several instances of the infection have been observed in beggars who have eaten insufficiently cooked fish. Clinical signs of the disease usually are not serious. The liver may be enlarged; jaundice rarely is observed. The eggs of this fluke are passed with the stools. In water the miracidia are soon hatched and invade the first intermediary hosts, which are small snails of the genera Bithynia and Parafossarulus. Within the snails cercariae develop which invade the second intermediary hosts, fresh-water fish, especially cyprinoid fish. In the muscles of the fish the cysts of *Clonorchis sinensis* develop. The terminal host is the human being who eats the raw fish. Dried and salted fish also may convey the infection. In Canton thin slices of raw fish called *yü shen* or *yü sheng chow* are popular delicacies. From the cysts metacercariae are hatched in the human duodenum. They migrate to the common bile duct and to the bile passages in the liver, where the mature trematodes develop. This migration may take only four to seven hours. Twenty-six days later eggs of *Clonorchis sinensis* may be present in the feces of the host. In the province of Kwangtung, the culture of fresh-water fish in ponds is an important industry and night soil, which is considered necessary for the development of the fish, is fed regularly to them. Thus, this established custom aids in the dissemination of the disease. The trematode also is found in cattle and dogs throughout many sections of the country. Thirty-five per cent of the cattle in the province of Szechwan, and 37 per cent of the cats and 25 per cent of the dogs in Peiping and 8.3 per cent of street dogs in Mukden are infected. It is only in the northwestern provinces that the trematode has not been found in animals; therefore, if raw fish is eaten, the danger of infection with *Clonorchis sinensis* will exist not only in the south, but also in widely spread districts throughout China.

PARAGONIMIASIS. This disease is caused by *Paragonimus westermani,* which invades chiefly the lungs of human beings and animals, giving rise to fibrosis of the lungs and chronic hemoptysis. Paragonimiasis is limited to only a few areas of China, chiefly Shaohing, south of Hangchow in Chekiang province. Isolated instances of the disease have been observed at Ichang in the province of Hupeh, in the provinces of Fukien and Yünnan, and in Manchuria. When sputum containing the ova of *P. westermani* is deposited in water miracidia develop. These escape from the eggs and enter the first intermediary hosts, snails belonging to the genus Melania. In the snails cercariae develop, which escape and enter the second intermediary host, which in China is the stone crab (Potamon). The disease is then spread to human beings and animals by the consumption of raw or insufficiently cooked crab meat. Since fresh-water crabs usually are eaten in a pickled condition, paragonimiasis of human beings is not common in China. Sometimes, however, "drunken crabs," prepared by the placing of living fresh-water crabs in a solution of salt which has been seasoned with wine and vinegar, are eaten. These crabs are allowed to remain in the solution overnight before they are eaten, and they are then consumed without being cooked. They contain living cercariae which cause the infection in man. Since the snails in many areas of China are infected with *Paragonimus westermani*, the danger of infection of human beings always exists when the following circumstances occur together: hilly country, fresh-water stream in the vicinity, presence of snails of the genus Melania and stone crabs (Potamon) in the stream, and the habit of eating raw crab meat.

Fasciolopsiasis. This infection is caused by *Fasciolopsis buski*, which is the largest trematode affecting man. The greatest incidence of this disease in China is found in an area of the province of Chekiang about the city of Shaohing. In some villages of the district in which the disease is endemic nearly all the inhabitants are affected. The infection also is found in other parts of Chekiang, especially Ningpo; in the provinces of Fukien and Kwangtung, especially near Canton and Swatow; in Hong Kong; in the province of Kiangsu around Shanghai and Nanking; near Kiukiang in Kiangsi; near Wuchang in Hupeh; and about Changsha and Ichang in the province of Hunan. One case has been reported from the province of Szechwan. *Fasciolopsis buski* lives in the duodenum. The ova escape with the feces and mature in water; miracidia develop after two or three weeks. These invade small-sized snails, *Segmentina nitidellus* and *Planorbis schmackeri*. In these snails cercariae develop which, after escaping, form cysts on grass and on the exterior of the water caltrop, water chestnut or water bamboo. Water chestnuts are eaten raw and frequently are peeled with the teeth. Cysts so ingested cause the infection. Patients who have fasciolopsiasis suffer from intermittent diarrhea and abdominal pain; edema and ascites develop. The abdomens of children who have the disease often are markedly protuberant.

Infection with *Euparyphium jassyense*. One case of infection with *Euparyphium jassyense*, a trematode living in the intestine, has been reported from Peiping. It has been suggested that the swallowing of living tadpoles may be responsible for the infection.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis is widespread in China and is increasing in incidence. Various factors, such as complete absence or lack of facilities for isolation, promiscuous spitting, crowding and inadequate diets, contribute toward the increase of this disease. Reliable statistics relating to the incidence of tuberculosis are difficult to obtain. In 1940 thirty per cent of reactions to the tuberculin test among healthy school children in northern China, who were five to six years old, were positive; 60 per cent of reactions among children eight to nine years old were positive; 85 per cent of reactions were positive among children 15 to 16 years old, and 92 per cent of reactions were positive among persons 19 to 20 years old. At least 8 per cent of the seemingly healthy adult Chinese of the professional class have moderately advanced tuberculosis. Comparable figures are obtained at the necropsy of persons who die of diseases other than tuberculosis. The disease is especially frequent among teachers, students and shop apprentices. It is estimated that about 35,000,000 people in China have some active form of tuberculosis. The mortality rate of tuberculosis in 1937 was considered to be from 4 to 5 per 1,000 of population, which is about 10 times greater than the rate in the United States for the same period. In view of the present condition, the morbidity and mortality rates must be even higher. Adequate hospital accommodations for patients who have tuberculosis do not exist.

Pneumonia, influenza, and meningococcic meningitis occur frequently. Meningococcic meningitis occurs in epidemic outbreaks in practically all parts of China. Such epidemics occurred in Hong Kong in 1918, in the province of Anhwei in 1920, in Shanghai in 1929, in Canton and Macao in 1932, and in the city of Changsha in 1935. The prevalence of this disease is partially shown in Table 4. During 1941 the National Health Administration reported 1,040 cases of this disease from 18 provinces of unoccupied China. That the disease is frequent also is indicated by the large amounts of antimeningococcic serum produced in the government laboratories of western China.

TABLE 4

Reported Cases of Cerebrospinal Meningitis in Manchuria, Shanghai and Hong Kong

	Manchuria			Shanghai			Hong Kong		
Year	Cases	Deaths	Population	Cases	Deaths	Population	Cases	Deaths	Population
1935	426	35	35,822,189	...	...	....	...	...	....
1937	103	20	38,139,978	191	75	3,552,199	...	...	....
1938	...	..	....	538	223	4,000,000	483	223	1,800,000
1939	...	..	....	400	119	3,500,000	488	114	2,000,000
1940	...	..	....	...	...	....	271	89	....

Pneumonia and influenza are more frequent in Manchuria and the northern part of China than in southern China. During 1935 in Manchuria there were 1,932 cases of pneumonia with 329 deaths; and 2,959 cases with 255 deaths were reported in 1937. The incidence of pneumonia in Manchuria is reported to be high among recently arrived Japanese. In Manchuria during 1935 and 1937, there were 44,096 cases of influenza, with 2,309 deaths; and 98,718 cases, with 9,751 deaths, respectively.

Encephalitis in recent years has become a frequent disease in the northern part of China. Outbreaks of encephalitis probably are associated with the influx of the Japanese, since most of the patients observed have a form of the disease caused by the Japanese encephalitis virus, type B. The clinical picture is similar to that as observed in the epidemic in Saint Louis, Missouri, in 1933, although the immunologic reactions of the two diseases differ. The disease has a sudden onset; usually meningeal symptoms predominate. Ophthalmic signs, such as ptosis, diplopia, nystagmus and strabismus, are infrequent; so also are lethargy and the residual effects, such as parkinsonism. The fatality in the acute stages differs, but often varies between 30 and 50 per cent. The disease occurs with the greatest frequency during the summer and fall.

Anterior Poliomyelitis. In contradistinction to what is recorded in the literature, anterior poliomyelitis is endemic in many sections of China.

Miscellaneous. Diphtheria, measles, and smallpox are endemic in China and occur in serious outbreaks. Results of a survey made in 1935 of the 29,468 patients admitted to the hospitals and outpatient departments in various parts of China for a communicable disease showed that 5 per cent had diphtheria. During 1941 a severe epidemic of diphtheria occurred in the provinces of Kansu and Shensi. Scarlet fever is of frequent occurrence in northern China. Usually the disease is mild, but in some years epidemics of the malignant type of scarlet fever occur. In the southern part of China, and especially in the tropical areas, scarlet fever is rare and the disease, when it does occur, is mild. Neither scarlet fever nor diphtheria has been reported from Hainan Island. Rheumatic fever and rheumatic heart disease, common in the northern part of China, are infrequent in central China and rare in southern China. Smallpox occurs throughout the country, although less frequently in the areas in which large-scale campaigns for vaccination have been carried out. In some areas epidemics occur yearly and may flare up in any place, even where the aforementioned campaigns have been conducted.

Bronchospirochetosis. This disease is characterized by fever and attacks of violent coughing during which large quantities of frothy, sticky, often blood-streaked sputum are brought up. If it is untreated, the condition becomes chronic. The disease is especially prevalent around the lower part of the Yangtze valley, where cases have been reported from Jukao, Nanking, Wusih and Shanghai (all in the province of Kiangsu). The disease also has been found in Amoy in the province of Fukien, Canton in the province of Kwangtung, and Paoting in the province of Hopeh.

Diseases Spread Chiefly through Contact

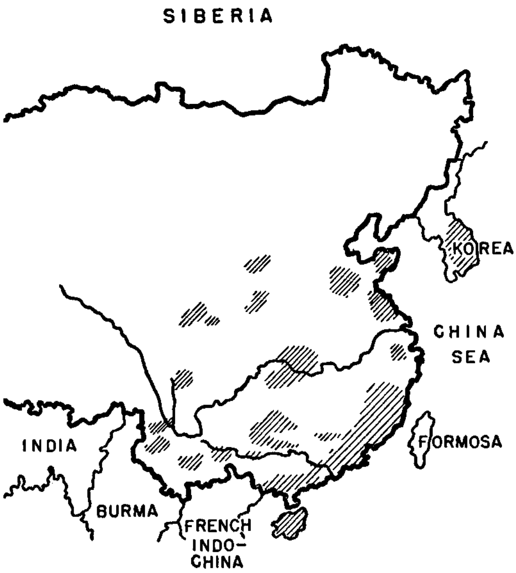
Venereal Diseases. All five of the venereal diseases, namely, syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale, occur in China. The first three are common in all parts of China, whereas the latter two are more prevalent in the southern part of China. Results of a survey of a few years ago indicated that 6.4 per cent of the patients treated in the hospitals and clinics in China reported for treatment of venereal disease. It is estimated that 10 per cent of the people have syphilis or gonorrhea. In northern China at least 10 per cent of those who offered themselves for examination as donors of blood had to be rejected because of syphilis. Analogous figures were obtained among healthy domestic servants and employees of hospitals. Among hospital patients the percentage of positive reactions to Wassermann and Kahn tests usually is much higher. In the large cities prostitutes are numerous. In the port cities the ratio of recognized prostitutes to the total population has been reported to be much higher (1:80 to 1:150) than in the west (1:400 to 1:900). In such cities brothels are plentiful and contacts are easily made. In the past little attempt has been made to control venereal diseases; under present conditions control is, for all practical purposes, lacking.

Yaws. Patients suffering from yaws repeatedly have entered China from Malaya, and in a few instances new infection has arisen from these foci to afflict children in the provinces of Yünnan, Kwangtung and Fukien. Yaws, however, has not become established in China.

Leprosy. Leprosy is widespread over China, from Manchuria in the north to Kwangtung and Hainan Island in the south and from the province of Chekiang on the east to that of Sinkiang on the west. It is estimated that more than a fourth of the world's 4,000,000 lepers are found in China. At least half of the people of China live in areas in which leprosy occurs. Hospitals and facilities for the treatment of lepers are entirely inadequate. In 1937 only 27 leprosaria, with 4,050 beds, were operating in China.

Diseases of the Skin. Diseases of the skin are extremely prevalent in China, and account for a large percentage of patients seen in outpatient departments.

Trichophytous infections, such as dhobie (washerman's) itch, tinea cruris, tinea versicolor, tinea imbricata and tinea pedis or so-called Hong Kong foot, are prevalent in China. Tinea imbricata occurs in the province of Szechwan and other parts of China, but is most frequent in the coastal parts of southern China. Fungous infections of the ear frequently are seen. Occidentals often have chronic mild tinea infections such as ringworm of the foot; under tropical conditions such infections



Leprosy in China

are likely to become acute. Impetigo and pemphigus contagiosus are present. Prickly heat and boils are common during the hot seasons. Ulcers are frequent. Chronic nonspecific ulcers frequently are observed. Parasitic diseases, such as scabies, and conditions of the skin caused by lice of human beings and by bedbugs, are of common occurrence. They are especially prevalent among the lower classes. Cutaneous leishmaniasis, known also as "Oriental sore," occurs in a small area in the southern part of Hunan province. It is caused by *Leishmania tropica,* which is transmitted by the sand fly.

Madura Foot or Pseudomycosis. A few cases in which it was not certain that this disease actually was present have been reported from the province of Kwangsi and from Hainan Island.

Rabies. This disease is widespread throughout China. Epidemics occurred in Hong Kong in 1914 and again in 1919. Accurate statistics concerning the occurrence of this disease are not available. Rabies is rare on Hainan Island.

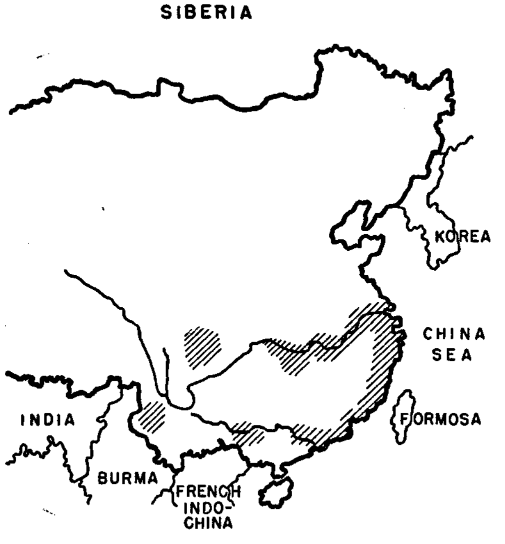
Tetanus. Tetanus frequently is seen among newborn infants, women in the postpartum period, and among patients who have infected wounds.

Leptospirosis. Spirochaetosis icterohaemorrhagica, or Weil's disease, caused by *Leptospira icterohaemorrhagiae,* has been reported only from Canton. Because of the great number of rats in China, the disease may be more prevalent than the number of reported cases would indicate, although in Peiping the serum of 181 rats examined did not agglutinate the strains of *L. icterohaemorrhagiae,* nor was *L. icterohaemorrhagiae* demonstrated by either direct examination of the blood or the results of inoculation of guinea-pigs. The serum of many dogs in Peiping contains *L. canicola* antibodies, but the disease has not been reported as afflicting human beings.

Schistosomiasis in China is caused by *Schistosoma japonicum.* The disease is frequent in the valley of the Yangtze River from the eastern border of Szechwan to the mouth of this stream. The so-called Ichang fever * of the upper Yangtze River is a form of schistosomiasis. The disease also occurs in eastern Chekiang, in eastern Fukien (especially in the area about Futsing), in northern Kwangtung (especially in the district about Shiuchow), and in the Pinyang area of the provinces of Kwangsi and northern Hunan. Recently, several cases have been reported from central Szechwan. Areas in which the disease is endemic also are found in western Yünnan near Talifu. In Hong Kong only imported patients have been observed. *Schistosoma japonicum* invades the mesenteric veins, the hepatic portal system, and occasionally

* Named for the treaty port on the Yangtze River in Hupeh province in which this type of schistosomiasis was first observed.

the hemorrhoidal veins. Eggs are deposited in the smaller veins of the submucosa and break through into the lumen of the gut. The incubation period of the disease is from 10 to 15 days. The first symptom is fever, often of long duration. At the same time, signs of dysentery commonly are observed. Marked eosinophilia develops, the spleen is large and firm, and usually the liver is also enlarged; afterward, cirrhosis



Schistosomiasis in China

of the liver develops in nearly 50 per cent of cases. From the eggs excreted with the stools miracidia are hatched. These larval forms invade snails, *Oncomelania hupensis* and *Oncomelania schmackeri* in the Yangtze valley, *Katayama tangi* in Futsing, and *Oncomelania yaoi* in Kwangsi. Within the snails, fork-tailed cercariae develop which leave the snails and attack mammals. They perforate the skin of bathers and waders and are transported to the portal system. The drinking of water containing cercariae also may cause the infection. The snails are found on the muddy banks of secondary canals and small streams. High and steep hills with swift-running streams usually form a barrier for the disease.

Undulant Fever. This disease occurs in China, but apparently is not common. In the course of the years more than 20 cases have been reported from Peiping. A few patients with the disease also have been observed in the provinces of Fukien and Honan, and in the city of Shanghai. The fact that the average Chinese does not drink milk probably is a factor in the low incidence of the disease.

Anthrax. Anthrax has been reported from many areas of China; namely, Hankow in the province of Hupeh, Tientsin in the province of Hopeh, Newchwang in the province of Liaoning in Manchuria, Chinkiang and Shanghai in the province of Kiangsu, and Chengtu in the province of Szechwan. In most cases the disease occurs among persons who handle bristles, horsehair and hides. Cases in which anthrax questionably was present have been reported from the southern part of China, but in most cases the disease occurs in northern China.

Glanders. Glanders is of common occurrence among horses and cattle in the northern part of China and in Manchuria, where in some areas from 30 to 40 per cent of the horses are said to be infected with the disease. Occasionally the disease in these areas affects human beings. In 1935 it was reported that glanders had afflicted a human being in Shanghai.

Diseases of the Eyes. Blindness and defective vision are extremely frequent. It is estimated that more than 500,000 people are blind in both eyes, that probably 5,000,000 more are blind in one eye, and that at least 15,000,000 are nearly blind. The chief causes of blindness in China are trachoma, smallpox and gonorrheal ophthalmia. Approximately half or more of the population has trachoma. Only about 25 per cent of the infection with gonorrheal ophthalmia occurs among infants; more than 50 per cent of the infection occurs among persons 15 to 35 years old. Other bacterial diseases of the eyes also occur.

Epidemic Keratoconjunctivitis. This disease occurs in China, but specific data concerning its incidence are scarce. A disease which presents a similar clinical picture (probably this disease) has been observed in the refugee camps in Shanghai. The disease is of potential importance in that it may completely incapacitate large numbers of persons for from one to two weeks and may result in various degrees of diminished visual acuity which persists for six to twelve weeks. It is a potential danger most likely to be encountered in districts in which people are brought into close or prolonged contact with one another.

Rat-bite Fever. This disease, caused by *Spirillum minus,* which is introduced into the wound made by the bite of the rat, is known to occur sporadically in China. Several cases were reported from the city of Kweiyang in Kweichow province, in 1940. During the last few years patients with this disease have been observed in the northwestern part of China.

Diseases Spread by Arthropods

Malaria. Malaria, known as *niao chi ping* and by various other local names, occurs in practically all parts of China, especially in the south. It is rare in Mongolia and until 1942, when it spread into parts of northwestern China, had been a rare disease in that area. A few years ago the disease was not found among the Lolo tribes who live in southwestern Szechwan in the foothills of Tibet, but it may now have been introduced into that area. The incidence of malaria in Manchuria, as compared with the incidence of this disease in other districts of China, is light. There is an area in the basin of the Amur River near the maritime provinces of Siberia, however, in which the incidence of the disease is high.

The frequency of malaria in China as a whole is demonstrated by the fact that 50 per cent of 29,468 patients admitted to hospital or outpatient departments in various parts of China in 1935 for a communicable disease suffered from malaria. During 1941 fully 70 per cent of the 504,228 cases of communicable diseases reported in the 18 provinces of unoccupied China were cases of malaria. In the province of Szechwan the incidence of malaria for 1934, 1935, 1936 and 1937 was 4.19 per cent among 35,837 hospital patients and 1.38 per cent among 265,413 outpatients. There were, however, great differences in frequency. Chungking, in the central part of the province, reported that the incidence of malaria was only 0.99 per cent among inpatients. In Yaan near the eastern border of the province, the incidence of malaria was 23.3 per cent among inpatients and 11.05 per cent among outpatients. The spleen indices for children less than 12 years old varied between 6.1 and 64.5 per cent, the figures being higher among the rural than among the city groups. The disease is especially prevalent in most sections of the southern part of China. This increased prevalence of the disease in the south is shown by the fact that in 1933 it was reported that in northern China 0.69 per cent of all persons admitted to the hospital suffered from malaria; in the Yangtze valley, 1.69 per cent of such persons had malaria, whereas in the southern part of China, 2.2 per cent of persons admitted to the hospital were suffering from this disease. In the province of Kweichow 14 per cent of persons admitted to the hospital had malarial infection. In many sections of Yünnan, Kweichow and Kwangsi most of the inhabitants are infected with malarial parasites. The valleys of the southern part of China are highly malarious, whereas the areas at elevations of more than 5,000 to 8,000 feet usually are nonmalarious. Native Chinese living in the higher mountainous areas often refuse to go down into the valleys because of the fear of contracting the disease, knowing that if they fall victim to it death commonly will ensue.

The three principal types of malaria occur in most sections of China. In addition, one case of malaria in which it was reported that the disease was caused by *Plasmodium ovale* has been reported from Chungking. The tertian type of malaria predominates in the northern part of China and Manchuria, where in almost 100 per cent of the cases the disease is of this type. In general, the incidence of tertian malaria is greatly reduced in the southern parts of China, varying somewhat in the different districts. The estivo-autumnal type of infection has been reported from practically all sections of China excepting northern Manchuria and the Tibetan border in the western part of Szechwan. In northern China the estivo-autumnal type of infection is rare, and patients who have this type of infection are chiefly persons addicted to the use of heroin and morphine who inject these narcotic drugs hypodermically without observance of precautions to insure asepsis. As a result of this practice the estivo-autumnal type of malaria is transmitted from an infected drug addict to a noninfected drug addict by means of needles and syringes contaminated by the mature gametocytes of *Plasmodium falciparum*. In many of the areas in which malaria is endemic, especially in the Yangtze valley, epidemics of the estivo-autumnal type of malaria tend to occur every few years. In many of the outbreaks thousands of people die. In the southern part of China estivo-autumnal malaria is prevalent; in some sections of Kweichow and Yünnan the percentage of this type of malaria may be as high as 70 to 95. Quartan malaria has an irregular distribution in China. In the north, cases of quartan malaria are rare, but in the Yangtze valley there are several areas where it prevails; namely, Hankow and Wuhsüeh in the province of Hupeh, and Luchow in the province of Anhwei. In Shanghai proper quartan malaria is not common, but in Kao-Chiao, a suburb of Shanghai on the eastern bank of the Whangpoo River, 34 per cent of the malaria is of the quartan type. In the Hwapa area of Yünnan near the border quartan malaria also is common. In the past quartan malaria has been thought to be rare or absent on Hainan Island, but in 1940 results of a survey in which 1,031 blood smears were made showed that 23.5 per cent of the smears contained the parasites causing this type of malaria. Quartan malaria is a chronic disease and often does not bring the patient to a hospital or clinic; thus, the incidence of this type of malaria may be somewhat greater than figures based on observations in clinics and hospitals would indicate. In Table 5 the distribu-

TABLE 5

Distribution of Tertian, Quartan and Estivo-autumnal Malaria in China

City or Province	Malaria, type and percentage *			Year
	Tertian	Quartan	Estivo-autumnal	
Hong Kong	35	2.5	62.5	1938-1940
(Kao-Chiao, eastern bank of Whangpoo River)	60	34	6	1933
Shanghai (specimens from pathologic laboratories)	94	0.2	6	1937-1939
Nanking (Kiangsu)	56	1.4	38	1933
Anhwei	77	1.2	21	1935
Kwangtung and Hunan (border districts)	73	0.4	26	1934
Fukien	74	19	7	1935
Kweichow	20	11	69	1940
Szechwan	52	7	41	1940
Yünnan (Shan tribes)	26	5	69	1940
Chungking	86	..	9	1940
Hainan Island	39	24	37	1940

* This table was compiled from several sources. Because of dissimilar methods of presentation in the original sources, percentages do not, in all cases, add to 100. The trends, however, are unaffected.

tion of the different types of malaria found in various parts of China is shown.

In the northern part of China the greatest incidence of malaria occurs during June, July and August. In the central and southern parts of China malaria occurs during all months of the year, the maximal prevalence obtaining during late summer and autumn. The seasonal peak of estivo-autumnal malaria usually occurs from one month to two months after the highest frequency of tertian malaria has been reached. In the province of Kweichow malaria is rampant during the rainy season, from April to October, and especially in May, June and July.

Epidemiologic investigations and measures for the control of malaria, which had been only started before 1937, were completely upset by the onset of the war. The National Health Administration, co-operating with the International Health Division of the Rockefeller Foundation and the United States Public Health Service, was doing some malaria-control along the Burma Road. The Japanese invasion of Burma interrupted this work. It is not known just how much work in the control of malaria is now being carried on, but it is probable that it is limited to the principal highways and a few of the larger cities. There is a scarcity of quinine and other antimalarial drugs; even in 1938 only small amounts of quinine were available in many parts of China.

The importance of malaria in China, and especially in the southern part of China, cannot be overemphasized. In the past, armies campaigning in southern China have been almost entirely wiped out by this disease. During the construction of the Burma Road not infrequently more than 50 per cent of the laborers in certain areas died as the result of infection with the estivo-autumnal type of malaria. In both cases the soldiers and the laborers were non-immune, having come into the region from outside areas. The native Chinese of those districts, however, because of their immunity to the local type of malaria, were able to carry on their work. Local observers have said that the failure of the Japanese in their 1939 campaign in the southern part of Kwangsi province was due not to the superior numbers and equipment of the Chinese, but to the large number of casualties suffered by Japanese troops because of malaria. Measures for the control of malaria apparently had not been enforced. The result was a withdrawal from Kwangsi and the southern part of Kwangtung.

Blackwater Fever. Blackwater fever is rare in China proper, but it occurs regularly in Hainan Island. It is observed occasionally in Yünnan province and at times has been reported from Hong Kong. In both places it usually occurs among persons from regions in which blackwater fever is common.

Filariasis. In China two types of filariasis occur, that caused by *Wuchereria bancrofti* and that caused by *Wuchereria malayi*. The disease is endemic in a belt 15 to 25 miles wide, from Indo-China northward along the coast to the southern part of the

Filariasis in China

province of Shantung. The clinical condition of elephantiasis extends northward through the provinces of Shantung and Hopeh into southern Manchuria. Filariasis extends inland along the banks of the Si River into the province of Kwangsi, along the Yangtze River into the southern part of the province of Szechwan, and along the other rivers of southern China. Occasional cases have been recorded from Kweichow and from Hunan near Changsha. Infection is found on the islands off the coast and smears of the blood of 10 of 200 persons examined at Hoihow on Hainan Island, contained *Wuchereria bancrofti.* The Luichow Peninsula in the southern part of Kwangtung is an area in which the disease is particularly endemic. In all these regions the clinical manifestations of filariasis, such as elephantiasis, chyluria and orchitis, are frequent. Filariasis caused by *W. bancrofti* is the common type found in China. Cases in which filariasis has been caused by *Wuchereria malayi* are reported, especially in the central part of the province of Chekiang; several cases also have been reported in Fukien and in Hunan near Changsha. This type may be more widely distributed than reports indicate.

Dengue Fever. Dengue fever, a disease carried by *Aedes aegypti* and *Aedes albopictus* mosquitoes, is endemic in the southern part of China. It also occurs sporadically along the coast of China to as far north as Chefoo and southern Manchuria and in the lower sections of the Yangtze valley. In 1940 a severe epidemic of dengue occurred in the Shanghai-Nantungchow section of Kiangsu province. It was thought that the disease was introduced into the area by Japanese soldiers from Formosa. In 1930 a minor epidemic of 23 cases was reported from Kashgar in the province of Sinkiang. The fatality rate of dengue fever is practically nil, but the morbidity rate is high. The disease is of special importance in that large numbers of nonimmune persons may be attacked at the same time, resulting in high morbidity rates during short periods.

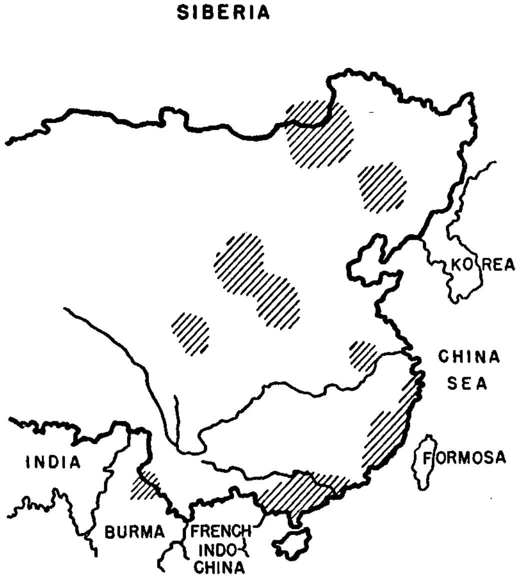
Yellow Fever. This disease never has been reported from China or other parts of Asia, but its principal vector, *Aedes aegypti,* and other mosquitoes capable of transmitting the disease are found in the southern part of China and also in the province of Sinkiang. Infected mosquitoes could be brought in from areas in Africa in which yellow fever is endemic, but in view of the distance and the measures of disinsectization now enforced in China, the possibility of such introduction is unlikely.

Typhus Fever. Three types of typhus fever, namely, the epidemic louse-borne type, caused by *Rickettsia prowazeki;* the endemic flea-borne type, caused by *Rickettsia mooseri,* and the mite-borne type caused by *R. orientalis,* are found in China. The epidemic type is widely distributed, but is less frequent in the southern part of China. Typhus fever has not been reported from Hainan Island; also, a section of the province of Szechwan near the Tibetan border has been reported to be free from this disease. Lice and fleas are common in both these districts. Mite-borne typhus fever or tsutsugamushi disease has been reported from the provinces of Wuchang, Hupeh and other sections of the lower Yangtze valley, and it probably occurs in Manchuria. This type of typhus fever is spread by mites of the genus Trombicula, usually *T. akamushi.* It is most common among those working in or with grasses, especially in areas subject to flood. Patients who have this disease are most numerous in late spring and summer.

The most important kinds of typhus fever found in China are the epidemic and endemic types. Results of different immunologic investigations indicate that in many cases the disease is caused by an agent intermediate between that of the louse-borne and the flea-borne types of typhus fever. During 1941 the National Health Administration reported 5,320 cases from 16 provinces of unoccupied China, but this probably represents only a fraction of the actual number of cases. In Shanghai, after a severe epidemic occurred in 1850, typhus fever practically disappeared until after the onset of hostilities in 1937. In 1938 typhus broke out in Shanghai and between March and July more than 1,000 patients with this disease were observed. In Nanking, where for several years there had been only a few instances of the disease, it became widely prevalent in the winter of 1940-1941. In the province of Hunan the disease was rare for several years, but since 1934 it has occurred there regularly. During 1938, 1939 and 1940 a few cases of it were reported from Hong Kong. The disease may suddenly appear in areas in which it has not been observed for years, especially among troops and refugees. The greatest incidence in the northern part of China occurs during April, May and June. The diagnosis of typhus fever must be considered in the examination of every patient who has fever of unknown origin. The rash usually does not appear before the fifth day and often is scanty or atypical. The fatality rate is about 20 per cent.

Plague. Plague, caused by *Pasteurella pestis* and carried chiefly by the tropical rat flea, has occurred in China for centuries. The more recent history of this disease, however, begins in about 1867, when victims of the disease came either from or through the province of Yünnan and entered Pakhoi in the southern part of Kwangtung province. Since that time the disease has appeared annually in Pakhoi and surrounding villages. Gradually the disease approached Canton, where a terrible epidemic broke out in 1894. In the same year the disease reached Hong Kong and Amoy in the province of Fukien. The harbor of Newchwang in the southern part of Manchuria was infected with plague in 1899, probably as the result of water-borne traffic. The first epidemic of plague occurred in Shanghai in 1908, and in the same year an epidemic broke out in the mining center of Tangshan in Jehol, about 90 miles from Tientsin. Since that time the periphery of the disease had become slowly retracted, so that until the outbreak of the war it had been confined to a few areas in the southern part of China. Since the beginning of the war it has increased in prevalence once again.

Prior to the onset of the present war, plague had been endemic in: (1) southern



Plague in China

China, (2) Hainan Island, (3) the central part of the province of Anhwei, (4) the provinces of Shansi and Shensi, (5) the southwestern part of Manchuria and (6) the northern part of Manchuria. Each of these districts will be considered separately.

Southern China. The provinces of Kwangtung, Kwangsi and Fukien are never completely free from plague. In 1935 severe outbreaks occurred in three areas of Fukien province. Plague is endemic among the Shan tribes in northern Burma, so that a focus exists from which the disease easily could be introduced into western and southern China.

Hainan Island. On Hainan Island plague occurs yearly, the area in which it is especially endemic being in the northern interior part of the island south of Tingan.

Central Part of Anhwei Province. Plague had been quiescent in this province during most of the period before the current war.

Shansi and Shensi Provinces. In these provinces, since 1912, outbreaks have occurred regularly, traceable to the Ordos country of Inner Mongolia (southern part of Suiyuan province). From that region the disease extends southeasterly into the provinces of Shensi and Shansi. Occasionally, outbreaks of plague in these provinces have resulted in widespread epidemics. In 1918 such an epidemic, starting in Shansi, attacked eight provinces, reaching north to Hopeh and Shantung and south to Kiangsu. In 1932 at least 20,000 people contracted plague in Shansi and Shensi.

Southwestern Manchuria. Epidemics of plague have occurred almost yearly in the central part of Liaoning since 1917, the year in which the first railway line penetrated that area. In some years the outbreaks have been minor, but in other years they have been extensive.

Northern Manchuria. In the northern part of Manchuria epidemics of plague of human beings follow the epizootics among wild rodents, especially the tarabagan. This animal is hunted for its fur. It is during the skinning of the animal that human infection is acquired. In the fall of 1910 and the winter of 1911 a most severe epidemic occurred, and it spread southward *via* Harbin and Mukden to Dairen, Tientsin, Peiping, Tsinan and Chefoo, a distance of 1,700 miles. There were 60,000 fatalities. In 1920 and 1921 a second epidemic, less severe than the one of 1910 and 1911, broke out in the same territory; it caused some 9,300 fatalities. Only a few victims of plague were observed in southern Hopeh and Shantung. Since 1928 plague in the districts in which the tarabagan occurs has been quiescent in northern Manchuria as well as in Outer Mongolia and Transbaikalia. In the northern part of Manchuria epidemics of plague are characterized by a high incidence of the pneumonic form of the disease. It is thought that the low temperature existing at the time of the outbreak results in close family contact with victims of the disease, thereby increasing the chances of transmission of the pneumonic form.

The tarabagan is a hibernating animal which stays above ground during the period from April to September. The epizootic starts in the autumn and extends into the cold season; outbreaks among human beings usually start in the late summer or autumn. This is due to the fact that the main hunting season for the tarabagan occurs at this period, as does also the harvesting of hay, during which time many people camp in the fields. Epidemics of bubonic plague, the common form of the disease in other parts of China, generally start in March and April, with the maximal prevalence occurring in June, July and August. The number of cases then decreases rapidly, so that scarcely any cases are recorded after October.

Until the outbreak of the Sino-Japanese war, plague in China proper, although it did remain endemic in the areas mentioned, was on the wane and was well under control, but in the last few years the situation has given reason for concern. In 1940, apart from instances of the disease in the areas in which it had always been endemic, an inextensive outbreak occurred on the Yünnan-Burma border and a fairly extensive epidemic occurred in Ningpo and Chuhsien in the province of Chekiang. During 1941, 626 cases with 395 deaths were reported in Fukien province. In the spring of that year the epidemic revisited Ningpo and Chuhsien. At the same time Changteh in the province of Hunan also was infected. This was especially grave because plague never before had been observed in this region, from which the disease could easily spread to the provinces of Szechwan, Hupeh and Kweichow. Fortunately, this was not the case, but even so, 10 provinces of China became infected and a total of 1,147 cases and 859 fatalities resulted. In 1942 the situation in respect to plague also was unfavorable. In the first half of 1942, 883 patients, of whom 817 died, were observed in six provinces. Changteh again was infected. The epidemic of plague was especially severe in the province of Suiyuan, south of Inner Mongolia, near the Ordos plains. Many deaths occurred also in the provinces of Shansi and Shensi.

Relapsing Fever. Louse-borne relapsing fever is widely distributed throughout all parts of China, including Hainan Island, and is relatively more prevalent in the southern part of China than is typhus fever. Tick-borne relapsing fever has been reported from western China in the area of Sinkiang and may possibly occur in other districts. Both types of relapsing fever are caused by *Borrelia recurrentis*. In Shanghai during 1932 the Lester Hospital admitted 234 patients who had relapsing fever. In 1935 in the same city 399 cases with 62 deaths were reported, and during 1939 there were 295 cases with 50 deaths. In the province of Fukien epidemics of relapsing fever occurred during 1918 and during 1923; during 1933 in Amoy another epidemic occurred which probably was associated with the movement of troops. Relapsing fever, like typhus fever, is especially frequent among beggars, refugees and similar groups. Epidemics are likely to develop in the spring after an especially cold winter. Thus, in most sections of China relapsing fever is most frequent during the spring, but in the southern provinces, such as in Yünnan, where the range of temperature is relatively small, the seasonal variation is less striking.

Sandfly Fever. There are few reports concerning the occurrence of sandfly fever in China, and in those which are available the data are vague and uncertain. Until further reports of a more reliable nature are received, the possibility of the occurrence of the disease in China must be kept in mind.

Kala-azar. Kala-azar, caused by *Leishmania donovani* and transmitted by sand flies, is a common endemic disease in the greater part of China north of the Yangtze River and also in Manchuria. In addition, it is present in all the provinces along the southern banks of the Yangtze River, but has been observed only sporadically in the provinces farther south and in the western part of China. The disease has not been found in Hainan Island. Most new infections occur during the season in which sand flies are prevalent, between May and October. The dog is the important reservoir of the disease and the Leishman-Donovan bodies are found in the subcutaneous tissues of an affected animal. Infection is spread from dogs to sand flies and then to human beings. Infection is especially frequent in children and young adult persons; it is rare among persons more than 50 years old. Kala-azar occurs also among the white population in China.

Nutritional Diseases

Nutritional diseases, such as secondary anemia, nutritional edema, hyperkeratosis, xerophthalmia, vesical calculosis, pellagra and scurvy, are common. In the northern part of China the diet of the poorer classes is low in calcium, vitamin A and vitamin C; but the intake of vitamin B is sufficient. The diet of natives in northern China is also low in vitamin D and cholesterol; osteomalacia is therefore frequently seen in certain districts, especially among married women who do not have the benefits of sufficient exposure to sunshine. In the southern part of China, where the staple food is polished rice, poor in its content of vitamin B, beriberi is frequent. Since the outbreak of the present hostilities there has been an increase in the incidence of beriberi in some areas. This has been true of people in Shanghai and other people who have depended upon polished rice for their staple food. In rural districts, where it was difficult to obtain polished rice, the people were forced to eat ground whole cereal grains; thus, beriberi practically disappeared. Goiter is a common disease in the provinces of Yünnan and Kweichow, and it occasionally occurs in other sections. Sprue frequently is seen among members of the Occidental population, but has not been observed among the Chinese.

Miscellaneous

Injuries Caused by Heat. Heat stroke, heat exhaustion, heat cramps and prickly heat occur in most parts of central and southern China during the hot season, and are more common among Occidentals than among the native Chinese. Proper preventive measures can do much to reduce and prevent these injuries.

SUMMARY

Public health, hospital and medical facilities in China are entirely inadequate for the health and medical requirements of the people. The splendid work of the National Health Administration, which was interrupted in 1937 by the onset of the war, has been continued in the unoccupied areas of China. Although difficulties arising from lack of trained personnel, medicines and supplies are great, increased numbers of trained personnel are being produced, greater amounts of drugs and supplies are being manufactured, and those drugs and supplies that cannot be made in unoccupied China are being imported. In spite of this and the fact that commendable progress has been made, much remains to be done. In occupied China little public health work is being achieved and there is a lack of trained personnel, drugs and supplies. The Japanese military forces have concerned themselves chiefly with attempts to control smallpox, cholera and plague. In Manchuria the public health program is somewhat more stable and extensive than in the other areas of occupied China.

Food and dairy products throughout China are limited, excepting small amounts of fruits and vegetables that are produced in season, and fish caught in some of the coastal areas. Sanitary inspection of food and dairy products is lacking or is inadequate. Water is plentiful in some areas and scarce in others; but regardless of its source, should be considered as unsafe for human consumption until it has been adequately treated. Systems in which sewage is water-borne are found in only a few of the largest cities; in the other areas the bucket commode and the open-pit latrine are in common use. Night soil is collected, stored and used for fertilizer. This results in widespread pollution of the soil and in the dissemination of infectious and parasitic diseases of the intestinal tract. Mosquitoes capable of transmitting malaria, filariasis, dengue fever and yellow fever are widely distributed in China. Flies, lice, ticks, mites, and fleas are indigenous. Rodents, poisonous and nonpoisonous snakes, centipedes, scorpions, leeches, monkeys, dogs, foxes, wolves, wild boars, bears and tigers are pests or potentially dangerous animals which vary greatly in their distribution.

Diseases of greatest importance are malaria; enteric diseases, such as typhoid fever, paratyphoid fevers, amebic dysentery, bacillary dysentery and the common diarrheas; venereal diseases, such as syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale; typhus fever; relapsing fever; dengue fever; diseases of the skin; the acute infectious diseases, such as pneumonia, influenza and meningococcic meningitis; injuries caused by heat, such as heat stroke, heat exhaustion, heat cramps, prickly heat and heat boils; cholera; plague; kala-azar; epidemic keratoconjunctivitis; tuberculosis; filariasis; infection with worms and flukes; and rabies. Yellow fever has not occurred in China or in other parts of Asia and the possibility that the disease might be introduced into China is slight.

BIBLIOGRAPHY

Anderson, J.: Rheumatic Infections in China. China M. J., **44**:1083-1100 (Nov.) 1930.

Anigstein, L.: Researches on Tropical Typhus. Kuala Lumpur, 1933 (Studies from the Institute for Medical Research, Kuala Lumpur, Federated Malay States, No. 22).

Ascaris Contamination of Soil. China M. J., **45**:177 (Feb.) 1931.

Barber, C. H.: Tropical and Subtropical Diseases. London, Oxford University Press, 1942.

Bare, N. H.: Notes on Diseases of the Sino-Tibetan Border. China M. J., **44**:1157-1167 (Dec.) 1930.

Bercovitz, N.: Tropical Diseases in Relation to General Health in Hainan, China. Tr. Far East. Ass. Trop. M., 9th Congr., **2**:849-852, 1934.

Burkwall, H. F.: Blackwater Fever; a Statistical Report of Twenty-five Cases Seen on Hainan Island. Am. J. Trop. Med., **23**:285-292 (Mar.) 1943.

Cadbury, W. W.: An Epidemic of Cerebrospinal Meningitis in Canton in 1932. Chinese M. J., **48**:536-550 (June) 1934.

Campbell, H. E.: Splenomegaly in Foochow Area, with Special Reference to Schistosomiasis and Its Relationship to Cryptogenetic Splenomegaly (Banti's Disease); Preliminary Report. Chinese M. J., **50**:1561-1576 (Nov.) 1936.

——: Schistosomiasis and Banti's Disease. An Inquiry into Their Possible Relationship. Chinese M. J., **53**:459-466 (May) 1938.

——, Webster, J. L. A., and Li, S. Y.: Human Sparganosis in the Foochow Area. Chinese M. J. (Supp. I), pp. 423-433 (Feb.) 1936.

Chang, K., and Lin, C. C.: Intestinal Parasite Infections of Man in Chengtu and Its Vicinity. Chinese M. J., **58**:570-581 (Nov.) 1940.

Chang, T. L.: The Anopheline Mosquitoes of Yünnan. Notes of Their Breeding Habits and Adult Behavior. Chinese M. J., **58**:218-233 (Aug.) 1940.

——: Malaria Transmission in Western Yünnan and the Natural Vectors. Chinese M. J., **59**: 54-66 (Jan.) 1941.

——: Mosquitoes of Hunan Province with Special Reference to Anopheles. Chinese M. J., **56**:52-62 (July) 1939.

Chapuis, J.: L'Assistance Médicale dans le Territoire de Kouang-Tcheou-Wan. L'Indochine Française, Hanoi, 1938, pp. 365-373.

Ch'en, C. C.: Scientific Medicine as Applied in Ting Hsien. Third Annual Report of the Rural Public Health Experiment in China. Milbank Memorial Fund. Quarterly Bulletin, **11**:97-129, 1933.

Chen, H. T.: Further Notes on the Life History of Paragonimus from Rats. Chinese M. J. (Supp. I), pp. 368-378 (Feb.) 1936.

Chen-Wong, Z. C.: Blackwater Fever in Kunming. Report of Three Cases. Chinese M. J., **59**:387-388 (Apr.) 1941.

Ch'eng, Y. L., and K'ang, H. J.: Cysticercosis Cellulosae in Man. Chinese M. J., **50**:137-139 (Feb.) 1936.

Chin, T. H.: On Helminth Parasites of Rats in Kweiyang. Chinese M. J., **56**:548-558 (Dec.) 1939.

Ch'iu, P. T. Y., Ho, E. A., and Li, C. C.: The Incidence of Tuberculous Infection and Pulmonary Tuberculosis among 8,282 Chinese with Special Reference to Students in Peiping. Chinese M. J., **58**:556-569 (Nov.) 1940.

Chinese Medical Directory, 1932, 3d ed. Shanghai, Chinese Medical Association, 1933.

Cholera in China, 1929. China M. J., **44**:255 (Mar.) 1930.

Cholera in 1932. Chinese M. J., **46**:1207-1209 (Dec.) 1932.

Chow, C. Y.: The Common Blue-Bottle Fly, *Chrysomyia megacephala*, as a Carrier of Pathogenic Bacteria in Peiping, China. Chinese M. J., **57**:145-153 (Feb.) 1940.

Chtcherbakoff, S. G.: Les maladies tropicales à Kachgar, Chine Ouest. Rev. de Méd. et d'Hyg. Trop., **22**:233-256, 1930. As reviewed in Trop. Dis. Bull., **28**:771, 1931.

Chu, C. F.: Schistosomiasis Japonica in Nanking. Chinese M. J., **52**:651-664 (Nov.) 1937.

Chu, F. T., Wu, J. P., and Teng, C. H.: Acute Encephalitis in Children. A Clinical and Serological Study of Ten Epidemic Cases. Chinese M. J., **58**:68-78 (July) 1940.

Chu, T. C., Liu, B. C., Ling, C. Y., and Zee, G. F.: A Survey of Intestinal Parasites in the Rural Experimental Health Area at Kao-Chiao, Shanghai. Chinese M. J., **50**: 1243-1254 (Sept.) 1936.

Chun, J. W. H.: Analysis of Cholera Problem in China with Special Reference to Shanghai. Tr. Far East. Ass. Trop. M., 9th Congr., Part 1, pp. 399-409. Also, Reports National Quarantine Service, China, Series 5, pp. 39-49, 1934.

——: Some Meteorological Factors in Smallpox and Cholera. Reports National Quarantine Service, China, Series 6, 1935-6. Shanghai, National Quarantine Service, 1936.

Chung, H. L.: Studies on Transmission of Relapsing Fever in North China; Preliminary

Observations. Chinese M. J., **50**:1723-1734 (Dec.) 1936.

Chung, H. L., and Chang, F. C.: Relapsing Fever: Clinical and Statistical Study of 337 Cases. Chinese M. J., **55**:6-33 (Jan.) 1939.

——, and Chong, J. H. M.: Studies on the Etiology of Typhus Fever in North China. Chinese M. J., **53**:513-538 (June) 1938.

——, and Lee, C. U.: Cysticercosis Cellulosae in Man with Special Reference to Involvement of Central Nervous System. Chinese M. J., **49**:429-445 (May) 1935.

Clow, J. M.: Shensi Province as an Endemic Focus of Kala-Azar; Preliminary Report. Chinese M. J., **59**:150-155 (Feb.) 1941.

Colonial Medical Reports, No. 373, Federated Malay States. The Transmission of *Microfilaria malayi.* J. Trop. Med., **44**:39-40, 1941.

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 2d ed. Philadelphia, Lea & Febiger, 1940.

Crawford, W.: Syphilis in West China. China M. J., **44**:1129-1131 (Nov.) 1930.

Crook, R. L.: Some Notes on Malaria in Szechwan. Chinese M. J., **55**:465-478 (May) 1939.

Cunningham, E. R., Kilborn, L. G., Maxwell, J. L., Morse, W. R., Mullett, H. J., and Dickinson, F.: The Nosu Tribes of West Szechwan. Chinese M. J., **47**: (Mar. Supp.) 1933, 56 pp.

Da Costa, P.: Epidemiological and Clinical Study of Cerebrospinal Meningitis Epidemic at Macao. Tr. Far East. Ass. Trop. M., 9th Congr., **2**:357-369, 1934.

Distribution of Leprosy in China. Chinese M. J., **47**:299-300 (Mar.) 1933.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Dixon, B. F.: Excerpts from a Gunboat Cruise. The Hosp. Corps Q., **11**:1-28, 1927.

Dorling, G. C.: Anthrax, with Special Reference to the Treatment of Malignant Pustule by Local Carbolic Injections. Chinese M. J., **49**: 662-666 (July) 1935.

Du, S. D., and Best, A. E.: Typhoid and Paratyphoid Fevers in Chengtu, Szechwan. China M. J., **45**:325-331 (Apr.) 1931.

——, ——: Kala-Azar in West China. Chinese M. J., **50**:273-277 (Mar.) 1936.

Fan, P. L.: The Control of Scarlet Fever. Part 2: Active and Passive Immunization against Scarlet Fever. Chinese M. J., **56**:532-547 (Dec.) 1939.

Faust, E. C.: Parasitic Infections and Human Disease in China. Arch. Path., **2**:223-240 (Aug.) 1926.

——: Preliminary Survey of the Parasites of Vertebrates of North China. China M. J., **35**: 196-210 (May) 1921.

——, and Wassell, C. McA.: Preliminary Survey of the Intestinal Parasites of Man in Central Yangtze Valley. China M. J., **35**:532-561 (Nov.) 1921.

Feng, L. C.: Brief Mosquito Survey in Some Parts of Central China. Chinese M. J., **47**: 1347-58 (Nov.-Dec.) 1933.

——: Development of *Microfilaria malayi* in *A. hyrcanus* var. *sinensis* Wied. Chinese M. J. (Supp. I), pp. 345-367 (Feb.) 1936.

——: The Egg of *Anopheles* (*Myzomyia*) *pattoni* Christophers. Chinese M. J. (Supp. III), pp. 300-303 (Mar.) 1940.

——: Geographical Distribution of Mosquitoes in China. Tr. 7th Internat. Congr. Entom., **3**: 1579-1588, 1938.

——: Intermediate Hosts of *Microfilaria malayi* in Chekiang, China. Proc. Soc. Exper. Biol. and Med., **32**:494-496 (Dec.) 1934.

——: Malaria and Its Transmission in Kwangsi, China. Chinese M. J., **50**:1799-1814 (Dec.) 1936.

——: Notes on Some Mosquitoes Collected from Shantung Province, North China. Chinese M. J., **49**:359-365 (Apr.) 1935.

——: The Present Status of the Knowledge of the Mosquitoes of China and Their Relation to Human Diseases. Chinese M. J., **49**:1183-1208 (Nov.) 1935.

——: The Tree-Hole Species of Mosquitoes of Peiping, China. Chinese M. J. (Supp. II), pp. 503-525 (Mar.) 1938.

——, and Chin, Y. T.: The Presence of *Anopheles maculipennis* in Certain Parts of Manchuria. Chinese M. J., **51**:496-499 (Apr.) 1937.

——, and Chung, H. L.: The Development of Leishmania in Chinese Sandflies Fed on Dogs with Canine Leishmaniasis. Chinese M. J., **56**: 35-46 (July) 1939.

First National Conference on Leprosy. Chinese M. J., **47**:297-298, 1933.

Forkner, C. E., and Zia, L. S.: An Outline of the Development of the Theories for the Transmission of Leishmaniasis together with Further Evidence to Support a Theory of Direct Transmission of Kala-Azar through the Agency of Oral and Nasal Secretions. Tr. Far East. Ass. Trop. M., 9th Congr., **1**:633-656, 1934.

Galt, C. M.: Leprosy in Yünnan. China M. J., **45**:867-868 (Sept.) 1931.

Gear, H. S.: Disease Incidence in China; Analysis of Hospital Records for 1934. Chinese Medical Association Hospital Survey. Chinese M. J., **50**:949-972 (July) 1936.

——: The Incidence of Venereal Diseases in Hospital Patients in China. Chinese M. J., **49**: 1122-1135 (Oct.) 1935.

——: A Note on Malaria in China. Chinese

Medical Association Hospital Survey. Chinese M. J., **50**:131-136 (Feb.) 1936.
Gear, H. S., and Pedersen, H.: Some Diseases Common to Man and Animals in China. Tr. Far East. Ass. Trop. M., 9th Congr., **2**:305-323, 1934.
Hodgman, G. E.: Comments on the Tentative Regulations for the Higher Vocational Nursing Schools. Chinese M. J., **49**:903-908 (Sept.) 1935.
Hoeppli, R.: Epidemiology of Kala-Azar in China. Chinese M. J., **57**:364-372 (Apr.) 1940.
Hong Kong: Report of the Director of Medical Services for the Year 1940. Hong Kong, 1940; Ibid., 1939.
Hou, H. C.: Diet and Health in China. Chinese M. J., **52**:413-420 (Sept.) 1937.
——: Dietary Intake of Vitamin B and Its Relation to Beri-Beri in Chinese. Chinese M. J., **61**:6, 1942.
Hsieh, T. Y., Chang, S. L., and Yang, C. S.: Typhus Fever in Changsha. Chinese M. J., **52**: 383-388 (Sept.) 1937.
Hsu, H. C.: Serum Carotinoids and Vitamin A in Chinese. Chinese M. J., **61**:1, 1942.
Hsu, H. F., Fan, Y. C., T'an, C. C., and Chin, K. Y.: Two Cases of Heavy Infestation by *Ascaris lumbricoides*. Chinese M. J., **57**:168-175 (Feb.) 1940.
——, and Li, S. Y.: Studies on Certain Problems of *Clonorchis sinensis*. Experimental Proof of *Bithynia longicornis* as the First Intermediate Host of *C. sinensis*. Chinese M. J. (Supp. III), pp. 241-243 (Mar.) 1940.
Hsu, K. L.: Scarlet Fever in Canton—a Mild Disease. Chinese M. J., **50**:405-409 (Apr.) 1936.
Hsu, Y. K.: Cerebral Cysticercosis and Acute Poliomyeloencephalitis. Chinese M. J., **57**: 318-329 (Apr.) 1940.
Hu, S. M. K.: Examination of Prisoners at Paoshan, Kiangsu Province, for Microfilariae of *Wuchereria bancrofti* Cobbold. Chinese M. J., **48**:1143-1145 (Nov.) 1934.
——: Notes on the Relative Adult Density of *Anopheles hyrcanus* var. *sinensis* Wied. during 1933 with Reference to Malaria Incidence in Kao-Chiao, Shanghai Area. Chinese M. J., **49**:469-474 (May) 1935.
——: Studies on the Susceptibility of Shanghai Mosquitoes to Experimental Infection with *Microfilaria malayi* Brug. Chinese M. J., **61**: 94-97, 1942.
——: Studies on the Susceptibility of Shanghai Mosquitoes to Experimental Infection with *Wuchereria bancrofti* Cobbold. III. *Culex tritaeniorhynchus* Giles. Peking Nat. Hist. Bull., **10**:39-43 (Sept.) 1935; Ibid., IV, *Aedes vexans* var. *nipponii* Theobald, Ibid., **10**:127-131 (Dec.) 1935.
Hu, S. M. K., Wong, H., and Li, B. C.: A Brief Survey of Filariasis in Foochow and Futsing Region, South China. Chinese M. J., **52**:571-578 (Oct.) 1937.
——, and Yu, H.: Preliminary Studies on the Blood Preferences of *Anopheles hyrcanus* var. *sinensis* Wied. in Shanghai Region. Chinese M. J. (Supp. I), pp. 379-386, 1936.
Huang, C. H.: Encephalitis, Japanese Type. Neutralization of Japanese Encephalitis Virus by Serum. Chinese M. J., **59**:34-44 (Jan.) 1941.
Huizenga, L. S.: History of Leprosy in China. Reports National Quarantine Service, Series V, 1934, pp. 89-108. Shanghai, National Quarantine Service, 1935.
——: Leprosy Problem in Matang Hsiang, Jukao Hsien. Chinese M. J., **53**:287-289 (Mar.) 1938.
Interviews and Reports, Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.
Jackson, R. B.: A Guide to the Identification of the Anopheline Mosquitoes of the Colony of Hong Kong. Chinese M. J., **53**:563-576 (June) 1938.
Japan-Manchoukuo Year-Book 1941. Tokyo, Japan-Manchoukuo Year-Book Company, 1941.
Japan Year-Book 1938-39. Tokyo, Foreign Affairs Association of Japan, 1938.
Jefferys, W. H., and Maxwell, J. L.: Diseases of China Including Formosa and Korea. New edition, J. Bale Sons and Danielsson, Ltd., 1911.
——, ——: Diseases of China Including Formosa and Korea. 2d ed. by J. L. Maxwell. Shanghai, China Medical Association, 1929.
Judd, F. H.: Curious Names and Remedies for Ague. China Med. Miss. J., **14**:163-164, 1900.
Kala-Azar in China. A brief addendum to the symposium on kala-azar published in the January "Journal." China M. J., **45**:146-147 (Feb.) 1931.
Kan, H. C.: Prevalence of Malaria in Kweichow Province. Chinese M. J., **59**:77-88 (Jan.) 1941.
——, and Kung, J. C.: Incidence of Schistosomiasis Japonica in an Endemic Area in Chekiang. Chinese M. J. (Supp. I), pp. 449-456 (Feb.) 1936.
Kao, C. L.: Tuberculosis in Children in Shanghai. Chinese M. J., **58**:113-123 (July) 1940.
Kao, Y. E.: Cerebrospinal Meningitis in Moukden. Chinese M. J., **50**:478-490 (Apr.) 1936.
——: The Incidence of Various Diseases among Children in Moukden. Chinese M. J., **50**:466-477 (Apr.) 1936.

Kau, L. S.: Histological Studies of Splenomegaly, with Special Reference to Material from the Foochow Area. Chinese M. J., **50**:1577-1584 (Nov.) 1936.

——, and Wu, R.: Preliminary Report on Histopathology of Paragonimiasis in Cats in China. Chinese M. J. (Supp. I), pp. 101-105, 1936.

Kessel, J. F., and Svensson, R.: Survey of Human Intestinal Protozoa in Peking, China. China M. J., **38**:961-982 (Dec.) 1924.

Khaw, O. K., and Cheu, S. H.: Treatment of Dog Heart-Worm (*Dirofilaria immitis* Leidy 1856) with Some Organic Antimony Compounds. Chinese M. J. (Supp. I), pp. 402-417 (Feb.) 1936.

Kikuta, K.: On the Investigations of Typhus in Manchoukuo. II, General Clinical Observations. J. Orient. Med., **29**:211-31 (July) 1938; Ibid., III, The Blood Picture of Typhus. Ibid., **29**: 715-48 (Sept.) 1938; Ibid., IV, On the Descending Velocity of the Red Blood Cell in Typhus. Ibid., **29**:749-60 (Sept.) 1938.

King, P. Z.: Public Health during 1940-1942. Chungking, National Health Administration, 1942.

Kobayasi, H., Yokoi, K., and Kawabe, K.: Parasitological Investigations in Hainan Island. I. Epidemiological Studies on Malaria and Splenomegaly among the Natives of Hainan Island, South China. Taiwan Igakkai Zassi, **39**:408-419, 1940.

Kroker, B.: A Brief Study of the Geography of China. China J., **34**:203-208; 253-258 (May, June) 1941.

Lai, D. G., and Chang, T. S.: Syphilis and Prostitution in Kiangsu. China M. J., **44**:558-563 (June) 1930.

League of Nations. Health Organisation: Enquiry into the Quinine Requirements of Malarial Countries and the World Prevalence of Malaria. Geneva, 1932.

——: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers: Report of China. Geneva, 1937.

Lee, E. L.: Tuberculosis in China. Journal-Lancet, **60**:145 (Apr.) 1940.

Lee, T'ao: Some Statistics on Medical Schools in China for the Year 1933-1934. Chinese M. J., **49**:894-902 (Sept.) 1935.

Leo, T. L.: A Case of Paragonimiasis. Chinese M. J., **49**:784-788 (Aug.) 1935.

Li, S., Lang, C. W., and Zia, S. H.: Brucella Agglutinin in Sera of Peiping Chinese. Chinese M. J. (Supp. II), pp. 297-305 (Mar.) 1938.

Ling, L. C., Liu, K. B., and Yao, Y. T.: Studies on the So-Called Changch'i; Changch'i in Yünnan. Chinese M. J., **50**:1815-1828 (Dec.) 1936.

Liu, H. L.: Balantidium Infection in Man. Report of a Case from Chefoo. Chinese M. J., **59**:476-479 (May) 1941.

Liu, K.: Filariasis in Changsha. Preliminary Report. Chinese M. J., **52**:579-582 (Oct.) 1937.

Liu, P. Y.: Experimental *S. enteritidis* Infection in Guinea Pigs. Chinese M. J. (Supp. II), pp. 227-242 (Mar.) 1938.

——: Serological Typing of *Salmonella enteritidis* Isolated in Peiping. Chinese M. J. (Supp. II), pp. 279-289 (Mar.) 1938.

Liu, W. T., and Chung, H. L.: Typhus Virus Isolated from Rats and Rat-Fleas in Typhus Houses. Proc. Soc. Exper. Biol. and Med., **40**: 353-355 (Mar.) 1939.

——, and Zia, S. H.: Studies on Murine Origin of Typhus Epidemics in North China. II. Typhus Rickettsia Isolated from Mice and Mouse-Fleas during Epidemic in Household and from Body Lice in Garments of One of Epidemic Cases. Am. J. Trop. Med., **21**:605-625 (Sept.) 1941.

——, ——, Chung, H. L., and Wang, C. W.: Typhus Fever in Peiping; Epidemiological Considerations. Am. J. Hyg., **35**:231-250 (Mar.) 1942.

McKinley, E. B.: A Geography of Disease. Washington, George Washington University Press, 1935.

Manson, P.: Manson's Tropical Diseases. Ed. by P. H. Manson-Bahr, 11th ed. Baltimore, Williams and Wilkins Company, 1941.

Maxwell, J. L.: Letter to the Editor on Leprosy and Climate in China. Internat. J. Leprosy, **5**:95-96 (Jan.-Mar.) 1937.

——: Notes on Incidence of Leprosy in Less Known Areas. China M. J., **45**:875-876 (Sept.) 1931.

——: Paragonimiasis in China. China M. J., **45**: 43-49 (Jan.) 1931.

——: Statistical Review of 1,379 Cases of Leprosy in China. Internat. J. Leprosy, **5**:151-157 (April-June) 1937.

Maxwell, J. P.: Modern Maternity Work in China. World Dominion and the World To-Day, **21**:10-12, 1943.

Meng, C. H., and Winfield, G. F.: Studies on Control of Fecal-Borne Diseases in North China. V. Preliminary Study of Density, Species, Make-Up, and Breeding Habits of House-Frequenting Fly Population of Tsinan, Shantung, China. Chinese M. J. (Supp. II), pp. 463-486 (Mar.) 1938.

Mora, A. D., and Soares, J. C.: Leprosy in Macao. Chinese M. J., **50**:721-725 (May) 1936.

Morris, H. H., Hwang, M. S., and Kuo, P. T.: Pellagra among War Refugees in Shanghai; Its

Associated Deficiencies and Nicotinic Acid Treatment. Chinese M. J., **57**:427-441 (May) 1940.

Nauck, G.: Altchinesische Medizin und Malaria. Arch. f. Schiffs- u. Tropen-Hyg., **31**:197-201, 1907.

Oldt, F.: Night-Soil as Fertilizer. China M. J., **40**:1059-1070 (Nov.) 1926.

Olpp, G.: Ueber die Blasensteinkrankheit in China. Arch. f. Schiffs- u. Tropen-Hyg., **39**: 179-188, 1935.

Ouyang, G.: Acute Bacillary Dysentery in Infants and Children; an Analysis of 315 Cases. Chinese M. J., **58**:456-472 (Oct.) 1940.

Patton, W. S.: Blood-Sucking Arthropods of Medical and Veterinary Importance in China. China M. J., **40**:543-553; 603-612 (June, July) 1926.

Pearce, R.: Distribution of Leprosy in Northwest China. Leprosy Rev., **10**:201-206 (Oct.) 1939.

Plague in Shansi and Shensi. Chinese M. J., **46**: 429-434 (Apr.) 1932.

Pollitzer, R., Yao, H. Y., Lai, D. G., and Chen, S. K.: The 1939 Cholera Epidemic in Yünnan Province. Chinese M. J., **59**:457-467 (May) 1941.

Prevention of Blindness. China's Sad Record: Twenty and a Half Million Afflicted More or Less. China M. J., **44**:45 (Jan.) 1930.

Raynal, J. H., Fournier, J., and Velliot, E.: Research on Typhus in Shanghai. Chinese M. J., **56**:11-28 (July) 1939.

Read, B. E., and Wagner, W.: Shanghai Vegetables. China J., **33**:206-220; 259-271 (Nov., Dec.) 1940.

Robertson, R. C.: Malaria in Western Yünnan with Reference to the China-Burma Highway. Chinese M. J., **57**:57-73 (Jan.) 1940.

——: Relapsing Fever in Shanghai (First Report). Chinese M. J., **46**:853-885 (Sept.) 1932.

——: Schistosomiasis in the Foochow Area. Chinese M. J., **50**:1555-1560 (Nov.) 1936.

——: Schistosomiasis in the Tali-Fu Region of Yünnan Province. Chinese M. J., **57**:358-363 (Apr.) 1940.

——: Transmission in China of Helminths by Vegetables. Chinese M. J. (Supp. I), pp. 418-422 (Mar.) 1936.

——, and Chang, T. L.: Malaria Survey in Western Yünnan, Lungling Area and Lushih County. Chinese M. J., **58**:446-455 (Oct.) 1940.

Scott, A. V., and Lair, K. S.: Disease Incidence among Chinese Children; Observations from Six Hospitals. Chinese M. J., **53**:169-184 (Feb.) 1938.

Scott, E. H.: Leprosy in Swatow District. China M. J., **45**:869-874 (Sept.) 1931.

Shanghai Municipal Council: Public Health Department; Report of the Commissioner 1939; Ibid., 1938; Ibid., 1937. Shanghai, North-China Daily News and Herald.

Shooting Notes: A Tiger Hunt in Manchuria. China J., **34**:184-185 (Apr.) 1941.

Shrimpton, E. A. G.: A Survey of the Incidence of Relapsing Fever in China. Chinese M. J. (Supp. I), pp. 312-344 (Feb.) 1936.

Snapper, I.: Chinese Lessons to Western Medicine. New York, Interscience Publishers, Inc., 1941.

——, Chung, H. L., Chu, I., and Chen, K. C.: Preliminary Observations on Human, Canine and Murine Leptospirosis in North China. Chinese M. J., **58**:408-426 (Oct.) 1940.

Sowerby, A. D. C.: The Insectivores of China and Neighboring Regions. China J., **33**:116-125; 156-166 (Sept., Oct.) 1940.

Stevens, H. K., and Cosman, T. M.: Report on Medicine and Public Health in Free China. (Supp.) New York, United China Relief, 1943.

——, and Mills, E. L.: Report on Medicine and Public Health in Free China. New York, United China Relief, 1942.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed., by R. P. Strong. Philadelphia, Blakiston Co., 1942. 2 vols.

Su, T. E.: Encephalitis Epidemica in Amoy. Chinese M. J., **50**:1279-1280 (Sept.) 1936.

Su, T. F.: Meningococcus Meningitis in Children. Report of an Epidemic in Changsha, Hunan, 1935. Chinese M. J., **50**:491-505 (Apr.) 1936.

Sun, C. J., and Wu, C. C.: Notes on the Study of Kala-Azar Transmission. II. Further Observations on the Natural Infection of *Phlebotomus chinensis* with *Leptomonas donovani.* Chinese M. J., **52**:665-673 (Nov.) 1937.

Sun, T. C. Y. and Thoroughman, J. C.: Tuberculosis in a General Hospital. Chinese M. J., **56**:69-77 (July) 1939.

Sweet, W. C., Feng, L. C., Chow, C. Y., and Hau, S. C.: Anophelines of Southwestern Yünnan and Their Relation to Malaria. J. Nat. Malaria Soc., 1942.

Sze, Szeming: China's Health Problems. New York, China Institute in America, Inc., 1942.

Tang, C. C.: Further Investigations of Schistosomiasis Japonica in Futsing, Fukien Province. Chinese M. J., **56**:462-473 (Nov.) 1939.

——: Schistosomiasis Japonica in Fukien with Special Reference to the Intermediate Host. Chinese M. J., **50**:1585-1590 (Nov.) 1936.

Tang, C. C.: Trichinella Infection in Rats in Fukien. Chinese M. J., **55**:537-541 (June) 1939.

Tang, C. T., and Forkner, C. E.: The Presence of Infective *Leishmania donovani* in the Urine and Prostatic Fluid of Patients with Kala-Azar. Chinese M. J. (Supp. I), pp. 394-401 (Feb.) 1936.

Tang, F. F., Liu, S. H., and Kau, L. S.: A Case of Glanders in Man. Chinese M. J., **49**:248-255 (Mar.) 1935.

Tao, C. S.: Transmission of Helminths' Ova by Flies. J. Shanghai Sci. Inst. 2 (Sect. 4) 109-116 (Apr.) 1936.

Tao, S. M.: *Entamoeba histolytica* Infection in North China; a Study of 1,000 Positive Cases. Nat. M. J. China, **17**:412-434 (Aug.-Oct.) 1931.

Taylor, A. G.: Report on Examination of Stools. China M. J., **45**:790 (Aug.) 1931.

Taylor, H. W.: A Few Facts about the Distribution of Kala-Azar in Manchuria. China M. J., **45**:40-42 (Jan.) 1931.

Thomason, H.: Diseases of Hong Kong and Canton. The Hosp. Corps Q., **11**:71-75, 1927.

Turner, W. H.: Typhus Fever Notes. China M. J., **45**:148-149 (Feb.) 1931.

Uttley, K. H.: Epidemiology of Bubonic Plague in Hong Kong. Caduceus (Hong Kong) 17, 1938.

——: Chinese Urban Death Rate in Hong Kong. Tr. Roy. Soc. Trop. Med. & Hyg., **31**:457-468 (Jan.) 1938.

Visskovsky, S. V., and Petroff, V P.: Epidemiology of Pappataci Fever in Central Asia. Tr. Sjezda Bakt., Epid., San Vrach., **1**:161-164, 11th Congr., Leningrad, 1929.

Vogel, H., Wu, K., and Watt, J. Y. C.: Preliminary Report on the Life History of Paragonimus in China. Tr. Far East. Ass. Trop. M., 9th Congr., Nanking, **1**:509-517, 1934.

Wan, F. E.: Gas Bacillus Infection. Review of Its Etiology, Symptomatology and Treatment. China M. J., **44**:97-118 (Feb.) 1930.

Wang, L. K., and Shen, J. K.: Lymphogranuloma Inguinale the Fourth Venereal Disease, with Report of Five Cases. Chinese M. J., **48**:615-622 (July) 1934.

Wang, S. H., and Hsieh, C. K.: Roentgenologic Study of Paragonimiasis of Lungs. Chinese M. J., **52**:829-842 (Dec.) 1934.

Weigl's Vaccine against Typhus in Mongolia. Pasteur Institute, Shanghai, Chinese M. J., **58**:257 (Aug.) 1940.

Wilcocks, C.: Summary of Recent Abstracts (1941); Cholera. Trop. Dis. Bull., **39**:1-5 (Jan.) 1942; Ibid.; Typhus. Ibid., **39**:655-663 (Oct.) 1942.

Williams, T. H.: A Survey of Intestinal Parasites in Rural Szechwan. Chinese M. J., **57**:464-472 (Apr.) 1940.

——: *Echinococcus granulosus* in Szechwan. Chinese M. J., **57**:176-178 (Feb.) 1940.

Winfield, G. F., and Chin, T. H.: Studies on Control of Fecal-Borne Diseases in North China; Epidemiology of Parasitic Amoebae. Chinese M. J., **56**:265-286 (Sept.) 1939.

Wong, A., and Wong, D. H.: *Bacillus welchii* Infection in Cases of Abortion. Chinese M. J., **47**:877-887 (Sept.) 1933.

Wong, D. H.: Brucella Agglutinins among the Chinese in Shanghai. Chinese M. J. (Supp. I), pp. 280-287 (Feb.) 1936.

Wong, K. C.: The Early History of Leprosy in China. China M. J., **44**:737-743 (Aug.) 1930.

——, and Wu, Lien-Teh: History of Chinese Medicine. Tientsin, Tientsin Press, Ltd., 1932.

Wu, C. J., and Zia, H. S.: Isolation of Typhus Fever Virus from House Rats in Peiping. Proc. Soc. Exper. Biol. and Med., **39**:163-165, 1938-39.

Wu, C. Y.: Occurrence, Distribution and Seasonal Prevalence of Rat-Fleas in China, with Note on Their Relation to Bubonic Plague. Reports National Quarantine Service, pp. 27-37, Shanghai, 1935.

Wu, K.: Distribution of Paragonimiasis in China. Chekiang Province. Chinese M. J. (Supp. I), pp. 442-448 (Feb.) 1936.

——: Snails as Carriers of Human Parasitic Disease in China. China J., **34**:173-183 (Apr.) 1941.

Wu, L. S.: Taenia Infection. Report Based on Stool Examinations of 56,286 Patients in the Peiping Union Medical School. Chinese M. J., **55**:561-565 (June) 1939.

Wu, L. T.: The Cholera Epidemic. Chinese M. J., **46**:931-934 (Sept.) 1932.

——: Hainan—Paradise of China. Reports National Quarantine Service, pp. 16-38, Shanghai, 1937.

——: Pestilence and Plague in China. Reports National Quarantine Service, pp. 1-25, Shanghai, 1935.

——, Chun, J. W. H., Pollitzer, R., and Wu, C. Y.: Cholera; a Manual for the Medical Profession in China. Shanghai, National Quarantine Service, 1935.

——, ——, ——, ——: Plague; a Manual for Medical and Public Health Workers. Shanghai, National Quarantine Service, 1936.

Wyatt, H. G.: Notes on Osteomalacia in North China. China M. J., **44**:1168-1182 (Dec.) 1930.

Wylie, J. H.: Typhoid and Paratyphoid Fever at Paotingfu. China M. J., **44**:81-91 (Feb.) 1930.

Yamane, Y.: Studies on the Natural Infections with *Trichinella spiralis, Entamoeba histolytica, Clonorchis sinensis,* and *Dirofilaria immitis* on the Street Dogs in Mukden. J. Orient Med., **29**:111-115, 1938.

Yang, C. S.: Rat-Bite Fever in Kweiyang; Report of Two Cases. Chinese M. J., **58**:245-250 (Aug.) 1940.

——, and Chiang, W. L.: Some Notes on Malaria in Nanking; Review of 250 Cases. Chinese M. J., **48**:124-137 (Feb.) 1934.

——, and Huang, K. K.: Beri-Beri in Nanking. Chinese M. J., **48**:20-36 (Jan.) 1934.

——, ——: An Outbreak of Pellagra in Nanking; Report of 30 Cases. Chinese M. J., **48**: 701-723 (Aug.) 1934.

Yang, F. H.: Etiology of Phlebotomus Fever. Tr. Far East. Ass. Trop. M., 9th Congr., **1**: 495-502, 1934.

Yang, Y. N., Landauer, E., Koo, C. K., and Lin, P. C.: Plague Work in Fukien, China, December 1935 to November 1936. Chinese M. J., **55**:55-73 (Jan.) 1939.

——, ——, ——, ——: Plague Work in Fukien. Rat and Flea Survey of Lungyen, Fukien. Chinese M. J., **55**: 479-487 (May) 1939.

Yao, H. Y., Yuan, I. C., and Huie, D.: Relation of Flies, Beverages, and Well Water to Gastro-Intestinal Diseases in Peiping. Nat. M. J. China, **15**:410-418 (Aug.) 1929.

Yao, Y. T.: On Peculiar Morphology of Malaria Parasite from Patient and Possibility of Its Being *Plasmodium ovale.* J. Trop. Med., **45**: 9-15 (Jan. 15) 1942.

——, and Chu, H. J.: Intestinal Parasites among the People under Suburban Conditions in Tangshan, Nanking. Tr. Far East. Ass. Trop. M., 9th Congr., Nanking, **2**:551-553, 1934.

Yao, Y. T., and Ling, L. C.: Epidemiological Study of Malaria in Nanking. Tr. Far East. Ass. Trop. M., 9th Congr., Nanking, **2**:89-106, 1934.

——, ——, and Liu, K. B.: Studies on So-Called Changch'i; Changch'i in Kweichow and Kwangsi Border. Chinese M. J., **50**:726-738 (May) 1936.

——, and Wu, C. C.: The Finding of *Phlebotomus chinensis* Newstead from Yünnan and Its Bearing on the Transmission of Kala-Azar in South China with Remarks on the Success in Infecting Chinese Hamsters with Flagellates from Naturally Infected *P. chinensis* Found in Tsingkiangpu. Chinese M. J., **60**:232-240 (Sept.) 1941.

——, ——: Notes on Species of Phlebotomus Newly Found in Tsingkiangpu, North Kiangsu, China. Chinese M. J. (Supp. II), pp. 527-537 (Mar.) 1938.

——, ——: One Year's Observation of *Anopheles hyrcanus* var. *sinensis* in Nanking, 1933. Tr., Far East. Ass. Trop. M., 9th Congr., Nanking, **2**:3-26, 1934.

Yu, K. Y., and Taylor, H. W. Y.: Notes on Leprosy in the Three Eastern Provinces. China M. J., **45**:855-867 (Sept.) 1931.

Yuan, I. C., Chu, F. T., and Lee, C. U.: The Seasonal Incidence of Kala-Azar in Infants and Its Significance in Relation to the Transmission Problem of the Disease. Chinese M. J., **56**:241-264 (Sept.) 1939.

Zia, S. H., and Wong, D. H.: Brucella Infections in Chinese. Chinese M. J., **46**:243-253 (Mar.) 1932.

4

Formosa

GEOGRAPHY AND CLIMATE

The island of Formosa, ceded to the Japanese by China in 1895, is situated between 22 and 26° of north latitude and approximately 120 and 123° of east longitude. The total area of Formosa is about 13,800 square miles, or slightly more than that of the state of Maryland (12,327 square miles). It is bounded on the west by the Formosa Strait, on the northeast by the East China Sea, on the east and south by the Pacific Ocean and on the southwest by the South China Sea. The southeastern coast of China is only 100 miles across the Formosa Strait. The island itself is only about 240 miles long and 80 miles wide at its greatest breadth.

The population of Formosa was said by Morishita in 1939 to be 5,200,000. The vast majority of inhabitants are Chinese, and Japanese number only about 309,000. Aborigines, who formerly were headhunters, are few, and are dwellers chiefly of the mountainous districts. They are said to be Malay in origin. In general, the population is concentrated along the western coast line of the island and in a narrow strip of territory along the southeastern coast. Most of the inhabitants are engaged in some form of agriculture.

Physically, Formosa is intersected for almost its entire length by a mountain range which is featured by five of the highest peaks in the Japanese Empire. One, Mount Morrison, is about 13,000 feet high; another, Mount Sylvia, is about 12,900 feet high. In the western portion of the island the slope is characterized by numerous valleys; in the eastern region a narrow strip of mountainous country persists to the eastern coast, where tremendous cliffs 3,000 to 8,000 feet high abut the Pacific Ocean. The eastern slope is covered by the largest forest of camphor trees (*Cinnamomum camphora*) thus far known.

Formosa has no exceptional hydrographic features. Such streams as are present are mountainous in origin and are very small during the dry season, but may become raging torrents in the rainy season. None are important commercially.

The climate of Formosa is both tropical and subtropical, but in areas of high altitudes may be frigid. In the spring the mean temperature from March through May is about 90° F. (32.2° C.); in the summer, from June through September, the temperature varies between about 80 and 90° F. (26.6 and 32.2° C.). July is the warmest month. Winter extends from September through March, with a temperature varying between 50 and 60° F. (10 and 15.6° C.). In October and November the weather corresponds to that of what is known as "Indian summer" in the northern part of the United States. It is cooler on the eastern coast during the summer, and colder on the western coast in the winter.

Rainfall on Formosa is heavy, and it is heavier in the extreme northern section than elsewhere. The city of Keelung is supposed to have more rainfall than any other city in the Far East. Data as to amounts of rainfall are not available; but it is known that the summer in the northern part of Formosa is long and rainy, and that the winter in the south is short and rainy. The southwestern monsoon is active from May through September, and the northeastern monsoon occurs from November through April.

PUBLIC HEALTH

Health Services

Organization. In Formosa, both medical care and health work are supervised by a central board, the Sanitary Bureau of the Department of Police in the Office of the Governor General. Medical care is rendered at government-controlled hospitals, which are located at the principal centers of the island. In addition, there are small units for the treatment of tuberculosis, leprosy and mental disease. The actual medical service is rendered by qualified physicians who are appointed by the prefectures and are stationed at the various centers, especially in the outlying districts. Medical service also is offered by qualified private practitioners. There is a certain number of unqualified practitioners of the "old Chinese school" who are permitted to offer medical services to the public. The public health work is carried out through the collaboration of police, trained physicians, veterinarians, sanitary inspectors, trained laboratory assistants and sanitary clerks. The staffs are stationed at prefectural health centers, districts, towns and villages. Each prefecture has a Bureau of Sanitation in the Department of Police, and its activities in both medical and public health matters are under the direct supervision and control of the police of the central board. It should be emphasized that the police constitute the controlling body and that all other units of the organization are subservient to them. Public health education is made available to medical students at the Imperial University of Taihoku. The majority of the physicians in Formosa are trained at this institution. The dissemination of public health information to the public is accomplished by means of instruction in the primary schools and by lectures, exhibitions, motion pictures and legislation. The services of the public health department include medical and sanitary services, quarantine, development of public works and measures for the control of vermin. Medical service in the remote rural districts where voluntary medical care is unavailable is effected through a system of "public physicians." These physicians usually are qualified and locally recognized, and are subsidized by the prefectural authorities, in addition to being permitted to carry on a general practice. This system has met with considerable success from the standpoint of making medical services available as well as disseminating information concerning public health, hygiene and sanitation.

Relative Effectiveness. Since the Japanese took over Formosa in 1895 there has been considerable improvement in the health of the people. Plague, which was rampant, was stamped out. Cholera and smallpox became rare. Malaria became much less prevalent than formerly, and the incidence of other diseases was materially reduced. The greatest improvement has occurred in the metropolitan areas, but during recent years considerable improvement in the health and sanitary conditions in the rural districts also has been claimed. Although this is probably true, general health and sanitary conditions on Formosa remain grossly inferior to those in the United States and do not compare favorably with those found in such tropical areas as the Panama Canal Zone, Puerto Rico and the Philippine Islands. This is especially true in the remote districts, where conditions are known to be very primitive.

Water Supplies

The island has an abundant supply of water, which is derived from rivers, wells, springs and collections of surface water. The principal supplies are drawn from rivers and streams, which frequently are contaminated. Water for the cities and large towns often is obtained from mountain streams, stored in well-constructed reservoirs and piped into the cities through modern mains. These supplies are said to be good, but most of the European residents prefer to use boiled water because of the endemicity of the enteric diseases. The majority of inhabitants, except for those using water that is piped into individual buildings, obtain their water from a common source (tap, pump, well or water cart) and transport it to the point of consumption in various types of containers. Water obtained from these sources and transported by this means is subject to varying degrees of contamination, even though it may have been potable at the source. No information is available concerning the methods for the treatment of water. In villages and rural districts deep wells are the usual sources of water. Regulations require that wells be covered and furnished with a pump; the use of common buckets is forbidden. The almost universal use of tea and the refusal on the part of the Formosans to drink cold water probably lower the incidence of enteric diseases. Nevertheless, the incidence of the infectious intestinal diseases is high, and epidemics are of relatively frequent occurrence.

Sewage Disposal

Systems for the disposal of sewage in Formosa are very primitive, according to modern standards. In Taihoku there is a limited canal system for the disposal of sewage, and in some of the modern buildings flush toilets are in use. A few institutions have septic tanks. In some towns the pan system of collection of night soil is used, whereas in others there are open concrete drains into which the refuse from homes, factories and hospitals flows. The natives frequently use the water from these drains for the purpose of washing their clothes and cleaning vegetables. Inasmuch as the coastal areas are relatively flat, problems of drainage are difficult, and the water-borne refuse in the open drains does not always flow fast enough to prevent stagnation. In some of the large towns and villages the police have insisted that houses be supplied with a single-chamber concrete tank. These tanks are emptied periodically, and the night soil is then stored until it has putrefied; the final product is used as fertilizer on cultivated lands. In rural areas the building and reconstruction of sanitary latrines have been encouraged, and in some instances enforced. For the most part, however, latrines are poorly constructed, insanitary and not flyproof. In districts where many premises are without facilities for the disposal of sewage, indiscriminate pollution of the soil is practiced. It should be emphasized that, regardless of the method of disposal in use, night soil is always salvaged and used as fertilizer. This practice frequently results in the development of outbreaks of one or another of the enteric infections.

Insects and Animals

Vectors of Disease. Mosquitoes. *Anopheles hyrcanus* var. *sinensis* is the most important carrier of malaria on the island of Formosa. The other important carriers are *Anopheles minimus* and *A. maculatus maculatus*. Dengue fever is carried by both *Aedes aegypti* and *A. albopictus*. *Culex fatigans* is the usual carrier of the larval form of *Wuchereria bancrofti*.

Lice. The body louse, *Pediculus corporis*, carries the rickettsia of the epidemic form of typhus fever, as well as the causative organism of louse-borne relapsing fever, *Borrelia recurrentis*, and the micro-organism of trench fever, *Rickettsia quintana*.

Flies. The common housefly, *Musca domestica*, by purely mechanical means, is capable of transporting the causative organisms of many of the intestinal diseases, principally typhoid fever, paratyphoid fevers, amebic dysentery, bacillary dysentery and cholera. Flies are said to be extremely common on Formosa. Other species of flies, especially *Chrysomyia bezziana*, are encountered. In the process of biting or lighting, the latter deposits its eggs in or on the skin or in open wounds, and the development of the maggots is accompanied by bacterial infection, with the subsequent formation of deep-seated boils or abscesses.

MITES. Mites (Trombicula) are the vectors of several different typhus-like diseases, and are found in association with rodents, particularly rats and mice. Some birds also harbor mites. Mites are most commonly found in areas that are subject to floods, and in the tall grass in areas that are under cultivation. The principal mite-borne disease on Formosa is Japanese river fever or tsutsugamushi disease, which is transmitted by the mite *Trombicula akamushi.*

FLEAS. In addition to being pestiferous, the flea *Xenopsylla cheopis* is the vector of at least two serious diseases: plague and murine (endemic) typhus fever. The rat is the common host for this flea. The finding of dead rats or other rodents frequently indicates that plague is prevalent among the local rat population. This is of importance because infected fleas will leave the dead or dying rodents and seek new animal hosts, including man.

RODENTS. Rats are important because they are the hosts for mites and fleas that are capable of transmitting several types of typhus fever as well as plague. The excreta of rats infected with *Leptospira icterohaemorrhagiae* may contaminate food or water supplies and give rise to leptospirosis in man. The rats that are encountered most frequently are the common house rat, *Rattus rattus,* and the brown rat, *Rattus norvegicus.* Other rodents attacked by the mites that are vectors of the rickettsia of Japanese river fever are *Rattus rufescens, R. losea, R. coxingi, Apodemus semotus, A. agrarius, Mus musculus,* and *M. formosanus.* In the Bôko Islands, *Mus musculus taiwanus* also is a host for these mites.

Snakes and Other Dangerous Animals. At least 11 varieties of poisonous land snakes are found on the island, of which four are commonly encountered; they are *Trimeresurus mucrosquamatus, Bungarus multicinctus, Naja naja atra* and *Trimeresurus gramineus.* These snakes are most likely to be encountered in the foothills. Eight species of poisonous sea snakes occasionally are found along the seacoast.

Mountain lions and wild boars are the only sources of physical danger from wild animals. They are found in the foothills and do not attack unless they are molested.

FOOD AND DAIRY PRODUCTS

Although up-to-date information is not available, it is said that limited amounts of foods were produced in excess of the needs of the native population. A list of the foods that were available and were the principal items of the native dietary included rice and fruits—bananas, pineapples, melons, papayas, pomelos, oranges and mangoes. Pigs and goats were plentiful, but other meats were limited; poultry was abundant, but the birds were small in size; seafoods were plentiful; vegetables, including cabbages, turnips, sweet potatoes, potatoes and bamboo shoots, were raised in large quantities; sugar was plentiful; salt was manufactured locally; and tea was available in abundant quantities. Diseases due to deficiency of vitamins were rare among the native Formosans, but were comparatively common among other racial groups. The use of night soil for the fertilization of cultivated lands was universal, and as a result the development of intestinal diseases due to improperly prepared and cooked foods was frequent. The natives ate raw fish in considerable quantities, and the custom led to infection with various flukes; difficulties occasionally arose because of the fact that several varieties of poisonous fish are found in the waters about Formosa, particularly the globefish, *Tetraodon maculatus.* Bovine tuberculosis and brucellosis were frequent, and no facilities were available with which to ensure a safe supply of meat or milk. No information is available concerning facilities for refrigeration on Formosa.

Miscellaneous Problems of Sanitation

Sanitary conditions in Formosa are poor. This is especially true in the remote and rural districts. In some metropolitan areas there are facilities for the provision of potable water and for the disposal of sewage. These, however, are limited, and where they do exist, they are not always efficient or properly maintained. The cities and metropolitan areas are overcrowded and contain large slum areas in which housing and sanitary conditions are deplorable. People in these areas are poor and are said to be dirty and infested with vermin. The incidence of communicable diseases among this portion of the population, who are largely Formosan-Chinese, is high, and epidemics are of frequent occurrence. Sanitary conditions in the towns and villages are poor, although during recent years there has been some improvement as the result of the efforts of the Society for Rural Reconstruction. This society has offices in each town and village, and both encourages and assists the inhabitants in the improvement of all phases of communal and rural life. Such improvement as has taken place has been accomplished largely as the result of propaganda and the will of the people to co-operate. However, when measures for the prevention of the spread of infectious diseases or for control of malaria become necessary and are not voluntarily undertaken, the inhabitants are compelled by the police to comply with the existing legislative regulations. Prefectural authorities assist in the improvement of the housing conditions, water supplies and facilities for the disposal of sewage, which for the most part have been primitive. The assistance, however, has been limited, and sanitary conditions are usually unsatisfactory. In the remote districts, the ignorance and indifference of the natives impede the introduction or application of even the elementary concepts of modern sanitation.

MEDICAL FACILITIES

Hospitals

Number of Beds. There are many government, public and private hospitals scattered throughout Formosa, but those of any considerable size are limited; only a few have a capacity greater than 80 beds. The majority of the private hospitals and clinics have 10 to 50 beds. Of the large hospitals, all except four or five are administered by the government. Taihoku is the medical and hospital center of the island and the largest and best hospitals are located there, as are a leprosarium and an institute for the control of venereal diseases. There is only one small tuberculosis sanatorium on the island. There is a medical school attached to the Imperial University of Taihoku.

Equipment. The large government hospitals, and particularly those in Taihoku, are believed to be well equipped, but the small hospitals have little equipment and provide insufficient beds to meet the needs of the native population.

Medical Personnel

Physicians. There are essentially three classes of physicians in Formosa: qualified physicians who are graduates of medical colleges and schools recognized by the Imperial Government; special persons who are granted licenses to practice by the local governor general after a professional examination and a consideration of their previous medical experience (these physicians have their professional activities restricted to certain localities and for limited periods of time); and physicians belonging to the "old Chinese school," who were present before Formosa was annexed by the Japanese. The number of qualified physicians in Formosa in 1935 was 1,983, or about 0.38 per 1,000 of population.* The majority of the qualified physicians were concentrated in the more populated districts. It is said that

* This figure is largely conjectural, because it was computed on the basis of the population for the year 1939, which Morishita said was 5,200,000.

many of them were excellent surgeons and that their technical skill was good; as diagnosticians, however, they were not particularly noteworthy. Owing to the scarcity of physicians, the government found it necessary to enlist the services of the second-class physicians (those granted local licenses) to administer to the medical needs of the people in the remote regions. Physicians belonging to the "old Chinese school" are comparatively few. The previously mentioned "public physicians" are qualified medical men who are subsidized by the prefectural authorities.

Nurses. Recent information concerning the number of nurses in Formosa is not available. However, in 1935 there were 170. These nurses are licensed by examination on the completion of two years' training.

Dentists. In 1935 there were 470 dentists on Formosa.

Others. Midwives are licensed after a course of training at a hospital recognized by the government or after passing an examination held by the same authorities. The majority of the midwives are concentrated in the more populated districts. To make their services available in the rural districts, the government has established a system in which "public midwives" are assigned to towns and villages according to the same plan used for making medical services available in these areas.

DISEASES

General Considerations. Diseases caused by pollution of soil and water—typhoid fever, paratyphoid fevers, amebic dysentery and bacillary dysentery—are prevalent. Intestinal parasitism frequently is encountered. The mosquito-borne diseases—dengue fever, filariasis and malaria—are widespread. Venereal diseases are common. Respiratory diseases, principally pneumonia, influenza and tuberculosis, are highly endemic and are associated with high mortality rates. Other contagious and acute infectious diseases that are commonly encountered in the United States are endemic in Formosa; namely, measles, mumps, whooping cough, scarlet fever, diphtheria, cerebrospinal meningitis, encephalitis and poliomyelitis. It is said that, because of rigid measures of control, there have been no cases of epidemic (louse-borne) typhus fever, plague or cholera in Formosa. The presence of these diseases in near-by countries, however, makes it possible for them to be introduced. Yellow fever has never been reported, although the vectors, *Aedes aegypti* and *A. albopictus,* are prevalent.

Diseases Spread Chiefly through Intestinal Tract

Enteric Diseases. Typhoid fever, paratyphoid fevers, amebic dysentery and bacillary dysentery are commonplace, and their prevalence is an indication of the inadequacy of the facilities for the protection of water supplies and for disposal of sewage. Accurate information concerning the prevalence of these diseases is not available because of the practice on the part of physicians of diagnosing the enteric diseases as "influenza" to avoid the necessity of conforming with a rigorous policy of disinfection that involves the patient's family, the premises and the confiscation or destruction of perishable stocks.

Cholera. Cholera formerly constituted a serious disease. Except for two cases of cholera reported in 1941, there is no recent information concerning the presence of this disease on the island.

Infection with Worms and Flukes. Worms and flukes abound throughout the island, and infection of human beings by these parasites is commonplace. Ancylostomiasis, ascariasis and infection with tapeworms are particularly prevalent in the southwestern coastal areas. Hydatid disease due to the dog tapeworm is not uncommon. The broad fish tapeworm, *Diphyllobothrium latum,* is transmitted to man by the eating of raw fish, and practically all types of fish in this area are infected with this tapeworm. Infection with the liver fluke, *Clonorchis sinensis*, follows the ingestion of raw fish which harbor these cercariae; snails of the genus Bithynia are the primary hosts for this fluke. The intestinal trematode fluke, *Fasciolopsis buski*, is acquired by man by the ingestion of uncooked or improperly prepared water plants. Paragonimiasis, caused by infection with *Paragonimus westermani*, follows the ingestion of uncooked crabs or crayfish that are infected with these flukes; the primary host is a snail of the genus Melania. The intestinal fluke, *Metagonimus yokogawai*, is one of the most common flukes in Formosa, and infection occurs as the result of the ingestion of raw or improperly cooked freshwater fish, usually goldfish.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia and Influenza. Pneumonia and influenza are extremely prevalent. In 1935, the death rate from pneumonia was 424 per 100,000 of population. The morbidity and mortality rates of influenza are not known but are said to be high.

Tuberculosis. Tuberculosis is prevalent in all parts of the island. The mortality rate for tuberculosis in 1935 was 137 per 100,000 of population. It is said that this disease remains unchecked because of the lack of facilities for isolation and treatment, poor sanitary conditions, overcrowding in small houses and careless disposal of sputum.

Diseases Spread Chiefly by Contact

Venereal Diseases. Syphilis, gonorrhea, lymphogranuloma venereum, granuloma inguinale and chancroid are believed to be prevalent, and poorly controlled. Under the brothel system prostitution flourishes, and although examination for venereal disease is required, the method of examination is entirely unsatisfactory; prostitutes are examined weekly, but are given special douches prior to examination and then are reported to be free of infection.

Schistosomiasis. Infection with *Schistosoma japonicum*, the blood fluke, is prevalent in the southern part of Formosa. This chronic disease is acquired by human beings as the result of swimming, bathing in, or drinking waters infested with the cercariae of these flukes. Snails that are known to serve as the intermediary host are of various genera, Oncomelania, Katayama and Schistosomophora, and are found in the ponds, streams and rivers.

Leptospirosis. Leptospirosis, caused by infection with *Leptospira icterohaemorrhagiae*, occurs in Formosa. The incidence is not known, but the disease is believed to be fairly common. The disease is contracted as a result of the ingestion of food or by bathing in water that is contaminated by the excreta of rodents infected with leptospira.

Diseases of the Skin. Specific information concerning diseases of the skin is not available, but it is known that cutaneous diseases, including fungous infections, pyogenic infections and scabies, are extremely common. Parasitic infestations due to the body louse, *Pediculus corporis*, the head louse, *Pediculus capitis*, and the pubic louse, *Phthirus pubis*, are frequent, particularly among people of the poorer classes.

Diseases of the Eyes. Various forms of contagious conjunctivitis are of common occurrence. Trachoma exists everywhere, and accounts for widespread blindness. Gonorrheal ophthalmia is not infrequent.

Diseases Spread by Arthropods

Malaria. The prevalence of malaria constitutes a major problem of public health in Formosa. Benign tertian malaria is the type most commonly encountered, but the majority of deaths are due to malaria of the malignant tertian type. It is said that quartan malaria scarcely exists on the island. In 1935, 3,782 deaths were caused by malaria, 85 per cent of which occurred on the east and west coasts along the southern half of the island and in Botel Tobago. The cities of Taihoku, Taichu and Tainan as well as the mountainous districts are said to be virtually free from malaria.

Filariasis. Filariasis is of common occurrence.

Dengue Fever. Dengue (breakbone) fever is both endemic and epidemic. This disease occurs throughout the island, and is of particular significance because of its tendency to occur in sudden sharp outbreaks involving large numbers of persons.

Typhus Fever. Epidemic (louse-borne) typhus fever has not recently been reported in Formosa; however, the general infection of the population with lice and the proximity of the island to foci in which the disease is endemic make the establishment of epidemic typhus fever a distinct possibility.

Information regarding endemic (flea-borne) typhus fever is lacking.

Japanese river fever or tsutsugamushi disease is a type of typhus fever that is transmitted by the mite, *Trombicula akamushi.* This disease is endemic throughout Formosa and is reported as occurring in the highlands as well as in the coastal area. There is great variation in the physical characteristics of the country in which the infection occurs: cultivated fields, jungles, in the plains, mountains, foothills, flood basins, and riversides. The disease occurs throughout the year, although there are slight variations in the seasonal incidence due to physical and meteorologic conditions. According to Morishita in 1939:

> In nature the larvae are found parasitic on Muridae, such as *Rattus rattus rattus, R. rattus rufescens, R. norvegicus, R. losea, R. coxingi, Apodemus semotus, A. agrarius, Mus musculus,* and *M. formosanus.* It occurs also parasitic on shrew (*Crocidiura murina*), dog, ox, and buffalo. Some birds, such as fowl, pheasant, *Turnix taigoon,* and *Centropus javanicus,* are sometimes infested by this mite. Although all these species of animals are known to be attacked by it, it is thought that they cannot all play a role as a reservoir host of the virus of tsutsugamushi disease. The most important hosts should be certain species of the rats. In the endemic area *R. losea* and *A. agrarius* are most common and are found to be very heavily infested by the mites, which attach themselves to the ear conchae of these animals, sometimes by the hundreds.

It is of interest that tsutsugamushi disease in Formosa is characterized by a low case fatality rate, averaging 12 per cent; whereas in Japan it frequently exceeds 50 per cent.

Plague. There have been no reports of the presence of plague in Formosa in recent years. Fleas capable of transmitting the disease are known to exist, and plague might be introduced into Formosa from near-by countries in which the disease is highly endemic.

Relapsing Fever. Louse-borne relapsing fever is said to occur very commonly throughout the island of Formosa.

Miscellaneous

Heat Exhaustion. Because of the heat and the high relative humidity, it is said that unacclimated persons are often subject to heat prostration.

SUMMARY

Public health activities and medical care in Formosa are under the direct supervision of the Department of Police. Hospitals, medical supplies and facilities for medical care are inadequate for the island as a whole. Sanitary conditions are poor, especially in the rural areas, and except for some metropolitan areas, facilities for the proper treatment of water and for the disposal of sewage are nonexistent. The almost universal practices of fertilization of crops with human excrement and of indiscriminate pollution of soil and water result in the gross contamination of locally grown vegetables and fruits and of water supplies. Native food products are produced in adequate amounts for the inhabitants.

Vermin are prevalent, especially mosquitoes, lice, mites, flies, fleas, rats and poisonous snakes. Many species of fresh-water fish in various rivers, lakes, and streams harbor worms and flukes that may infect human beings. Thus, bathing, swimming or wading in any fresh-water stream is hazardous, particularly because of the possible presence of the Japanese type of liver fluke.

The diseases that are of greatest significance in this area are malaria; the enteric diseases, including typhoid fever, paratyphoid fevers, amebic dysentery and bacillary dysentery; venereal diseases; infestations with various worms and flukes; dengue fever; the common acute contagious diseases; tetanus; and various types of diseases of the skin. Other diseases of potential importance are epidemic (louse-borne) typhus fever, endemic (flea-borne) typhus fever, Japanese river (tsutsugamushi) fever, relapsing fever, plague and cholera.

BIBLIOGRAPHY

Encyclopaedia Brittanica, 14th ed. London, Chicago, Encyclopaedia Brittanica, Inc., 1939.

Formosa: Die hygienischen Verhältnisse der Insel Formosa. Dresden, C. C. Meinhold, 1911.

Interviews and Reports, Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Japan Year-Book, 1937. Tokyo, The Foreign Affairs Association, 1937.

Morishita, K.: Tsutsugamushi Disease: Its Epidemiology in Formosa. Proc. Pacific Sc. Congr. 1939, 6th Congr., **5**:639-647. Berkeley and Los Angeles, University of California Press, 1942.

Noda, H., Toyozumi, M., and Sugita, K.: Epidemiological Observations on Smallpox in Formosa. Taiwan Igakkai Zassi (Jr. Formosa Med. Assn.), **39**:547-569, 1940. Abst. in Far Eastern Science Bulletin, **1**:1 (Apr.) 1941.

5

French Indo-China

GEOGRAPHY AND CLIMATE

The region known as French Indo-China actually is composed of five parts: (1) Cochin China, a French colony which sent one delegate to the French Assembly; (2) Cambodia, north of Cochin China; (3) Annam, which was occupied by the French in 1787 and established as a protectorate in 1884; (4) Tonkin, which was annexed to France in 1884 and the chief town of which, Hanoï, has been the capital of French Indo-China since 1902; and (5) Laos, which has been a French protectorate since 1893. The territory of Kwangchowan was leased from China in 1898.

French Indo-China lies, roughly, between 8 and 24° of north latitude and 100 and 110° of east longitude. It is bounded on the north by China, on the east and southeast by the South China Sea, on the southwest by the Gulf of Siam, and on the west by Thailand. The area of the entire country is 274,385 square miles, and the population is thought to be about 23,853,000. It has not been possible to obtain recent or accurate figures as to the composition of this population, but it is thought that the Annamese constitute about four fifths of all the people in the country. Next in importance probably are the Khmers or Cambodians; the Chams of the southern part of Annam; the Thais, including the Laotians; and some tribes classed as Moi or Khas by the other peoples of French Indo-China.

Physically, French Indo-China is featured by two great tracts: the delta of the Red River and that of the Mekong River. The first forms the state of Tonkin and the second, the state of Cochin China and part of Cambodia. Between them is the Cordillera of Annam, to the west of which is the mountainous section of Laos. The northern part of French Indo-China consists chiefly of plateaux and sandstone hills, the origin of the Cordillera of Annam. As a matter of fact, the only real plain country in French Indo-China is that of the delta of Tonkin and the delta of Cochin China. Plateau areas are found in several sections, but the great Cordillera of Annam, which is situated roughly parallel to the coast from the Gulf of Tonkin to Cochin China, is perhaps the dominating physical feature.

The hydrographic features of French Indo-China have contributed to the relatively good system of communications that was developed in the country. The Mekong River, 2,600 miles long, runs through the plateau areas of Laos to the South China Sea, and the Red River, arising from the mountains of Yünnan province in China, receives the Black River and the Clear River. These rivers are navigable for variable distances, but steps had been taken to improve the waterways so that a certain degree of shipping by steam vessels could be achieved. How far this improvement has progressed is not known. Most rivers in French Indo-China are swollen in the summer and comparatively low in the winter because of the effect of the monsoons. The coast line itself is muddy in the vicinity of the deltas, but is sandy along the coastal plains and even faced with rocky declivities where the mountainous districts approach the sea. In general, the coast is not readily accessible to large ocean-going vessels.

The climate of French Indo-China is not

wholly tropical. There are a wet season and a dry season, but variations in altitude, latitude and other factors combine to produce a diversity of climatic features. In Cochin China and Cambodia, for instance, the seasons are regular, corresponding to the periods of the monsoons. In Laos, situated at a higher altitude in the interior of the country, the climate is somewhat dry and cool. In most parts of the country it is hottest in April and May, at which time the temperature ranges between 86 and 93° F. (30 and 33.9° C.). From about October to April in Cochin China and Cambodia the northeastern monsoon blows steadily, and during this period the temperature varies between 78 and 81° F. (25.5 and 27.2° C.) during the daytime and recedes to about 68° F. (20° C.) at night. From April to October, however, the monsoon blows from the northwest, and it is during this period that the rains prevail. Temperature almost throughout the period is about 84° F. (28.8° C.), day and night. In Annam the climate is not so regular: rain prevails in September, but northeastern gales reduce the temperature to as low as 59° F. (15° C.). In this province the months of June, July and August constitute the dry season, during which the temperature ranges between 86 and 95° F. (30 and 35° C.), although the nights are relatively cool. In Tonkin a winter season extends from October to May. Fog and rains keep the temperature at about 75° F. (23.8° C.), although it has declined to 50° F. (10° C.) in the delta and to 43° F. (6.1° C.) in the highlands. In the summer in Tonkin the wind is from the southeast and prevails from that direction until October.

PUBLIC HEALTH

Health Services *

Organization. Until 1914 public health activities in French Indo-China had been carried on under the supervision of naval and colonial physicians associated with or subject to the military authorities. Since that year this type of work had been directed by the Inspector General of Hygiene and Public Health, who was appointed by the French Ministry of Colonies. Various services for the development of preventive medicine and care of the sick, both European and native, were conducted under the direct supervision of the aforementioned Inspector General. The five states—Tonkin, Annam, Laos, Cambodia and Cochin China, plus the territory of Kwangchowan, which was leased from China—each had a local director of health who worked under the direction of the Inspector General.

The Office of the Inspector General of Hygiene and Public Health was responsible for the enforcement of the public health laws, for supervision of maritime and domestic quarantines, and for the overseeing of government hospitals, Pasteur institutes, the school of medicine at Hanoï, and the pharmacologic agencies. This office also exercised control over the medical facilities which all industries in French Indo-China, including the plantations, had to provide for their workers. The Inspector General also had certain other duties which concerned military affairs.

The Office of the Inspector General of Hygiene and Public Health was divided into four chief agencies or divisions. The administration division carried out such activities as the keeping of records, management of financial accounts and supervision of property belonging to the Inspector General's office. The preventive medicine division conducted special epidemiologic campaigns, programs for vaccination, educational and publicity activities, work in general sanitation and all general preventive procedures in conjunction with the Pasteur institutes and the division of medical and social assistance. The latter division was concerned with the inspection of public

* Unless otherwise indicated, governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

works, public houses, clinics and other special medical services. A fourth division was charged particularly with the control of drugs and traffic in drugs.

Actual administration of the health program was entrusted to the officers in the *chefs-lieux,* which corresponded to American county seats. They were the capitals of the provinces. All statistics were gathered at the *chefs-lieux* by these officers, who in turn reported them to the local director of the particular province or state concerned. The port facilities were supervised by the port medical officers.

Relative Effectiveness. Because the facilities for transportation and communication in French Indo-China are excellent as compared with those in Asia as a whole, problems of health were solved somewhat more easily than would be possible elsewhere. Each of the five states which compose French Indo-China had special health problems. The difficulties involved in the conduct of an effective program of public health were greater in the state of Laos, for instance, than in other states, because in Laos the people are more primitive, means for the dissemination of information are fewer, and the population is relatively sparse. Yet the willingness of the people of French Indo-China to accept the benefits of Occidental medicine, even though they might be opposed to Occidental political and economic policies, assisted in the development of the public health program in that country. As in most lands in Asia, in French Indo-China there was no separation of the public health program *per se* and medical aid to the individual person. The native mind cannot, of course, distinguish between curative medicine and preventive medicine, and views with suspicion anyone who attempts to administer a medical program purely preventive in nature. On the other hand, the physician who administers medical care to the individual native patient is trusted, and is permitted by the natives to carry out preventive medicine as well as curative medicine. In French Indo-China trained personnel and funds were not available to permit the co-existence of one system of preventive medicine and another of curative medicine; hence, both were of necessity combined. The fact that Pasteur institutes were situated in four states was a great stimulus to the public health program in French Indo-China.

On the whole, the medical services that were offered in French Indo-China were superior to those in Thailand and Burma and compared favorably to those of the Netherlands East Indies. The medical school at Hanoï was said by some to be one of the best in the Orient. Diagnostic procedures offered in the several laboratories assisted in increasing the efficiency of the medical work. Machinery for dealing with serious epidemics was present, and proved to be effective when the need for it arose.

Water Supplies

As in many tropical countries, water in French Indo-China is generally not safe to drink until after it has been boiled. In the provincial capitals and in the larger cities attempts were made to supply potable water, which was tested by laboratories controlled by the Pasteur institutes. Water was obtained from near-by streams, rivers, canals, shallow wells, and, in a few instances, from deep wells. Bottled water imported from France usually was available in the larger cities and constituted a safe supply. It was believed that even the water which was treated was unsafe because it was known that some of the pipe lines were laid faultily. Again, treatment systems at times have failed without warning to those using the water. The government had, however, made a considerable effort to provide good water for the people.

Sewage Disposal

In general, disposal of sewage in French Indo-China was not satisfactory. In cities and hotels or other accommodations for tourists flush toilets were employed, but with few exceptions no attention was given to the disposal of sewage. Night soil was used regularly and extensively as fertilizer in the delta region of French Indo-China. Women carrying little bamboo baskets went about at night collecting excreta from ditches and elsewhere. This night soil was then sold to the farmers. Attempts had been made to institute the use of simple pit latrines, but even had such attempts continued unhampered, it would have required years for the practice to be accepted by all the inhabitants.

Insects and Animals

Vectors of Disease. Mosquitoes. More than 50 different species of mosquitoes have been found in French Indo-China; it is likely that more exist. Malaria is one of the most important problems of disease in the country, but the vectors of it vary in importance in different parts of the land. Twenty-three species of anopheline mosquitoes have been found, of which 13 are vectors of malaria. These are: *Anopheles culicifacies, A. fuliginosus, A. hyrcanus, A. maculatus, A. stephensi, A. subpictus, A. vagus, A. minimus, A. jeyporiensis, A. tessellatus, A. leucosphyrus, A. aconitus* and *A. barbirostris.*

Two species of Aedes mosquitoes in French Indo-China may be vectors of dengue fever. They are *Aedes aegypti* and *A. albopictus.*

Culex mosquitoes are found in most parts of French Indo-China. Among those identified thus far are *Culex bitaeniorhynchus, C. vishnui, C. fatigans, C. malayi,* and *C. sitiens.* There are other culicine types.

Lice. The three species of lice commonly associated with human beings are found in French Indo-China; that is, *Phthirus pubis, Pediculus capitis* and *P. corporis.* The latter type of louse carries relapsing fever and epidemic typhus fever in several sections of Annam, Cochin China and Tonkin. Other lice, parasitic on animals, occur in French Indo-China, but have no relationship to the spread of disease to man. *Polyplax spinulosa,* for instance, is a rat louse which transmits murine typhus fever from rat to rat, but does not bite human beings.

Flies. The housefly, *Musca domestica,* is prevalent throughout French Indo-China, and probably is one of the principal factors in the spread of intestinal diseases, and especially the bacillary types. During the rainy season the enormous number of flies makes it almost impossible to prevent contamination of foods. In the smaller cities, towns and villages the insanitary methods of disposal of sewage and the virtual omnipresence of flies constitute a combination which readily explains the high incidence of dysentery.

Horse flies and deer flies, members of the family Tabanidae, are found throughout French Indo-China. They are not known to transmit any disease to human beings in French Indo-China, but deer flies elsewhere have transmitted tularemia to man, and certain species of Tabanus have transmitted anthrax to man. From May to October in French Indo-China these flies are a terrible affliction to persons in the jungle areas. The bites they inflict swell and cause much itching; at times a traveler may even be disabled for a short period after he has been attacked by such flies. The horse fly is known to spread *Trypanosoma evansi,* which causes the disease of horses called surra.

Sand flies, members of the genus Phlebotomus, have been studied in the northern part of French Indo-China (from 15 to 25° of north latitude), and these species have been identified: *Phlebotomus stantoni, P. argentipes, P. bailyi* var. *campester, P. barraudi, P. sylvestris, P. tonkinensis, P. hivernus, P. sylvaticus, P. minutus* and *P. iyengari.* In India *P. argentipes* is a carrier of kala-azar.

Ticks. Tick-borne disease of human beings has not been reported from French Indo-China, although it is possible and even probable that such diseases do exist there. Ticks parasitic on animals are described in reports of veterinary workers, but the scientific names have not been given.

Fleas. *Xenopsylla cheopis,* a rat flea, is the chief vector of plague in French Indo-China. It occurs in most parts of the country, but seems to be infected only in the larger centers. *X. astia,* potentially a carrier of plague, is not an efficient vector of the disease. *X. cheopis* also can carry endemic typhus fever, but the number of cases of this disease reported in French Indo-China is comparatively small. *Pulex irritans,* probably not a vector of disease, occurs in certain sections of the country.

Rats. The black rat, *Rattus rattus,* probably is the most common rat in French Indo-China. Another rat, a member of the genus Rhizomys, known as the "bamboo rat," occurs in hordes at periodic intervals. It is thought that when the bamboo flowers and dies (about each five to ten years), scarcity of this natural food of the rats results. Deprived of the vital roots of the bamboo, the rats sweep across the rice fields in great swarms, attacking the crops so voraciously as to cause comparative devastation. This is especially true in the mountainous and plateau sections of the northern part of the country. It is known that the brown rat, *Rattus norvegicus,* is found in Thailand; doubtless it occurs also in French Indo-China.

Others. Certain larvae of mites of the genus Trombicula serve as vectors of what is called mite typhus fever, which appears to be the same as tsutsugamushi disease in Japan. The mite involved invades the ears of several species of rodents, and the disease is acquired when a blood meal is taken. The disease persists in the mite from one generation to another, and human beings are attacked by mites of the second generation. Snails, members of the genera Planorbis or Segmentina, found along the banks of waterways, are intermediate hosts for cercariae of the intestinal fluke, *Fasciolopsis buski.* The miracidia hatch from the eggs of *F. buski,* and enter the snail, where the cercariae develop. The cercariae in turn become free-swimming, and encyst on water chestnuts, *Eleocharis tuberosa,* and reach the human duodenum after a victim has peeled the hull of the plant with his teeth.

Snakes and Other Dangerous Animals. Poisonous snakes of French Indo-China are similar to those of India, Burma and Thailand. They are the common krait, *Bungarus candidus;* banded krait, *Bungarus fasciatus;* and Russell's viper, *Vipera russellii,* which is from 4 to 5 feet (1.22 to 1.52 meters) long. Pit vipers of the family Crotalidae also occur. Three kinds of cobras are found: the Indian cobra, *Naja naja,* which is rarely more than 5 feet (1.52 meters) long; the black cobra, *Naja melanoleuca,* which has black, gleaming scales and may be 7 feet (2.1 meters) long; and the king cobra, *Naja hannah,* said to be one of the most intelligent of all snakes and therefore one of the most dangerous. The king cobra may be from 12 to 15 feet (3.7 to 4.6 meters) long, and its venom is extremely toxic. As a rule, a cobra will attack when it is attacked, when it is protecting its young, and during the mating season.

Tigers, leopards and bears are found in certain areas of French Indo-China. Under ordinary circumstances they avoid human beings. The wild boar, in particular, is very dangerous. Poisonous fish occur in the waters along the coast line from Tonkin to Cochin China.

Leeches, and particularly the terrestrial leech, *Haemadipsa zeylanica,* are found in French Indo-China. *H. zeylanica* clings to long grasses or weeds near wet places and attaches itself as a human being passes by. It can pierce the skin almost imperceptibly, and as it does so, releases an anticoagulant agent in its saliva. Profuse bleeding and intense itching can ensue, especially if more than one leech has attacked the victim; but the chief danger is that of infection at the site of the wound or wounds.

Dangerous Plants

Sack Tree. The sack tree or deadly upas tree (*Antiaris toxicaria*), known as *bohun upas* to the natives, attains a height of 100 feet (30 meters) and has leaves much like those of the elm. It has a poisonous, milk-like sap, somewhat like latex. This sap has been used for the poisoning of arrows.

Nettles. Various species of the genus Urtica are found in Tonkin, Annam and Cochin China. Natives call them *mang ong voi* or *ribon* or *nan tia to*. The plants attain a height of from 9 to 16 feet (2.7 to 5 meters), and have pointed, heart-shaped, toothed or serrated leaves, along the edges of which are the poisonous hairs. A painful eruption follows contact with these hairs.

Derris. The roots of a woody vine (*Derris elliptica*) occurring in French Indo-China are used to poison fish. Use of this poison is prohibited in certain areas.

Food and Dairy Products

Rice, manioc, soya beans, sweet potatoes, cucumbers, cabbage and fruit usually could be obtained in adequate quantities throughout French Indo-China, with the exception of the mountainous and plateau regions of the interior. Tea grew wild in the upper part of Laos and has been cultivated in the highlands of Annam and Tonkin. Coco and coffee were raised in Cambodia and Tonkin. Cinnamon bark (*Cinnamomum loureirii*) and cardamoms (*Elettaria cardamomum*) were gathered in Laos and Annam. Ground nuts, sesame (*Sesamum indicum*), sugar cane and pepper were produced in many regions. European fruits and vegetables have been introduced into Tonkin, where most of them, but not all, have flourished.

The rivers generally abound in fish. Two kinds of sole—called *pa-beuk* and *pa-leun*—which may attain a length of 6 feet (1.8 meters), are plentiful in the Mekong River. Some reptiles were utilized as food by the natives. The zebu bull, *Bos indicus*, was used extensively as a beast of burden; in some places the milk of the cows was consumed. Meat from the water buffalo, *Bubalus bubalus*, occasionally was eaten. As a rule, however, meat was not available in sufficient quantity; moreover, many cattle were infected with tuberculosis and tapeworms. Hogs were kept but were likely to have trichinosis. Dogs sometimes were eaten. In normal times meat was inspected by the health officer of the district in which the meat was prepared, and in the larger cities meat could not be sold to Occidentals unless it had been inspected and approved by a sanitary officer. In the rural districts inspection of meat was likely to be either less frequent or entirely absent. Facilities for refrigeration existed only in the larger cities. Beef, pork, ham, chickens, ducks, turkeys, rabbits, fish, lobster, shrimp and crabs were known to be available in the markets of Haiphong in 1943.

The supply of milk was limited. Herds were owned chiefly by East Indians, who rarely if ever carried out sanitary measures. Pasteurization was not required by either local or national regulations. The quality of the milk was poor. Most Occidentals used dried, evaporated or sweetened condensed milk. This milk was expensive, in terms of the income of a native laborer; one can cost the equivalent of two days' pay of such a worker.

Generally, the poorer natives of the agricultural class subsisted on rice taken with salt and preserves. More fortunate natives included fish in their diet. The abundance of vegetables should be considered in association with the fact that night soil was used extensively as fertilizer. Hence, such products, consumed without careful cleansing, were potentially dangerous.

MEDICAL FACILITIES

Hospitals

Number of Beds. It is believed that there were more than 15,000 hospital beds in French Indo-China. A capital of a province (into which the states are divided) usually had a fairly well-equipped hospital, and in the larger cities there were hospitals with considerable equipment. It was said that there were 10 hospitals in the area of Saigon, for instance, with a total of 6,500 beds, and in the state of Annam there were 20 hospitals with some 3,500 beds. But it is thought that these figures are not entirely accurate; they are presented herein only as estimates.

One asylum for the insane was situated in Cochin China and another was located in Tonkin. Four agricultural leper colonies were maintained in Annam, one in Cambodia, six in Tonkin and two in Laos. In Cochin China there was an asylum as well as an agricultural colony for lepers.

Railway hospitals were situated at strategic points along the railway, and timber companies and rubber and tea plantations also maintained hospitals.

Equipment. In the larger centers the equipment of hospitals was modern; in the smaller hospitals, equipment naturally was limited. It was said that if a patient could not be treated adequately at a smaller hospital, he or she was transported to a larger one. No hospital or surgical equipment was manufactured in French Indo-China.

Supplies. The distribution of medical supplies in French Indo-China was controlled by the Inspector General of Hygiene and Public Health. Supplies as a rule were brought from France and then distributed to the pharmacies in the larger centers of the provinces. The quality and quantity of such supplies, it was believed, in this way were carefully supervised. Small quantities of quinine are known to have been produced in French Indo-China under the direction of the government.

Medical Personnel

Physicians. In 1937 the total number of European physicians in French Indo-China was 157. There were 245 Indo-Chinese physicians.

Dentists. There were 100 dentists in French Indo-China in 1937. Such dentists as had settled there were of French or Japanese extraction, but a few were Indo-Chinese. Most of them apparently were well trained. The practice by which a native becomes a dentist's assistant for a few months and then engages in practice as a dentist was not permitted in French Indo-China, although it was common in Thailand and Burma.

Nurses. In French Indo-China nursing was carried on by male nurses, perhaps more so than in any other country in the Orient. An *infirmier,* if he was not in charge of a dispensary, generally was a male nurse in a hospital. There were 1,732 *infirmiers* or compounders in French Indo-China in 1937. There were also a few female nurses, but the exact number is not known.

Others. In 1937 there were 1,185 midwives and 893 medical personnel of unspecified types in French Indo-China. A midwife was known either by the French term, *sage-femme,* or by the native designation, *ba-mu.* In some cases a midwife served as a female nurse in a hospital. Midwives received various degrees of training, ranging from empiricism alone to first-rate obstetrical instruction. Such veterinarians as were present were attached to the various Pasteur institutes. Compounders of drugs are the *infirmiers* previously mentioned; they may also serve as vaccinators, and in times of need have been known to serve as physicians in the rural areas. In certain states a few laborers or ward servants are detailed to hospitals to serve in various capacities.

Medical Institutions

The medical college at Hanoï was established in 1920 by the government. The growth of this college has been slow but steady, and its students were admitted to the best medical colleges in France. The school had sections devoted to medicine, surgery, stomatology, veterinary medicine, pharmacy and anthropology. The school was affiliated with three hospitals, the Protectorate Hospital, the Réné-Robin Hospital and the hospital of the Ophthalmologic Institute.

There were four Pasteur institutes, two of which were devoted to the treatment of human diseases. One of the latter was situated at Saigon; the other at Hanoï. At the institute in Nhatrang in the state of Annam vaccines and drugs for the treatment of animals were manufactured, and at this one institute research was conducted on diseases of animals. At Dalat the Pasteur institute was engaged in the manufacture of serums or vaccines for typhoid fever, plague and cholera. These four institutes also supervised laboratories situated in various parts of the country. The institutes and the laboratories they controlled provided several types of diagnostic services, such as examination of stools for evidences of intestinal parasites; serologic examinations or tests for typhoid fever, typhus fever and syphilis; examination of the blood for evidences of malaria and filariasis; and examination of cerebrospinal fluid, bile and gastric juice. Specimens of water, wine and milk were examined or tested on request, and food products were inspected or tested to detect fraudulence in preparation. Studies of arboreal physiology and pathology were carried on in respect to such trees as the rubber tree (*Hevea brasiliensis* and *Ficus elastica*), the tea shrub (*Thea sinensis*), the coffee shrub (various species of Coffea), the kola tree (*Cola acuminata* and *C. vera*), cinnamon tree (*Cinnamomum zeylanicum*), the kapok tree (*Ceiba pentandra* or *Eriodendron anfractuosum*), and cinchona (*Cinchona ledgeriana* and *C. succirubra*). At the Indo-Chinese Institute of Radium at Hanoï, which had branches in other cities, facilities were available for the diagnosis and treatment of diseases requiring the use of radium or roentgen rays.

Social Services. It was said that there were more than 100 institutions such as orphanages, and homes for incurable patients, the aged and blind, in French Indo-China. Red Cross organizations were situated in various sectors. A child welfare and maternity center was in operation in Vientiane, the capital of Laos, and an antituberculosis league had been organized in Tonkin.

DISEASES

Diseases Spread through Intestinal Tract

The Dysenteries. In 1936 in the hospitals of French Indo-China there were 5,010 cases of amebic dysentery and 135 deaths; in the same year there were 991 cases of bacillary dysentery and 162 deaths. There were 947 cases of typhoid fever and 186 deaths, and eight cases of cholera with eight deaths. These figures refer only to patients treated in hospitals.

It would appear, then, that amebic dysentery is more important than bacillary dysentery; but actually it is likely that the reverse is true, for two reasons. First, the condition of the patient with amebic dysentery is likely to be chronic, so that as a result of exhaustion he usually is hospitalized much more often than is the patient with bacillary dysentery. Second, there is a question as to the accuracy of diagnosis in all cases of dysentery in French Indo-China.

The 991 cases of bacillary dysentery referred to *supra* are, of course, far less than the total number in French Indo-China in a year. Flies, which are very prevalent from the end of March through November in the south, and from the end of March until October in the north, spread much of the infection. During the rainy season epidemics of dysentery break out in many villages.

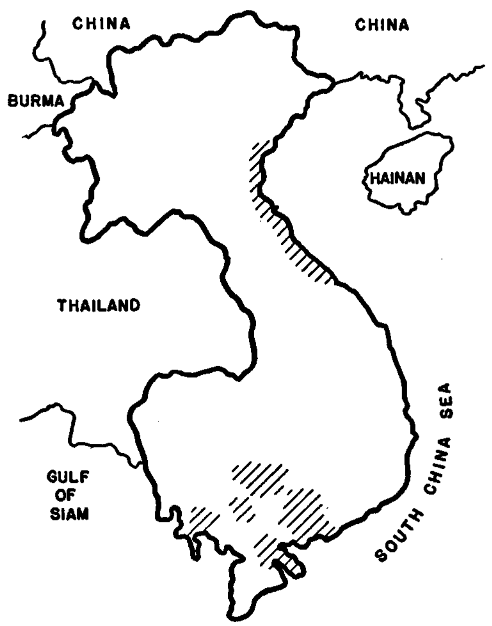
Cholera has occurred both sporadically and in epidemics in French Indo-China (Table 6). It was said that inoculation was carried out for 1,400,000 persons along the Mekong River in 1936. As a rule, outbreaks of cholera occurred in March or April and persisted throughout the rainy season. When this occurred, trained workers from the nearest Pasteur institute were sent to the focus or foci with anticholera vaccine, and all roads leading from the area

TABLE 6

French Indo-China: Reported Cases of Certain Diseases, 1935-1938

	Year			
Disease	1935	1936	1937	1938
Cholera......	124	74	11,858	8,507
Plague.......	19	47	19	4
Smallpox.....	3,655	1,872	3,053	7,043
Tropical typhus fever..	2	12	52	4
Typhoid fever.	923	910	1,279	1,136
Relapsing fever........	6	133	5	1
Measles......	3,870	2,457	3,321	1,310
Scarlet fever..	2	59	9	4
Diphtheria....	147	150	123	176
Dysentery....	17,759	19,227	15,355	14,475
Acute poliomyelitis....	248	87	12	5
Cerebrospinal meningitis..	20	40	40	30

or areas were blocked and guarded. No person was permitted to leave unless he or she had been inoculated, and all persons were urged to undergo inoculation. Education of



Cholera in French Indo-China

the public by means of posters, lectures and official orders was attempted. It was said that in such a manner outbreaks could be checked in a comparatively short time. The most recent severe epidemic of cholera in French Indo-China was in 1926. In that year 4,000 persons died of cholera in the state of Annam, 30,000 died in Tonkin and 885 died in Laos.

Typhoid Fever. In Table 6 the number of cases of typhoid fever in relation to the number of cases of dysentery is shown. Typhoid fever was said to be frequent among the natives, although it was a problem of declining importance among other persons. Antityphoid vaccine was produced at the Pasteur institutes. In Tonkin typhoid fever appeared more often from April to October than at other times; deaths were most numerous in July. In Saigon and Cholon the seasonal incidence closely approximated that of dysentery; that is, it was most prevalent during the rainy season, July to the end of October.

Intestinal Parasitism. Infection with intestinal helminths is frequent in French Indo-China, and it was said that some natives were infected with as many as two or three types of parasites. In a study of 1,250 persons the incidence of *Trichuris trichiura* was 77 per cent; that of Ascaris, species not divulged, was 71 per cent; that of Ancylostoma, species not divulged, was 50 per cent; and that of Taenia, species not divulged, was 2.5 per cent. *Taenia saginata,* or the beef tapeworm, is the species of Taenia usually found, but *T. solium,* or the pork tapeworm, is known to be present. *Enterobius vermicularis* was said to be rare, a surprising circumstance, in view of the ease with which this nematode is spread.

INFECTION WITH *Clonorchis sinensis.* This fluke, known as the Chinese or Asiatic liver fluke, is contracted by the eating, raw, of certain fresh-water fish. This infection is common on the eastern coast of French Indo-China, where it was said that about half the natives were victims. Native persons in the region of the delta of the Red River also were said to be infected. In a survey of 1,250 persons in French Indo-

China the incidence of *Clonorchis sinensis* was found to be 27 per cent.

Infection with *Fasciolopsis buski*. Infection with the trematode intestinal fluke, *Fasciolopsis buski*, has been reported from Cochin China, and it probably occurs in Tonkin as well. It would not appear that this type of infection occurs in the inland sections of French Indo-China.

Melioidosis. A glanders-like disease of rodents, known as "melioidosis," and caused by *Malleomyces pseudomallei* (known as *Bacillus whitmori* by some), has been reported chiefly from Cochin China. The rat constitutes the reservoir of infection. The disease can be transmitted to man, in which case the clinical manifestations of the disease may resemble those of plague, cholera, malaria or typhoid fever. Patients with melioidosis usually die within 10 days. Diagnosis is made by bacteriologic examination. Prevention is said to be maintained by the exercise of especial care in the storage of food that is likely to be contaminated by the feces or urine of rats.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Pneumonia is most frequent in French Indo-China in the cold season, as it is in other countries. It is thought that the types of pneumococci encountered there are the same as those in other countries. It appears, however, that the pneumonia which occurs in French Indo-China has a shorter course in the acute phase than pneumonia ordinarily has elsewhere. In 1936, patients suffering from pneumonia admitted to hospitals in French Indo-China numbered 2,508. Of these, 972 died.

Tuberculosis. Tuberculosis is an important disease, so far as the native Indo-Chinese are concerned. At Haiphong in 1937, the mortality rate per 100,000 of population for pulmonary tuberculosis was 233; for other types of tuberculosis that year the rate was 30. At Hanoï in the same year the rate for pulmonary tuberculosis was 178.7; for other types of tuberculosis at Hanoï in the same year the rate was 2.2. At Saigon in 1937 the rate for pulmonary tuberculosis was 285.1; the rate for other forms of the disease was 10.4.

It was said that vaccination with BCG vaccine was employed extensively; that 45,000 persons were treated in 1935, and that 56,000 persons were treated in 1936. Considerable work was being carried out, it was said, in the control of bovine tuberculosis by the various Pasteur institutes. In 1936, of 18,302 cattle tested for evidence of tuberculosis in Cambodia, 47 animals were found to have the disease.

Diphtheria. Diphtheria never became a serious problem in French Indo-China (Table 6). It was said to occur chiefly in Tonkin and Cochin China. It seems likely that in many cases the disease was mild, and for that reason was not reported or perhaps was not recognized. Immunization was practiced. The disease was said to be more common among Europeans living in the country than among native Indo-Chinese.

Scarlet Fever. Scarlet fever occurred in French Indo-China, but appeared to be mild (Table 6).

Measles. Measles, mumps, whooping cough and chickenpox are present throughout French Indo-China (Table 6). It was said that these diseases occurred in epidemic form every few years.

Smallpox. In 1943, from January to the end of February, 718 cases of smallpox were reported from Cochin China and 405 cases were reported from Tonkin. In the previous year 3,729 cases of the disease were recorded, presumably from French Indo-China as a whole.

Cerebrospinal Meningitis. Epidemic meningitis and acute poliomyelitis appeared every year among patients in the hospitals of French Indo-China. They were encountered most often in Tonkin, but were frequent in Cochin China. In 1935 there were 248 cases of acute poliomyelitis. Forty cases were reported in 1936; 40 cases were reported in 1937; and 30 cases were reported in 1938 (Table 6).

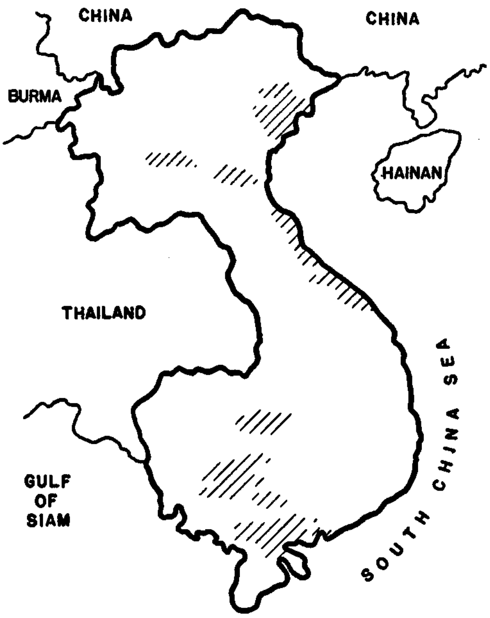
Psittacosis. Psittacosis has not been reported from French Indo-China, but results of epidemiologic studies indicated, some years ago, that the condition might be found among the wild parrots, pigeons and parakeets.

Diseases Spread Chiefly by Contact

Venereal Diseases. Syphilis, gonorrhea and chancroid all are present in French Indo-China, and are a constant menace. Lymphogranuloma venereum or climatic bubo and granuloma inguinale likewise occur, but much less frequently than the aforementioned three diseases. In 1936, in the hospitals of French Indo-China, there were 11,031 patients with syphilis, 8,928 patients with gonorrhea, and 3,167 patients with chancroid. The rate for syphilis, per 1,000 of all illnesses encountered in hospitals, in that year was 32; for gonorrhea, 26; for chancroid, 9. The rate for the three diseases combined, calculated on the same basis, was 67; the mortality rate, similarly calculated, was 15. It should be pointed out, again, that these figures pertain only to those patients encountered in hospitals.

Yaws. In 1935, 1,246 patients with yaws were admitted to hospitals in French Indo-China. This meant, roughly, that four out of each 1,000 persons admitted to the hospital for any cause had yaws. In 1937, in all French Indo-China, 97,442 cases of yaws were recorded. As a rule, patients who have yaws do not report to the hospital, but are usually treated by local physicians.

Diseases of the Skin. Tropical ulcer, or phagedenic ulcer, occurs throughout French Indo-China. In 1936, cases of this condition reported by the government amounted to 4,373. There were 41 deaths. Scabies is found in all states of the country, most commonly among members of the hill tribes, who are said to find bathing and washing of clothes difficult because of the scarcity of water. It is known that fungous infections of the skin occur throughout the Orient, and French Indo-China is not spared. Infections caused by fungi of the genera Trichophyton and Epidermophyton are encountered, as is also piedra, an infection of the shafts of hair caused by *Trichosporon giganteum.* Rhinosporidiosis, characterized by polypoid lesions in the nose, ears and lacrymal ducts, is caused by



Yaws in French Indo-China

Rhinosporidium seeberi. This affliction seems to be particularly prevalent in Cochin China. Madura foot, caused by *Actinomyces madurae,* occurs in Cochin China.

Leprosy. French Indo-China has large numbers of lepers; in 1938 it was said that there were over 4,000 known lepers. As set forth previously herein, there were 14 asylums or colonies devoted to the treatment of leprosy in the country; and it was estimated that there were 15,000 lepers in the country as a whole, but some observers believe this figure represents only a half or a third of the actual number. It is very difficult to ascertain the true number of lepers in French Indo-China because in certain sections a leprous person was permitted to receive treatment at home and in a dispensary for two years before he or she was sent to an asylum or a leper colony.

Trachoma. Trachoma is very common among the natives. French physicians in French Indo-China were said to have treated trachoma by surgical procedures on the eyelids. In 1935, 6,942 patients were treated for the disease. Since patients who have trachoma usually seek medical care only when the condition becomes severe, and since the disease itself is rarely cured by surgical intervention, it can be assumed that the disease is extremely prevalent in French Indo-China. It was said that some 5,000,000 persons in the country have trachoma in some form or other. It was also said that in Pnom-Penh in Cambodia 43 per cent of the school children had the disease.

Tetanus. Tetanus was rather common. In 1934 there were 291 cases of this disease, and 172 deaths from it.

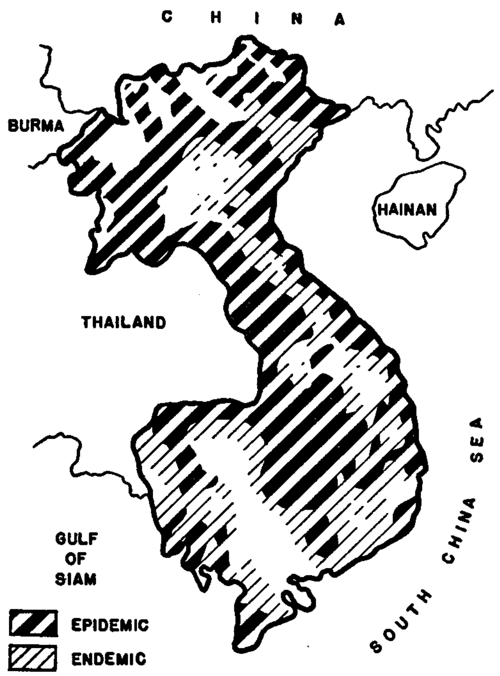
Rabies. From 1891 to 1929 in Saigon 9,000 people received antirabic treatment. From 1920 to 1929 in all French Indo-China 15,000 persons were given antirabic treatment. It was said that 8,777 doses of antirabic vaccine were prepared in 1936 in the several Pasteur institutes in the country, and it was recorded that in the same year 833 persons received prophylactic treatment. Thirty-five of them died.

Anthrax. Anthrax has been reported from all parts of French Indo-China. Apparently, it was most prevalent in the southern part of Annam, where it caused from 40 to 96 deaths a year.

Sparganosis. Sparganosis is an infection of the muscles and tissues of the body by *Sparganum mansoni*, the larva of a tapeworm often found in dogs, cats, wolves, leopards and tigers. The intermediate hosts are frogs, snakes and species of Cyclops. Infection with the larval parasite may take place by the drinking of water contaminated with infected species of Cyclops, but usually arises from the native custom of applying a split live frog as a poultice to sores on the hands, eyes or female genitalia. In such a case, assuming that the frogs are infected, the parasites migrate from the tissues of the frog into those of the native. Much disease of the eyes is caused in this manner in the delta region of Tonkin. The parasites settle in the eyelids or in the orbital fat (not in the globus) or in the region of the temples, root of the nose or the cheek.

Diseases Spread by Arthropods

Malaria. Malaria is responsible for most of the recorded illness in French Indo-China, and with the exception of minor



Malaria in French Indo-China

conditions, doubtless causes most of the unrecorded illness. About a fifth of all patients who entered hospitals in French Indo-China in 1937 had malaria. The incidence of the disease among hospitalized patients in Tonkin in that year was 15.7 per cent; in Laos it was 28 per cent. It is said that every native Indo-Chinese who has attained the age of twenty-five years has had malaria one or more times, a statement which of course would not apply to those who live in high altitudes or in large cities in which malaria is not present. The greatest incidence of malaria was reached, not in the low regions, but on the plateaux or in the foothills of the mountains. The incidence of malaria was comparatively low in the delta region of the Red River in the vicinity of Hanoï and Haiphong and in the delta region of the Mekong River near Saigon in Cochin China. *Anopheles hyrcanus sinensis* was the mosquito found most often in the delta region of Tonkin, but it should be recalled that a mosquito which is a vector in one section may not be a vector in another. *A. tessellatus,* for instance, was found to be of no importance in one area, but in another it was the second most important vector encountered. *Anopheles hyrcanus sinensis,* because of its willingness to feed on the blood of animals, usually is not a dangerous vector, but in two epidemics at Hanoï it was found to be the mosquito most responsible for infection.

In one area of the province of Haiduong an epidemic of 1,055 cases of malaria occurred during May, June and July; the incidence of the three kinds of plasmodia discovered was: *Plasmodium vivax,* 61 per cent; *P. falciparum,* 28 per cent; and *P. malariae,* 10 per cent. In November, for the same area, the incidence was: *P. vivax,* 76 per cent; *P. falciparum,* 16 per cent; and *P. malariae,* 7 per cent.

In a second area, studied from October through March, 1,003 cases of malaria were recorded. In this area the incidence was: *P. vivax,* 46 per cent; *P. falciparum,* 47 per cent; and *P. malariae,* 7 per cent. Examination of mosquitoes showed the following percentages of various species to be infected: *Anopheles hyrcanus sinensis,* 3.9; *A. tessellatus,* 2; and *A. hyrcanus nigerrimus,* 1.4.

A. minimus and *A. jeyporiensis* are important vectors of malaria in the northern part of French Indo-China because they prefer the blood of man to that of animals. In the valley of the Mekong River in the upper part of Laos *A. maculatus* and *A. culicifacies* are important vectors. In the foothills of Tonkin the chief vector is *A. minimus.* In the southern part of French Indo-China the most important vectors are *A. vagus, A. hyrcanus sinensis, A. tessellatus* and *A. barbirostris.* The latter three mosquitoes will feed on the blood of pigs, dogs and buffaloes, in addition to that of man; hence, they are not so dangerous as *A. minimus, A. maculatus* and *A. jeyporiensis,* which prefer human blood.

Blackwater Fever. This disease is rather severe in the upper portions of Laos and is encountered from time to time in other sections. It does not occur often in the delta region of the Red River, but is found at times along the upper reaches of the Clear and Black rivers. In general, blackwater fever may arise wherever malaria is found, but in some regions in French Indo-China blackwater fever is extremely frequent in occurrence.

Measures of Control. Preventive measures were carried out by two groups: one worked in the north from the Pasteur institute at Hanoï; the other worked in the south from the Pasteur institute at Saigon. Many epidemiologic examinations were made, and entomologic investigations and inspection tours were carried out. Antilarval measures, such as draining and oiling of waters, and spraying with Paris green, were done by these groups.

Dengue Fever. Dengue fever is encountered throughout French Indo-China. It was first recorded in 1870 at Haiphong; it then appeared at Hanoï and Saigon. The fact that *Aedes aegypti* is ubiquitous in French Indo-China means that the possibility of spread of the disease should be borne in mind.

Filariasis. Filariasis is caused by *Wuchereria bancrofti* and *W. malayi.* Certain types of mosquitoes, such as *Culex fatigans, Anopheles hyrcanus* and various species of Aedes, have been shown to be vectors. Forty per cent of the people in the region of the Tonkin delta were said to be infected with *Wuchereria bancrofti,* although the valleys of the Red and Black rivers are free from the disease. Filariasis is found in Annam and Cochin China. *Wuchereria bancrofti* predominates in the delta area of Tonkin.

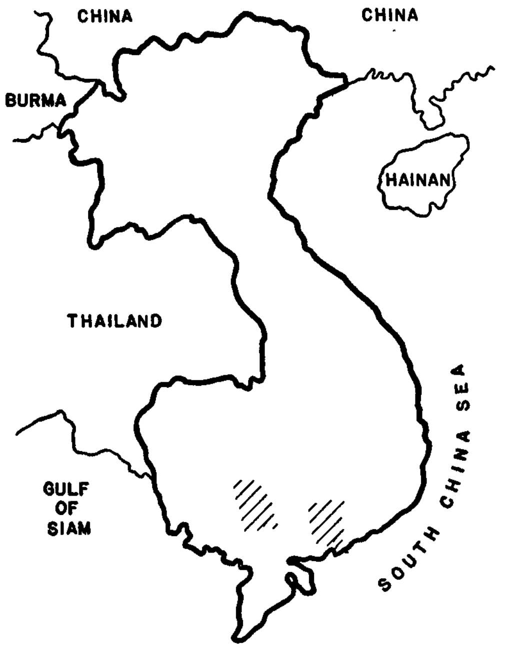
Yellow Fever. Yellow fever has never been reported from French Indo-China. The vector of yellow fever, *Aedes aegypti*, is present throughout the country.

Typhus Fever. All three types of typhus fever are found in French Indo-China. Epidemic typhus fever was said to be limited to outbreaks in prisons. It was reported in Cochin China in 1938. Scrub or mite typhus fever was most often encountered in the outlying districts. Undoubtedly, much typhus fever occurs throughout the country, but is not diagnosed. Unfortunately, so far as this report is concerned, typhus fever was not classified when it was reported by the government. Only six cases of typhus fever were reported in 1936, and only 11 were reported in 1942. Both figures obviously must be far less than the actual numbers.

Relapsing Fever. Relapsing fever, caused by spirochetes of the genus Borrelia (formerly, the genus Spirochaeta), was reported from French Indo-China (Table 6). The louse, *Pediculus corporis*, was suspected to be the most common vector. The louse does not transmit the disease by biting: infection results only when the louse is crushed on the victim's skin, in which case the organisms enter through a scratch or abrasion. Louse-borne relapsing fever is encountered more often during cold weather. It rarely seems to afflict small children. The tick-borne type of relapsing fever has not been reported from French Indo-China, and probably does not occur, as ticks which are vectors of the disease have not been identified in this part of Asia.

Relapsing fever was first reported from Annam in French Indo-China in 1906. In 1907 it was recorded in Tonkin. From 1906 until 1915 cases ranged from 1,200 in one year to less than 100 in another year, in Annam. After 1915 no cases were reported from Annam. At Tonkin the range was 800 in one year to less than 100 in another year, until the year 1918, in which the disease seemed to disappear for a time. In 1935 six cases were reported; 133 cases were reported in 1936; and in 1937 five cases were reported.

Plague. There are three centers in this general area from which plague may



Plague in French Indo-China

spread under suitable conditions: Cholon in Cochin China, Pnom-Penh in Cambodia and the territory of Kwangchowan. Yet it should be said that the regions just mentioned actually had very few instances of plague. Only 47 cases of plague were reported in 1936; in 1937 there were 19 (Table 6); in 1942 there were 81. It should not be assumed that these figures represent the total number of cases, however; many doubtless were not recorded. The pneumonic or septicemic type of plague has occurred only rarely. The black rat, *Rattus rattus*, is the chief reservoir of the disease, and the Oriental rat flea, *Xenopsylla cheopis*, is the vector of the disease. *Rattus* *norvegicus* is important as a reservoir of plague in Thailand, and may be a factor in the spread of the disease along the valley of the Mekong River in French Indo-China. It has been said that antiplague vaccine was developed in French Indo-China by French physicians, and that it was successful. In 1936, 31,000 persons were inoculated with this vaccine.

Kala-azar. Kala-azar or visceral leishmaniasis was rare in French Indo-China. When it did occur, the victims generally were found to be foreigners.

Cutaneous Leishmaniasis. Cutaneous leishmaniasis was recorded as attacking dogs in French Indo-China. Some have suggested that this infection may have a relationship to the ulcers of human beings so prevalent in French Indo-China. The disease is spread by sand flies, members of the genus Phlebotomus.

Nutritional Diseases

Goiter. Goiter occurred among the natives, and particularly in the mountainous areas, where the content of iodine in the soil and water is low. In such areas, it was said, from 20 to 80 per cent of the natives have goiter.

Beriberi or *bouffissure d'Annam*. Beriberi is very common in French Indo-China; it appears to have been most common in Cochin China, where the incidence was 800 per 100,000 population. The condition appears most frequently among those persons 20 to 45 years old. Some of the local French physicians adhered to the belief that the disease was of bacillary origin, ascribing it to what they called *B. asterogenes*, an organism not recognized in American bacteriologic classifications! In the five states of Cochin China, Tonkin, Cambodia, Annam and Laos in 1929 there were 3,871 cases of beriberi and 540 deaths. In 1936, in the hospitals of French Indo-China, 6,471 patients with beriberi were admitted for treatment, and of these, 288 died.

Sprue. It has been said that the proportion of cases of sprue in French Indo-China is high.

Miscellaneous Conditions

Injuries Caused by Heat. Since French Indo-China is located in the tropics, almost any condition or injury that can be caused by excessive heat may be encountered there. The native Indo-Chinese, as might be expected, are afforded protection to the rays of the sun in the form of their pigmented skins, but light-skinned persons can be seriously affected. Some natives, however, are attacked at times by what they call "a touch of the sun," which seems to consist chiefly of intense headache. Heat prostration or sunstroke, however, is rarely seen among the natives, although it may affect Europeans.

Alcoholism. In French Indo-China alcohol was manufactured from rice, and three different strengths of alcohol were recognized by the government: 35 per cent, 40 per cent and 75 per cent. It was necessary to obtain a special permit before the last-named strength of alcohol could be purchased. Alcoholism, although not a serious problem, was said to be increasing in prevalence. The condition was encountered most often in Cochin China, where some 10,000 liters of alcohol were produced each year to meet the needs of about 4,000,000 people. European liquors, being imported, were relatively expensive, and for that reason were not much used by the natives.

Addiction to Opium. The smoking of opium was common throughout French Indo-China, particularly in Cambodia and Laos. The Annamese of the delta region smoked opium more than did the natives of the jungle districts. It was estimated that persons smoking opium included 50 to 70 per cent of the Chinese, 20 to 40 per cent of the Annamese, 40 per cent of the Muongs and 35 per cent of the Thos.

SUMMARY

Since 1914 work in public health in French Indo-China had been under the supervision of the Office of the Inspector General of Hygiene and Public Health. The Inspector General of Hygiene and Public Health was appointed by the Ministry of Colonies of the Republic of France. Prior to the year 1914 this work had been carried out by French military and naval physicians in the colony. Working under the direct supervision of the Inspector General were members of the services for the development of preventive medicine and care of the sick, both native and European. Each of the five states, Tonkin, Annam, Laos, Cambodia and Cochin China, plus the territory of Kwangchowan, leased from the Republic of China, had a local director who worked under the direction of the Inspector General. The Office of the Inspector General of Hygiene and Public Health was responsible for enforcement of the public health laws and regulations, supervision of maritime and domestic quarantine measures, the overseeing of government hospitals, Pasteur institutes, the government medical college at Hanoï, and the several pharmacologic agencies. This office also exercised control over the medical facilities which all industries, including the plantations, were required to provide for their workers. The office likewise was responsible for the medical and surgical work carried on among French troops in the colony, although this work actually was performed by physicians or surgeons who were attached to the French armed services.

The health department itself was divided into four chief divisions. Actual conduct of the activities of the health department was entrusted to the various officers in the *chefs-lieux* or capitals of the provinces. All statistics were gathered by these officers and reported to the local director of the state concerned. Medical facilities in ports were supervised by port medical officers. The relatively good system of communications, such as roads, waterways and railways, contributed to easier solution of the health problems in French Indo-China. These problems, as might be supposed, were more difficult in some states than in others. The natives, as a rule, were willing to accept the benefits of Occidental medical care, a fact which aided considerably in the development of the public health system. Since the native Indo-Chinese was not able to distinguish between curative medicine and preventive medicine, it was the policy of the government to initiate a system in which the same physician administered both preventive and curative medicine. Four Pasteur institutes were existing in the country at the time of the last report. It was believed that the medical services afforded by the governmental health program compared favorably with those of other countries or colonies in contiguous areas.

Water, in general, should be boiled before it is used. In some of the larger cities an attempt was made to provide potable water, but it was said that even treated water should, at times, be regarded with suspicion. The disposal of sewage was not satisfactory. An attempt had been made to introduce the pit latrine system among the natives; some degree of progress had been made in this respect, but it would have taken some years for the practice to become widespread.

Twenty-three types of anopheline mosquitoes have been identified in French Indo-China; 13 species are proved carriers of malaria. Culicine mosquitoes also are found there. The three types of lice commonly associated with human beings exist in the country, as do houseflies, deer flies and horse flies. Ticks are known to be present, but it is not believed that tick-borne diseases occurred. Fleas are ubiquitous. Snakes, tigers, leopards, bears, wild boars, land leeches, and poisonous fish still must be considered as potential dangers. Toxic plants are not uncommon.

Hospital facilities were fairly good. In the larger centers hospital equipment was modern; in smaller places it was not. Most supplies, including drugs, were brought from France. In 1937 there were only 157 European physicians in French Indo-China, but there were 245 native physicians. There were comparatively few dentists in the country, but those practicing there were well trained. The number of nurses was not known, but the number of male *infirmiers*, who sometimes served as male nurses, was considerable. Four Pasteur institutes were situated in French Indo-China, and there was a government medical college at Hanoï. At Dalat there was an institute at which various kinds of vaccine were manufactured.

The chief disease in French Indo-China was malaria; a fifth of all patients in hospitals in 1937 were admitted for treatment of this condition. Enteric diseases were frequent, and this was especially true of bacillary dysentery. Epidemics of cholera have occurred. Syphilis, gonorrhea and chancroid constituted a problem. Plague was endemic, at the time of the last report. Injuries caused by heat were not to be dismissed lightly; diseases of the skin, typhus fever, dengue fever, rabies, relapsing fever, filariasis, infection with flukes and with various helminths, all were noteworthy. Leprosy, beriberi, typhoid fever, trachoma, pneumonia, yaws, addiction to alcohol and to the use of opium, all were important so far as natives were concerned. Anthrax, tetanus, sparganosis, melioidosis, kala-azar, cerebrospinal meningitis, acute poliomyelitis, scarlet fever, diphtheria, goiter, sprue, and cutaneous leishmaniasis also occur.

BIBLIOGRAPHY

Bablet and Mesnard: Le typhus exanthématique au Tonkin. Tr. Far East. Ass. Trop. M., Calcutta, 7th Cong., **2**:548-550, 1928.

Bernard, N., and Bauche, J.: Conditions de propagation de la filariose souscutanée du chien. *Stegomyia fasciata*, hôte intermédiaire de *Dirofilaria repens*. Bull. Soc. path. exot., **6**: 89-99 (Jan.) 1913.

Bernard, P., and Lambert, A.: Contribution à l'étude béribéri. Arch. Inst. Pasteur d'Indochine, **2**:153 (Oct.) 1925.

——, ——: Le choléra en Indochine et en Extrême-Orient. Arch. Inst. Pasteur d'Indochine, **6**:3-75 (Apr.) 1935.

Borel, M.: Anophèles et paludisme dans la région de Chandoc (Cochin-Chine). Résultats d'une enquête faite du 16 au 21 janvier 1926. Bull. Soc. path. exot., **19**:806-811 (Nov.) 1926.

——: Enquête entomologique et épidémiologique à Can-Tho et Bac-Lien (Cochin-Chine). Bull. Soc. path. exot., **20**:974-976 (Dec.) 1927.

——: Note préliminaire sur les moustiques de Cochin-Chine et du Sud-Annam (Massif du Langloian). Bull. Soc. path. exot., **19**:472-479 (June) 1926.

——: Note sur les gîtes de *Neocellia maculata* en Cochin-Chine et dans le Sud-Annam. Bull. Soc. path. exot., **19**:703-704 (Oct.) 1926.

——: Paludisme en Cochin-Chine. Résultats de mesures prophylactiques à la plantation de Suzannah (11 au 13 août 1926). Bull. Soc. path. exot. **19**:811-815 (Nov.) 1926.

Borel, M.: Résultats d'une enquête épidémiologique et entomologique à la plantation de Gia Nhan (Cochin-Chine). Bull. Soc. path. exot., **19**:677-680 (Oct.) 1926.

——: Résultats d'une enquête épidémiologique à Yaback (Annam). Bull. Soc. path. exot., **19**: 845-852 (Nov.) 1926.

——: Résultats d'une enquête malariologique à Dalat (Cochin-Chine). Bull. Soc. path. exot., **20**:427-434 (May) 1927.

——, and Le Van-An: Le paludisme à Saigon. Bull. Soc. path. exot., **20**:99-1004 (Dec.) 1927.

Burkill, I. H.: A Dictionary of the Economic Products of the Malay Peninsula. London, Published in Behalf of the Governments of the Straits Settlements and Federated Malay States by the Crown Agents for the Colonies, 1935, 2 vols.

Buxton, P. A.: The Recorded Distribution of Certain Fleas. Bull. Entom. Res., **32**:119-122 (Aug.) 1941.

Casaux and Houdemer: Note préliminaire sur les sparganoses humaines et animales au Tonkin. Bull. Soc. path. exot., **19**:802-804 (Nov.) 1926.

Christophers, S. R.: Family *Culicidae*. Tribe *Anophelini*. London, Taylor and Francis, 1933

(The Fauna of British India, including Ceylon and Burma, *Diptera,* vol. 4).
Crevost, C., and Lemarie, C.: Catalogue des produits de l'Indochine. Hanoï, Imp. d'Extrême-Orient, 1917-1935, 5 vols.
Delbove, P., Pochon, J., and Ragiot, C.: Sur la répartition des groupes de pneumocoques (G. Cooper) au cours des pneumococcies de l'Annamite de Cochin-Chine. Bull. Soc. path. exot., **30**:231-233 (Mar.) 1937.
Ennis, T. E.: French Policy and Developments in Indochina. Chicago, University of Chicago Press, 1936.
Essai de démographie des colonies françaises. Bull. Office internat. d'hyg. pub., 30(1) supp. no. **2**:1-53, 1938.
Franc, P.: Note sur les irrigations avec assecs antimalariens. Bull. écon. de l'Indochine, **42**: 32-38, 1939.
Faune des colonies françaises. Paris, Société d'éditions géographiques, maritimes et coloniales, 1927-1937, 6 vols.
Faust, E. C.: An Inquiry into the Prevalence of Malaria in China. China M. J., **40**:937-956 (Oct.) 1926.
Gagnepain, F.: Contribution à l'étude géobotanique de l'Indochine. Ann. Mus. Colon., Marseilles, **4**:1-48, 4th ser., 1926.
Gaillard, H.: L'anthropophilie de *Culex fatigans* au Tonkin. Bull. Soc. path. exot., **29**:517-518 (May) 1936.
Gaschen, P.: Prospection entomologique au Laos. Bull. Soc. méd-chir. de l'Indochine, **12**:533-540 (May) 1934.
Gourou, P.: Les paysans du delta tonkinois; étude de géographie humaine. Paris, Les Éditions d'art et d'histoire, 1936.
Herms, W. B.: Medical Entomology, 3d ed. New York, The Macmillan Co., 1939.
Indo-China, French Service de la Statistique Générale: Annuaire statistique de l'Indochine, Hanoï, 1934-1939.
Interviews and Reports, Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.
Joyeux, B., Truong-cam-Cong, and Nguyen-Xuan-Nguyen: Nouvelles contributions à l'étude de la sparganose oculaire au Tonkin. Rev. méd. franç. d'Extrême-Orient, **17**:27-46 (Jan.) 1939.
Koun: Évolution du paludisme dans la ville et les environs de Hue. Bull. Soc. path. exot., **19**: 335-337 (May) 1926.
Kumm, H. W.: The Geographical Distribution of Malaria-Carrying Mosquitoes. Baltimore, American Journal of Hygiene, 1929 (Am. J. Hyg. Monographic Ser. No. 10).
——: The Geographic Distribution of Yellow Fever Vectors. Baltimore, American Journal of Hygiene, 1931 (Am. J. Hyg. Monographic Ser. No. 12).
League of Nations. Health Organisation: Public Health Services in the French Colonies, by S. Abbatucci, Liége, Imp. G. Thone, 1926.
——: Intergovernmental Conference of Far Eastern Countries on Rural Hygiene, Preparatory Papers. Report of French Indo-China. Geneva, 1937.
Lecomte, H.: Flore générale de l'Indochine. Paris, Masson et Cie, 1907-1939, 7 vols.
McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.
Marneffe, H., Gaschen, H., and Nguyen-ba-Tung: Contribution à l'étude du paludisme du delta Tonkinois. Arch. Inst. Pasteur d'Indochine, **7**:263-296 (Apr.) 1938.
Mathis, C., and Leger, M.: Recherches de parasitologie et de pathologie humaines et animales au Tonkin. Paris, Masson et Cie, 1911.
Meyer, K. F.: Ecology of Psittacosis and Ornithosis. Medicine, **21**:175-206 (May) 1942.
Morin, H. G. S., and Pirot, R.: Sur l'épidémiologie de la dengue d'Extrême-Orient. Arch. Inst. Pasteur d'Indochine, Nos. **3-4**:41-50 (Apr.-Oct.) 1926.
——, ——: Recherches sur l'index paludéen de la population indigène dans la région du Kontum (Centre Annam). Bull. Soc. path. exot., **21**:26-34 (Jan.) 1928.
Petelot, P. A.: La botanique en Indochine (bibliographie). Bull. Écon. de l'Indochine, **32**:587-632, 1929.
——, and Magalon, M.: Éléments de botanique indochinoise. Hanoï, Imp. d'Extrême-Orient, 1929.
Public Health Reports, **58**:503 (Mar. 19); 586 (Apr. 2); 718-719 (Apr. 30) 1943.
Ragiot, P., Delbove, P., and Nguyen-van-Huong: Note sur les méningites pneumococciques en Cochinchine. Bull. Soc. path. exot., **30**:261-264 (Apr.) 1937.
——, and Delbove, P.: Typhus endémique et typhus tropical en Cochinchine. Bull. Soc. path. exot., **28**:163-167 (Mar.) 1935.
Raynal, J.: Contribution à l'étude des phlébotomes d'Indochine. Arch. Inst. Pasteur d'Indochine, **6**:349-374 (Apr.) 1936.
Roussel, F., Jauffret, R., and Tran-van-Buu: La tuberculose bovine au Cambodge, Bull. écon. de l'Indochine, **42** (fasc. 4): 806-818, 1939.
Stanton, A. T.: The Mosquitoes of Far Eastern Ports, with Special Reference to the prevalence of *Stegomyia fasciata.* Bull. Entom. Res., **10**:333-344, 1920.
Stanton, A. T.: Notes on Malayan Culicidae.

London, J. Bale Sons and Danielsson, Ltd., 1926. (Studies from the Institute of Medical Research, Kuala Lumpur, Federated Malay States, No. 20.)

Statesman's Year-Book. London, The Macmillan Co., Ltd., 1943.

Thompson, V.: French Indo-China. New York, The Macmillan Co., 1937.

Toumanoff, C.: Étude de l'indice maxillaire de Rouband en tant que méthode pratique d'investigation sur les aptitudes trophiques des espèces anophèliennes d'Extrême-Orient. Tr. Far East. Ass. Trop. Med., **9(2)**:37-51, 1934.

——: L'anophèlisme en Extrême-Orient. Paris, Masson et Cie, 1936.

——: Recherches sur la fréquence saisonnière de diverses espèces anophèliennes au Tonkin. Bull. Soc. path. exot., **26**:1020-1022 (Oct.) 1933.

Treillard, M.: Destruction saisonnière domestique des anophèles adultes (*H. mininea*) pour la prophylaxie antipaludique en Indochine méridionale. Bull. Soc. path. exot., **27**:937-939 (Dec.) 1934.

Treillard, M.: Répartition annuelle de *Myzomyia minima, M. aconita* et *Anopheles hyrcanus,* Anophèles porteurs de *Plasmodium* malarien en Cochin-chine et au Cambodge oriental. Bull. Soc. path. exot., **25**:920-928 (Oct.) 1932.

——: Tableau synoptique pour la détermination rapide des Anophèles d'Indochine. Bull. Soc. path. exot., **27**:751-753 (Oct.) 1934.

Vogel, E., and Riou, M.: Les maladies épidémiques, endémiques et sociales dans les colonies françaises pendant l'année 1937. Ann. méd. pharm. col. Par., **37**:257-551, 1939.

Weyer, F.: Die Malaria Überträger. Leipzig, G. Thieme, 1939.

Wu, Lien-tê, Chun, J. W. H., Pollitzer, R., and Wu, C. Y.: Plague: A Manual for Medical and Public Health Workers, Shanghai, Weisheng-shu National Quarantine Service, 1936.

6

India

GEOGRAPHY AND CLIMATE

India, so extensive that it might almost be considered as a separate continent, lies between approximately 8 and 37° of north latitude and 61 and 97° of east longitude. At the north it is bounded by the Himalaya Mountains; on the west it is bounded by the Arabian Sea; on the east by the Bay of Bengal; and on the south by the Indian Ocean. Terrestrially, it is bordered by Burma on the east, Tibet, Bhutan and the Kingdom of Nepal on the northeast, the Chinese province of Sinkiang and part of Soviet Russia on the north, Afghanistan on the northwest and Iran on the west. British India proper has an area of about 1,809,000 square miles, which is more than half the area of the United States.

India has a population of some 353,000,000 people. It is impossible to present herein the various types of people in so large a country; but it can be said that three main distinctions are possible: (1) the melanoderms, who have black skins, curly hair, everted lips, broad noses and long heads; (2) the leucoderms, who have darkish skins, fine noses, and long heads, such as the jungle tribes of southern India, the lower castes in western Bengal and to some extent the lowest castes in upper India; (3) the xanthoderms, who have yellowish skins and Mongoloid features, such as certain people in the central, northern and eastern parts of Bengal and the Savaras on the eastern coast in Madras presidency. These three main types, which at best constitute a superficial classification only, have a total of 222 vernaculars. The variety of religions in India is well known. According to the census of 1931 there were 239,195,140 Hindus, 77,677,545 Mohammedans, 12,786,806 Buddhists, 4,335,771 Sikhs, 1,252,105 Jainists, 6,296,763 Christians, 109,752 Parsees and 8,280,347 Animists, or a total of 349,934,229.

Physically, India is isolated from the rest of Asia by the aggregate of ranges known as the Himalaya Mountains. From these ranges southward the country can be divided into three main parts. The first of these is encompassed by the Himalaya Mountains, which extend for 1,500 miles along the northern part of India. Next is the plain country, watered by Himalayan rivers. The plains extend from the Bay of Bengal on the east to the borders of Afghanistan and the Arabian Sea on the west, and in general are the most heavily populated regions in India. The third part is the great southern tableland in the peninsula-like portion of India. It includes the Central Provinces, Berar, the presidencies of Madras and of Bombay, and also Hyderabad, Mysore and other states. It can be defined roughly by the Vindhya Mountains running approximately east to west, and from this range southward to the peninsular coastline. This plateau or tableland is from 1,000 to 3,000 feet above sea, with some ranges which are more than 4,000 feet high. Ootacamund, for instance, which is the summer capital of the presidency of Madras, is 7,000 feet above sea level.

The great hydrographic feature of the interior of the country is the Ganges River, which originates in the Himalaya Mountains and flows for about 1,500 miles to empty into the Bay of Bengal. The Indus River, 2,000 miles long, originates not in India but in Tibet, traversing Kashmir, Punjab and Sind to enter the Arabian Sea in the vicinity of Karachi. Still another is the Brahmaputra River, 1,800 miles long, which originates in Tibet, flows through Assam, and enters the Bay of Bengal in the presidency of Bengal. Others are the Tapti, some 436 miles long, flowing through the Central Provinces to enter the Gulf of Cambay in the presidency of Bombay; the Narbada, about 800 miles long, flowing through the central part of India to enter the Gulf of Cambay; and the Godavari, about 900 miles long, sacred to the Hindus, which flows eastward through Bombay and Hyderabad and empties into the Bay of Bengal. Despite the fact that the coastline of India is some 5,000 miles long, there are very few first-class anchorages.

India is so large that almost every type of climate is found within its borders. Generally, it can be said that the greatest extremes of heat and cold occur in the northwestern section; that in the north the climate is essentially cold and dry; that in the south it is tropical. Three seasons prevail: the cold season, from October through February; the hot season, from March through June; and the rainy season, from June through October.

In January the temperature is typically cold in the north, and it slowly increases as one proceeds to the south; at Peshawar in North-West Frontier province it is commonly less than 50° F. (10° C.); in northern Punjab it is 55° F. (12.7° C.); at Benares in the United Provinces it is about 60° F. (15.6° C.); at Madras, in the presidency of that name, it is 75° (23.8° C.); at Calicut in the same presidency, 78° F. (25.5° C.); at Trichinopoly in Madras, 82° F. (27.7° C.); at Bombay, 80° F. (26.6° C.); and at Karachi, in the province of Sind, about 77° F. (25° C.).

The usual temperature range is: in January, in the eastern coastal strip, 67 to more than 75° F. (19.4 to more than 23.8° C.); in the western coastal strip, 60 to 70° F. (15.6 to 21.1° C.); in the central tablelands, 70 to 75° F. (21.1 to 23.8° C.); in the plain country, 60 to 65° F. (15.6 to 18.3° C.); and in the Punjab and the valley of the Indus River, from 40 to 60° F. (4.4 to 15.6° C.). In July the temperature in the eastern coastal region is between about 85 and 90° F. (29.4 and 32.2° C.); in the western coastal region it is from 70 to 80° F. (21.1 to 26.6° C.); in the central tablelands it is between 80 and 85° F. (26.6 and 29.4° C.); in the plain country, between

TABLE 7

Salient Climatic Data, Annual Figures, Certain Cities in India

City	Temperature, ° F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Agra	120	30	77	25	54	W, 26	554
Bangalore	101	46	74	35	68	......	3,021
Bombay	100	56	43	43	32	NE, 22	37
Calcutta	108	44	79	63	77	......	21
Cherrapunji	88	33	63	424 *	78	SW, 29	4,309
Hyderabad	112	47	80	32	61	C, 29	1,719
Karachi	118	39	77	8.8	..	W, 35	13
Madras	113	57	83	51	77	SE, 21	22
Nagpur	117	39	80	49	56	W, 22	1,017
Srinagar	99	0	55	27	64	C, 36	5,204

* One of the rainiest areas in the world; as much as 170 inches of precipitation has been recorded here in a single month.

85 and 90° F. (29.4 and 32.2° C.); and in the Punjab and the valley of the Indus River, more than 90° F. (32.2° C.).

Similarly, there is a wide range of rainfall in India. In the sub-Himalayan region the annual precipitation is, on an average, about 60 inches (1.5 meters); on the plains it is about 39 inches (1 meter); in the west, from the Tapti River to Cape Comorin, about 100 inches (2.5 meters); in the northeast, from the Ganges delta to Cape Comorin, from 50 to 60 inches (1.25 to 1.5 meters); on the tableland, about 30 inches (about 0.8 meter).

Data pertaining to the salient climatic features of 10 cities in India, presented in annual figures, are found in Table 7.

PUBLIC HEALTH

Health Services

Organization. Medical and public health work in India is a function of several departments of the central government. The health of the civil population of British India is under the jurisdiction of the Department of Education, Health and Lands; that of the Indian states and agencies is the concern of the Foreign and Political Department; and the Home Department is responsible for the health of inmates of jails and mental hospitals. The Director-General of the Indian Medical Service is the advisor to the Government of India on all questions of a medical nature; he is the head of the Indian Medical Service (an imperial service) and also of the Indian Medical Department (a subordinate service composed of assistant surgeons and sub-assistant surgeons). Members of these two organizations serve in research institutions and in numerous medical and public health advisory and administrative positions throughout India. The Director-General also is in charge of the technical department, among whose officers are included a Deputy Director-General (in charge of stores), the public commissioner, and a medical statistician. The public health commissioner with the Government of India is the advisor of the Government of India on all public health matters and acts as staff officer for public health to the Director-General. He has no control of public health work in the presidencies, provinces and states, visits them only on invitation, and may give advice only when asked to do so. Representing the Director-General, he is in administrative control of the Medical Research Department and is secretary of the Scientific Advisory Board and of the governing body, the Indian Research Fund Association. He serves on various committees, such as the Indian Red Cross Society, Indian Council of the British Empire Leprosy Relief Association, the King George Thanksgiving (antituberculosis) Fund, the Maternity and Child Welfare Bureau and the Delhi Health School, all of which are directly or indirectly concerned with different aspects of public health work. He is also responsible to the Government of India (Department of Education, Health and Lands) for port quarantine, medical aspects of overseas pilgrim and emigration traffic and international health matters.

Each presidency and province has, and some states have, a minister or director of health, and a public health department which varies in such aspects as budget, personnel and program. The director of health for a presidency, a province or a state, under the surgeon general of the province (a member of the Indian Medical Service), is responsible for the public health policy in that particular territory. In addition to the director, there are several assistant directors who supervise large subdivisions, including the work of local medical officers of health. These organizations vary in type and scope. In Madras, United Provinces and Punjab there is one medical officer of health for each 1,000,000 people. In Bengal, Assam, Bihar, Orissa, Central Provinces, Sind, Bombay, and North-West Frontier, there are no rural medical officers of health who are employed by the provincial government; such medical officers are employed by the municipalities and are subject to them. The directors of public health usually are officers of the Indian Medical Service and most of them are Indians.

In 1937 a Central Advisory Board of Health was formed. The chairman of the Central Advisory Board of Health is Minister of Health, Education and Lands for India, and the secretary of the board is the public health commissioner. The members of the Central Advisory Board of Health include representatives of the Central Government, the health ministers of the provincial government, representatives of a number of states, and members of the central legislature. This board may become a most important force in directing public health policies in India, but at present its functions are only advisory. The Central Government, by means of appropriations and other measures, is able to control much of the medical and public health work in India. Liaison with the provincial and state governments is effected through the Central Advisory Board of Health. In 1937 there were 946 full-time and 86 part-time medical officers; 1,382 physicians and others on the so-called epidemic staff; 4,294 sanitary and health inspectors; 14,664 vaccinators; 170 inspectors of vaccinations; 160 school medical officers; and 19,820 clerks and other helpers.

Relative Effectiveness. Public health work in India has been hampered by a variety of conditions, including ignorance, superstition, religion, poverty, the caste system, and by the lack of trained medical personnel. However, advances have been made, especially since the first World War. This progress is shown in the decline in incidence of epidemic diseases, by the advances in medical research, and by the increased numbers of trained Indian personnel. Yet, until more time, money and effort are expended on the public health program and until there is a general improvement in the social and economic status of the people, it is thought that progress in public health work necessarily will be slow.

Water Supplies

Although water is plentiful in most parts of India, that which is available usually is polluted and unfit for use until it has been adequately treated. The supply of water varies in different parts of India. In sections of Assam there may be as much as 500 inches (1,270 cm.) of rainfall each year, whereas in Sind and the northwestern part of India the annual rainfall may be only 8 inches (about 20 cm.) or less. In some districts the fluorine content of the subsoil water is high and if such water is used exclusively, signs of fluorosis may appear. In the towns and cities either rain water, water stored in reservoirs or lakes, or river water is used. It is reported that only 13 per cent of cities with a population of less than 30,000, 56 per cent of cities having a population of 30,000 to 50,000 and 76 per cent of cities having a population of more than 50,000 have a piped system of water supply. Many of the large cities have filtration and treatment plants, but some of the plants are not efficiently managed and chlorination is not used in all of them. In many instances bacteriologic examination of the city water supplies is not done frequently enough to be of value. It is reported that some of the cities and towns have dual water systems; one carrying unfiltered water to be used for washing and bathing, and one carrying water to be used for drinking purposes. The drinking water is turned off for many hours each day, resulting in a negative pressure in pipes and consequent pollution through leaks. Water from many sources is used in the rural areas (90 per cent of the people live in such areas), and in districts not supplied with city water. These sources include rain water collected in cisterns, tanks and other containers; surface water which has been collected in ponds, streams and lakes; and ground water obtained largely from poorly protected wells and springs. The insanitary habits of the people, such as the washing of clothes and bathing in ponds, streams and about cisterns and wells; promiscuous defecation and the disposal of night soil in streams, lakes, ponds; the use of poorly constructed latrines which allow the seepage of fecal material into near-by water supplies; the custom of burning the dead and disposing of the half-charred bodies in the streams—all have resulted in widespread contamination of water supplies. Such habits, along with the drinking of water from "consecrated" streams, have led to the spread of cholera and other intestinal diseases, and to infection with guinea-worm throughout most sections of India. The government has made definite advances in the improvement of water supplies by the installation of municipal treatment plants and by the construction of properly protected wells and cisterns; but in general all water obtainable in India must be considered as unsafe for consumption or for purposes of bathing until it has been properly treated or until results of repeated laboratory tests have proved its safety.

Sewage Disposal

The methods of disposal of night soil in general use throughout most parts of India are entirely unsatisfactory. A few of the larger cities have well-built and well-equipped sewage disposal plants which are carefully supervised, whereas others have systems through which untreated sewage is emptied directly into the rivers or into the sea. In many city districts bucket latrines are used and the night soil is collected by the "untouchables" and dumped into sewers or into storage basins. Septic tanks are used in some of the cities and towns. Bombay, in 1939, was reported to have more than 15,000 basket (bamboo basket-lined bored-hole) latrines. Most of the towns have public latrines which are ill-kept and insanitary. In some sections of the country the rainfall is excessive and the ground-water table is so high that the operation and maintenance of sewers are difficult.

In the rural areas and, in fact, throughout many sections of India, defecation is promiscuous and side streets or, more commonly, banks of ponds, canals or rivers or the margins of tanks, often are the sites for defecation. In some of the rural areas poorly constructed latrines and privies are used, but in many districts there are no such facilities. Such methods of disposal of night soil have led to widespread pollution of the soil and have been the principal factors in causing the high incidence of cholera, dysentery, typhoid and paratyphoid fevers, and intestinal helminthiasis, as well as contributing to the increased prevalence of certain disease-carrying insects and animals. The governmental authorities have constructed numerous sewage disposal plants in the cities and have encouraged the use of bored-hole latrines in many of the rural sections of India, but much still remains to be done before satisfactory methods of disposal of sewage can be established.

Insects and Animals

Vectors of Disease. Mosquitoes. *Anopheline.* More than 50 varieties of anopheline mosquitoes have been reported from various parts of India. The most important ones are listed in Table 8.

In addition, several mosquitoes, namely, *Anopheles hyrcanus nigerrimus, A. hyrcanus sinensis, A. sundaicus, A. minimus minimus* and *A. philippinensis* are vectors of *Wuchereria bancrofti,* which is the causative agent of one type of human filariasis; *A. hyrcanus sinensis* and *A. barbirostris* are also natural vectors of *Wuchereria malayi.*

Aedes. Four types of Aedes mosquitoes have been reported from India. *A. aegypti* and *A. albopictus* are the vectors of dengue fever in India. Both *A. aegypti* and *A. albopictus* are capable of transmitting yellow fever, *A. aegypti* being the principal vector in countries in which this disease is endemic. Yellow fever never has been reported from India or other parts of the Orient. *A. vittatus,* which experimentally is capable of transmitting yellow fever, also

TABLE 8

Important Vectors of Malaria Found in India

Mosquito	Distribution	Habit
A. culicifacies...	Throughout India from Baluchistan to Burma and into south India. Ordinarily a plains species but has been found in the hills.	Breeds in a wide variety of places; usually in fresh, clear water, irrigation channels, land pools, rice fields; occasionally in brackish water.
A. stephensi stephensi	Throughout India. Has adapted itself to cities.	Breeds in wells, cisterns, flower pots, discarded tins, roof gutters, and other temporary receptacles; commonly found in cowsheds, barracks, and houses; females readily feed upon blood of man.
A. fluviatilis (listoni)	Widely distributed in foothill areas from Baluchistan to Burma and to the southern end of India.	Breeds in edges of foothill streams and pools, springs and irrigation channels; sometimes at edges of swamps, lakes and tanks; found usually between 1,000 and 5,000 feet altitude in south India; occasionally higher elsewhere; females prefer human blood.
A. minimus..... *minimus*	Chiefly eastern and northern India.	Breeds in clear, sunlit, slow-running streams and springs with grassy margins, in irrigation ditches and rice fields, at low to moderate altitudes; commonly found in large numbers in houses and cattle sheds.
A. philippinensis	Chiefly East India.	Breeds in pools, drains, tanks, ditches, swamps, borrow pits, rice fields.
A. varuna......	Most of India except northwestern part.	Breeds in stagnant water, in pools, ditches, wells, slow-running streams and irrigation canals; especially abundant in wells. Adults are found in houses and cowsheds. Females feed readily on blood of man.
A. sundaicus....	East India, especially Bengal.	Breeds in sea water, lagoons, swamps and collections of brackish water behind coastal embankments and in similar places. It is a strong flier and may travel 3 miles. Occurs in large numbers in cowsheds, houses and similar habitations; prefers human blood.
A. superpictus...	Baluchistan, N.W.F.P., Waziristan; not found east of Indus River.	Breeds in fresh-water pools, drains and seepage water, generally in hill districts, but adapts itself to desert conditions; enters houses; prefers human blood to that of animals.

is found in India. These mosquitoes are found about human dwellings, where they breed in domestic utensils, barrels, gutters and holes in trees. They readily enter houses and often bite during the day. *A. vexans* also is recorded from India; it bites viciously and in some parts of the world (United States and Canada) has been involved in the transmission of equine encephalomyelitis.

Culex and Others. Several species of Culex mosquitoes are indigenous to India, the most important of which is *Culex fatigans* (*C. quinquefasciatus*). It is a domestic mosquito and is the chief vector of *Wuchereria bancrofti*. *C. fatigans* also transmits *Wuchereria malayi* and *Dirofilaria immitis*. *C. tritaeniorhynchus* and *C. vishnui* are present. *C. vishnui* is also a vector of *Wuchereria bancrofti*. In the mountainous areas *C. mimeticus* is recorded. Several species of Mansonia mosquitoes are found in the southern, central and eastern parts of India, including *M. annulifera*, *M. uniformis* and *M. indiana*. They are chiefly vectors of *Wuchereria malayi*, but *M. annulifera* is also a vector of *Wuchereria bancrofti*. These species are primarily jungle mosquitoes, and it is there that filariasis of the type caused by *Wuchereria malayi* is more commonly found. *M. uniformis* also is capable of transmitting yellow fever. The names of numerous other mosquitoes found in India, not known to be vectors of disease, are not recorded in this chapter.

Measures of Control. Under the direction of the central and local governments, much important work in control of mosquitoes has been done. In recent years, the International Health Division of the Rockefeller Foundation has assisted in this work. Under present conditions some of the control work of necessity may have to be abandoned, resulting in the increased breeding of mosquitoes in certain districts.

LICE. Infestation with the body louse, *Pediculus corporis;* the head louse, *P. capitis;* and the pubic louse, *Phthirus pubis* is common, especially among the lower classes of people in the cooler sections of India. The first two of these, and especially the body louse, are vectors of epidemic typhus fever and of trench fever. These lice are also vectors of species of the genus Borrelia which cause relapsing fever. The rat louse, *Polyplax spinulosa*, an important vector of endemic typhus fever among rats, also may be present. Both typhus fever and relapsing fever occur in India, the louse-borne type of these diseases being more common in the northern part of India than in other districts.

FLIES. Many varieties of flies are reported from India. In the family Muscidae are the common housefly, *Musca domestica*, and *Musca determinata;* the lesser housefly, *Fannia canicularis;* and the camp fly, *Musca sorbens*. The cattle fly, *Philaematomyia crassirostris* is found, but rarely attacks man. The stable fly, *Stomoxys calcitrans*, in some areas a proved vector of *Leishmania tropica*, is present. A member of the family Calliphoridae, *Chrysomyia bezziana*, is found, and causes myiasis of the body cavities, especially the nasal cavity, in man and animals in India. The warble fly, *Hypoderma bovis*, which at times causes cutaneous myiasis, is recorded as occurring in India. Several types of flesh flies of the family Sarcophagidae, which cause myiasis of wounds and body cavities, occasionally are encountered in India; they are *Wohlfahrtia magnifica* and *Sarcophaga carnaria*. These flies also are mechanical vectors of various intestinal and ophthalmic diseases, which are common throughout India.

Members of the family Psychodidae are present, and include the sand fly *Phlebotomus papatasii*, which is an important vector of the virus which causes pappataci or sandfly fever, and of *Leishmania tropica*, which causes Oriental sore. *P. papatasii* is found chiefly in the northwestern part of India. It rarely carries kala-azar. *P. argentipes*, the principal vector of *Leishmania donovani*, the causative agent of kala-azar, is found most abundantly in the eastern part of India, east of a line from Delhi to the southern part of the presidency of Madras; west of this line *P. papatasii* is more commonly found. *P. minutus*, *P. major*, *P. sergenti*, *P. chalami* and *P. colabaensis* also are present. Sand flies are reported to be very numerous, especially in damp or muddy places, at the beginning and end of the rainy season. These flies bite chiefly at night.

TICKS. The two principal ticks found in India are the common dog tick, *Rhipicephalus sanguineus*, and the tick, *Ornithodorus papillipes* (*tholozani*). They are vectors of the spirochete which causes tick-borne relapsing fever and of the virus of tick typhus fever.

FLEAS. The most important type of flea found in India is the Oriental rat flea, *Xenopsylla cheopis*. It is the chief transmitter of the causative organism of plague to man and is also the vector of *Rickettsia mooseri,* the causative agent of endemic typhus fever. The rat flea, *Nosopsyllus fasciatus,* the dog flea, *Ctenocephalus canis,* and the cat flea, *Ctenocephalus felis,* are present. All of them are possible transmitters of plague. Two fleas of minor importance found in India are *X. astia* and the *X. brasiliensis.* These two fleas seldom attack man. The human flea, *Pulex irritans,* of minor medical importance, may also be present.

Rodents. The black rat, *Rattus rattus,* and its varieties are the principal rats found throughout India; they form the principal rodent reservoir for human plague. The brown or sewer rat, *Rattus norvegicus,* is found chiefly in the seaports. The climbing rats, *Rattus alexandrinus,* and *Rattus frugivorus,* also are present. A field rat in many regions forms the chief reservoir for sylvatic plague. The rice-field rat and the bamboo rat also are reported. Storage of grains in the homes has led to the increased prevalence of rodents in these places. Rats and other rodents serve as hosts for lice, fleas, and mites, vectors of plague, typhus fever and other diseases. The excreta of rodents may contain pathogenic organisms of the genus Salmonella, *Leptospira icterohaemorrhagiae* and a variety of ova and cysts. *Spirillum minus,* which causes rat-bite fever, is transmitted by the bite of rats. Some work in control of rats has been done; and in 1937 alone, 2,287,000 rats were reported to have been killed in areas in which plague was endemic.

Mites. Mites found in India are the scabies or itch mite, *Sarcoptes scabiei,* and *Trombicula akamushi* and *T. deliensis.* Mites of the genus Trombicula are the vectors of mite-borne typhus fever and are commonly found in the grasses of the hill country, in cut-over jungles, and in the palm-tree plantations.

Bedbugs. The tropical bedbug, *Cimex hemipterus,* is found throughout India. The ability of the bedbug to transmit diseases by biting is a moot question; however, it is possible that the crushing of infected bugs on the skin at times may be a factor in the acquisition of certain diseases.

Kissing Bugs. *Triatoma rubrofasciata* is reported from the northern part of India. Its medical importance is slight, although it could act as a possible vector of Leishmania. It is known to frequent human dwellings and bite man.

Snakes and Other Dangerous Animals. The poisonous snakes found in India may be divided into three families, the first of which is the Elapidae, which includes the cobra, kraits and their allies. The king cobra, *Naja hannah,* or hamadryad, and the Indian cobra, *Naja naja,* or *cobra de capello,* are fairly common. The king cobra may attain a length of 15 feet, but the Indian cobra seldom reaches a length of more than 6 feet. Both are dangerous snakes. Their venom is neurotoxic and if not neutralized promptly usually causes death. Several varieties of kraits are found. Some half dozen or more species belong to the genus Bungarus, among which are the common krait, *B. candidus* and the banded krait, *B. fasciatus.* They usually are not more than from 2 to 5 feet long. The kraits are nocturnal in habit and often are found inside houses or lying in the dust on roads. In such places they are likely to be stepped on and will retaliate by biting. They frequent houses and sometimes crawl onto mantels or into drawers of dressers, desks or other furniture. Other kraits encountered are species of the genera Hemibungarus, Calliophis, and Doliophis. Sea snakes of the family Hydrophidae form the second group of poisonous snakes. They are spoken of as the "sea allies of the cobras and kraits." More than 50 species of sea snakes are reported from the Persian Gulf to the Pacific Ocean. They have wide, paddle-like tails vertically compressed, and have an average length of 4 to 5 feet, although they may attain a length of 8 to 10 feet. Their venom acts on the nervous system and is highly toxic. The family Viperidae, forming the third group of poisonous snakes found in India, is divided into the pitless vipers and the pit vipers. The toxin of the vipers is hemolytic in action and also acts on the vasomotor and respiratory centers. The most dreaded of the pitless vipers is the Russell viper, *daboia* or *tic-polonga.* It is very common in the plains area and may attain a length of as much as 5½ feet. The Indian saw vipers, the venom of which usually is localized rather than systemic in its action, are common in the northwestern and southern parts of India. The two main classes of pit vipers found are the common green tree viper, *Trimeresurus gramineus,* and the Himalayan viper, *Agkistrodon himalayanus.* In the eastern part of India the moccasin, *Agkistrodon hypnale,* also is found. It is stated that in India each year more than 20,000 deaths are caused by snake bite. A bivalent antivenom serum for the treatment of persons bitten by the Indian cobra and by Russell's viper is prepared at Kasauli from venom collected at the Haffkine Institute in Bombay. It is supplied to the civil and military hospitals and dispensaries throughout India.

Poisonous Fish. Many varieties of poisonous fish are reported in the seas about India. Of these fish, members of the genus Muraena have poison glands connected with hollow teeth through which the toxin passes. The toxin is neurocardiac in its action. Scorpion fish, members of the family Scorpaenidae, form the second class of poisonous fish. Their poison glands are attached to their dorsal fins. Several species of these fish are found in the seas around India. Their toxin causes severe pain and in some cases results in convulsions and death. The sting ray, of the family Trygonidae, also is indigenous. The wounds which are made by the spines on the tails of such fish are very slow in healing because of the poison which is deposited when the wound is made.

Scorpions. Scorpions most commonly found in India belong either to the genus Buthus or to the genus Palamnaeus. Scorpions never sting unless they are disturbed, and the sting is rarely fatal.

Others. Among the dangerous animals found in India are leopards and tigers frequenting grasslands and edges of the jungle; bears, and especially the Malayan bear in the hilly jungles; wolves; wild dogs; and jackals. The latter three are primarily of importance as possible reservoirs for the virus of rabies. Other dangerous animals include elephants, wild buffalo, and wild pigs. The danger from these animals is always minimal if one remains on the usual trails and roads, especially since most of these beasts will not attack man unless molested.

Pests. Various kinds of ants, cockroaches, spiders, centipedes and millipedes are common pests in India. Leeches are common in the grass and jungle lands and they are serious pests. Both the large and small varieties are found. They cause much loss of blood and infection may occur at the site of their bites. If present in drinking water they may attach themselves to parts of the nasopharynx or larynx and may later cause death by means of asphyxiation. One of the buffalo gnats, *Simulium indicum,* is reported from India. It is a voracious bloodsucker and bites in the daytime, but has not been identified as a vector of any specific disease in this area. Finally, the monkey found in many areas of India is a pest as well as a carrier of disease.

Poisonous Plants

Cannabis indica, or Indian hemp, grows in many parts of India. The dried flowering tops are mixed with tobacco and smoked. A mixture of the leaves and capsule is made into decoctions. A dry, resinous exudate made from the cut heads of the female hemp plant is also used. It is a dangerous and habit-forming drug. In Bengal it is reported to be used as a fish poison. The poisonous mushroom, *Amanita* *muscaria,* causes a number of deaths each year. A species of the Strychnos plant, *Strychnos colubrina,* is used homicidally and suicidally and for killing dogs, rodents and the like. The "physic nuts," from the shrub or tree, Jatropha, if ingested in large numbers, give rise to severe intestinal irritation. The yellow plant, *Cerbera thevetia,* is reported to be poisonous. Juice from the asclepias herb is used as an infanticide. Juice from the poppy is used in its crude form and also in its refined form as opium. The opium habit is widespread over India. In times of stress the chick-pea, *Lathyrus sativus,* one of the vetches, is used for making bread. The ingestion of such bread may cause a disease known as "lathyrism," a type of spastic paralysis associated with symptoms of weakness and muscular pains without psychic disturbances. Epidemic dropsy, which is associated with the use of mustard oil for seasoning that has been contaminated with the oil of *Argemone mexicana,* is seen in eastern India.

Food and Dairy Products

Factors influencing the diet of the Indian are his religion, his social and economic status and the food available in the district in which he lives. Theoretically, the Hindu is a vegetarian, but some Hindus do eat mutton; some refuse to eat chicken and eggs of chicken, but have no objection to eating the eggs of ducks and wild birds. The Moslem, on the other hand, eats mutton and beef, but ordinarily does not eat pork. Rice is the chief article of the diet of the people living in Bengal, Assam, Bihar, and Madras, whereas wheat furnishes the principal food in the diet of the inhabitants of the United Provinces, Punjab and the adjoining districts. Millet and other small grains also are grown in India. Vegetables, fruits and nuts produced include spinach-like vegetables, celery, asparagus, beans, onions, Irish and sweet potatoes, taros, carrots, beets, cucumbers, tomatoes, peas, lentils, beans, vetches, pomelos, oranges, lemons, pineapples, papayas, mangoes, litchi, dates, ground nuts, chestnuts, coconuts and others. Sugar and sugar cane are being produced in increased amounts, but in the past it has been necessary to import much beet sugar from Java. A sugar known as *jaggery* or *gur* is prepared from sugar cane and juices of the date, coconut and palmyra palms, and it is much superior to the commercial Indian refined white sugar. Tea, salt and condiments are locally produced.

Various kinds of meat are used, including beef, mutton, fish and the meat of several species of fowls. Dairying and the production of beef have not been highly developed. Cattle and buffalo are underfed and ill-kept and produce a poor grade of meat which is tough and low in fat. The quality of the mutton is not much better. Hogs, except where they are raised and eaten by outcastes, are not commonly found in India. Milk is used in all districts of India, but the supply is inadequate. Butter, cheese and ghee (clarified butter) are widely used; they supply fat and proteins, and also serve as a chief source of vitamin A. The Indian is prejudiced against the use of fats of animal origin other than those obtained from milk, and thus he obtains his main supply of fat from mustard, linseed, sesame, ground nut and coconut oils, which are deficient in vitamin A. Chickens and other kinds of poultry are raised throughout India, but little attention is given to their production. Diseases not infrequently occur among the flocks, and the types of chickens produced are of poor quality. Consequently, supplies of eggs are not adequate. Many types of fish are used for food. Salt-water fish include several species of mullet, mackerel, whiting, Bombay duck, and several varieties of mango fish. Fresh-water fish include members of the carp family, the *rohu,* the *catla,* the *mrigal,* the *bekti,* mullet, trout and perch.

The natives of the sections of India in which rice is eaten predominantly are slender, poorly developed and often unhealthy, whereas those living in districts in which a better diet is customary (wheat and meat) are usually taller, better developed and healthier. An example of the latter type is the Sikh warrior from Punjab. It is in the areas in which rice is the chief article of food, especially among the poorer classes, that vitamin B deficiencies are common. Deficiencies of vitamin A and vitamin D are most common in the areas of the interior. Deficiencies of vitamin C are widespread over India. As a whole, the food supplies of India are not adequate for local needs. Rice had to be imported from Burma. In some years there are small excesses of wheat, which are exported, but the supply is hardly sufficient for the needs of the country. Agriculture has not been developed; crops generally are not rotated; and manure is used as fuel in most rural districts. Famines after droughts are not unusual, since transportation is inadequate to facilitate the bringing in of foodstuffs from other regions. Pure food laws are found in only a few provinces, and they are inadequate and often not enforced. Milk is commonly adulterated, and in the cities in which pasteurized milk is occasionally obtainable there is no guarantee that the milk has not been contaminated after pasteurization. Vegetables and fruits all must be considered as potentially contaminated with various pathogenic bacteria, cysts or ova. Beef or pork may contain tapeworm larvae; pork may contain the larvae of *Trichinella spiralis*. Fish and crustaceans may contain the cercariae of the lung fluke.

Miscellaneous Problems of Sanitation

Poverty, ignorance, social customs, superstitions and prejudices are important factors in the insanitary conditions existing in India. Crowding in the homes is marked and ventilation and lighting are poor. It is stated that 95 per cent of the houses occupied by laborers in industrial centers are unsatisfactory for healthful habitation. In Bombay it is estimated that a third of the population live in rooms each of which is occupied by 5 or more persons. In rural areas crowding in homes also is found. Such crowding, associated with promiscuous expectoration, has led to an increase in the incidence of tuberculosis. Insects and rodents which carry disease are common in these homes. Pilgrimages and the gatherings of the people at religious fairs have resulted in the dissemination of communicable diseases. Epidemics of cholera have been traced to such gatherings, as have plague and the various enteric diseases. The marriage of children is still condoned; child wives often die in childbirth and infant mortality rates are generally very high. More than a third of the 6,000,000 people who die each year in India are children less than the age of 5 years. The average length of life in India is only 27 years, whereas that for Japan is 46 years, for Great Britain 62 years, and for the United States, approximately 62 years. Yet, in spite of such high mortality rates, and the short length of life, India's population has increased by more than 250,000,000 in the past 90 years.

MEDICAL FACILITIES

Hospitals

In the official government report for 1938 the following types of hospitals are given: state public, 505; local fund, 4,106; private but aided, 865; state special, 399; railway, 385; private but unaided, 569; subsidized, 98; a total of 6,927. These hospitals are reported from the British provinces and from four of the provinces under the control of the chief commissioner. No specific data are available concerning hospitals in the states governed by the Indian princes; it is believed that there are comparatively few hospitals in those states. Among the hospitals reported above are 19 mental institutions which in 1934 were reported to have had 9,518 patients. Also listed in the above hospitals are 182 mission hospitals. In addition, mission organizations operated 54 asylums for lepers, nine sanatoria and 111 dispensaries. In another source it was stated that in 1940 there were 6,500 curative institutions in India, of which 3,000 were hospitals and 3,500 were outpatient dispensaries. Thus, it seems justifiable to conclude that only about 3,000 of the 6,927 reported institutions could be classified as "standard-type hospitals."

Number of Beds. In the official government report for 1938 it is said that in the state public, local fund, and private but aided hospitals noted above, there were 57,827 beds; the remaining hospitals reported 15,709 beds, making a total of 73,536 beds. Another source states there were 95,000 hospital beds in India for the year 1940. If a liberal number were used—100,000 as the number of hospital beds and 350,000,000 as the population of India—there would result the computation of 3 hospital beds per 10,000 of population. In the United States there are approximately 97 beds per 10,000 of population. Obviously, such a small number of hospital beds is entirely inadequate for the needs of India.

Equipment. The equipment in the larger government hospitals is the equal of that found in any of the larger hospitals of the United Kingdom. In such institutions, complete operating-room equipment and adequate x-ray, laboratory and other facilities are available. The equipment in the smaller government hospitals which are located throughout India is less adequate and is sufficient only to care for the average patient requiring medical and surgical attention. Patients whose condition is more serious are transferred to the larger near-by government hospitals. Many of the smaller medical institutions are of the dispensary type and treat outpatients only. The larger institutions are staffed with well-trained medical personnel, the directors in most cases being members of the Indian Medical Service. Those stationed in the small institutions are members of the Indian Medical Department.

Supplies. Many hospital and medical supplies are obtainable in India; most of those that have to be imported come from within the empire. Of the imported instruments and equipment, about 50 per cent came from Britain and her colonies; the United States furnished about 15 per cent and Japan furnished approximately 10 per cent. X-ray equipment was imported from Germany, the United States and England. Locally produced quinine, grown in Bengal and Madras, is not sufficient. Additional supplies were imported from the Dutch East Indies. Most of the serums and vaccines used in India are prepared in the Central Research Institute located at Kasauli, and in the other government laboratories. Plague vaccine is prepared at the Haffkine Institute in Bombay. Serums prepared in these institutions are said to be of excellent quality. It is estimated that only 65 per cent of the items of medical equipment and supply are manufactured in India.

Medical Personnel

Physicians. In 1940 there were 14,000 medical graduates and 27,000 medical licentiates, or a total of 41,000 physicians practicing in India. If the population is considered as a whole, there is thus one physician for each 10,000 people, as compared to one physician for each 800 people prevailing in England or to one physician for each 1,000 of population in the United States (both figures are pre-war). The physicians are found chiefly in the cities, and large rural sections may be entirely without medical care. In 1940, of the total number of licensed practitioners of medicine, 6,407 were in government medical service, and an additional 1,206 were employed in public health work. In the same year 740 white physicians were in service in missionary hospitals in India.

Nurses. In 1937, 3,222 nurses were reported as being employed in the urban areas of India, whereas 169 were recorded as being at work in rural India. No school nurses are employed in India. In another report it was said that 3,619 nurses were in service in India in 1936. In 1938, nurses employed in missionary institutions consisted of 283 European, 781 national, and 1,567 student nurses. The majority of the Indian nurses are women, irrespective of family prejudices or religious customs. In view of the total population of India, the aforementioned figures are stark evidence of the great scarcity of nurses.

Others. In 1938 it was estimated that there were approximately 2,000 dentists in India, only 15 per cent of whom were qualified. For the year 1936, 1,619 trained midwives and 724 native midwives or *dhais* were employed.

Medical Institutions

In India there are 10 medical colleges which grant a medical degree and 27 medical schools which give a medical license. Approximately 12,000 medical students are receiving instruction annually. Each year about 700 medical students (including 100 women) and 1,500 licentiates are graduated. These schools are not well distributed in India.

The following medical institutions are found in India: the Central Research Institute at Kasauli in the Simla Hills, controlled by the Government of India; the All-India Institute of Hygiene and Public Health at Calcutta, controlled by the Government of India; the School of Tropical Medicine at Calcutta, controlled by a governing body; the Haffkine Institute at Bombay, controlled by the province of Bombay; the King Edward VII Memorial Pasteur Institute and Research Institute at Shillong, controlled by Assam province; the King Institute of Preventive Medicine at Guindy, controlled by Madras province; the Radium Institute at Ranchi in the province of Bihar, controlled by a board of management; and the Hygiene Institute at Lucknow in the United Provinces, controlled by the government of the United Provinces.

Lymph vaccine institutes or depots are situated at Calcutta in Bengal presidency; at Namkum (Ranchi) in Bihar province; at Shillong in Assam province; at Patwa Dangar in the United Provinces; at Belgaum in Bombay province; at Lahore in the province of Punjab; and at Nagpur in the Central Provinces.

Pasteur Institutes are situated at Kasauli; at Coonoor in the province of Madras; at Shillong in the province of Assam; and at Patna in Bihar. Pasteur sections are maintained in the School of Tropical Medicine at Calcutta and in the Haffkine Institute at Bombay.

Other medical organizations are the India Research Fund Association, controlled by the government; the Malaria Institute of India, controlled by the government; the International Health Division of the Rockefeller Foundation; the Ross Institute of Tropical Hygiene, controlled by the London School of Hygiene and Tropical Medicine; and numerous missionary medical associations.

Social Services. In India there are the Indian Council of the British Empire Leprosy Relief, the Tuberculosis Association of India, the All-India Maternity and Child Welfare League and the Saint John Ambulance Association.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Intestinal infections (cholera, helminthiasis, typhoid fever, paratyphoid fevers, amebic dysentery, bacillary dysentery and common diarrheas) are widespread throughout India. The use of polluted water and the general insanitary and unhygienic conditions universally existing in all parts of the country, together with the high incidence of human carriers of disease, have been the chief factors responsible for this marked prevalence.

Typhoid Fever and Paratyphoid Fevers. These diseases probably are more prevalent than the recorded cases would indicate. The absence of adequate medical and laboratory facilities in large sections of the country has made it almost impossible to diagnose accurately diseases of this group. Furthermore, it is certain that many patients who have milder forms of these diseases are not brought to the attention of physicians. In 1937, the province of Delhi reported 650 cases and 536 deaths from enteric fever, a fatality rate of 82.5 per cent. Such a high fatality rate would indicate that only those who had the most serious forms of these diseases were treated and reported on. Table 9 is an index to the prevalence of enteric fever, which includes typhoid fever and paratyphoid fevers.

TABLE 9

Enteric Fever in India as Treated in Hospitals and Dispensaries in 1937

Province	Patients treated	Population
North-West Frontier Province	4,857	2,523,589
Punjab	19,666	26,069,627
Delhi	903	699,157
United Provinces	10,198	52,390,009
Bihar	7,904	34,695,892
Orissa	634	7,209,846
Bengal	22,506	52,195,805
Central Provinces	2,373	16,604,896
Bombay	6,142	19,383,756
Sind	2,760	4,237,554
Madras	22,773	47,201,665
Coorg	169	164,619
Assam	918	8,438,246
Baluchistan	137	868,617
Totals	101,940	272,683,278 *

* Total in this column is not constant throughout all tables because in some a province or two has been omitted.

—Modified from table in: *Annual Report of the Public Health Commissioner with the Government of India for 1937*, New Delhi, Government of India Press, 1939, vol. 1.

During 1937 and 1940 the enteric diseases were responsible for only 0.8 and 1.2 hospital admissions per 1,000, respectively, of British troops in India.

Amebic Dysentery and Bacillary Dysentery. These are common throughout India. In official reports deaths caused by these diseases are not recorded according to type of dysentery, but during 1938, in British India, the diseases were responsible for 292,482 deaths. For this same year 1,499,619 patients with dysentery and 11,079 patients with abscess of the liver were treated in the government hospitals and dispensaries in British India. Most of the cases of liver abscess must have been of amebic origin. The incidence of dysentery is greatest in the monsoon period and lowest during the driest part of the year. The urban mortality rates from these diseases are usually higher than the rural rates. During 1937 the rate of admission to hospitals for dysentery per 1,000 in the British army in India was 25.5 per annum, but in 1940 this rate had increased to 33.0. In Table 10 is shown the relative prevalence of dysentery in British India. However, among British and Indian army personnel bacillary dysentery is much more frequent than the amebic type, as is shown by the fact that during 1940 there were 4,324 cases in which bacillary dysentery was proved by culture and only 235 cases of amebic dysentery. The types of bacillary

TABLE 10

Amebic and Bacillary Dysentery in India as Treated in 1937

Province	Dysentery, type		Population
	Amebic	Bacillary	
North-West Frontier Province	9,522	25,889	2,523,589
Punjab	70,396	87,310	26,069,627
United Provinces	92,847	66,596	52,390,009
Bihar	115,391	37,203	34,695,892
Orissa	28,728	6,727	7,209,846
Bengal	242,543	40,159	52,195,805
Central Provinces	25,427	31,139	16,604,896
Bombay	42,310	20,157	19,383,756
Sind	14,261	3,911	4,237,554
Madras	213,224	104,244	47,201,665
Coorg	6,005	1,642	164,619
Assam	25,560	20,495	8,438,246
Baluchistan	75	2,417	868,617
Totals	886,289	447,889	271,984,121 *

* Total in this column is not constant throughout all tables because in some a province or two has been omitted.

—Modified from table in: *Annual Report of the Public Health Commissioner with the Government of India for 1937*, New Delhi, Government of India Press, 1939, vol. 1.

dysentery found in India are shown in Table 11, which is taken from the official report of the army in India.

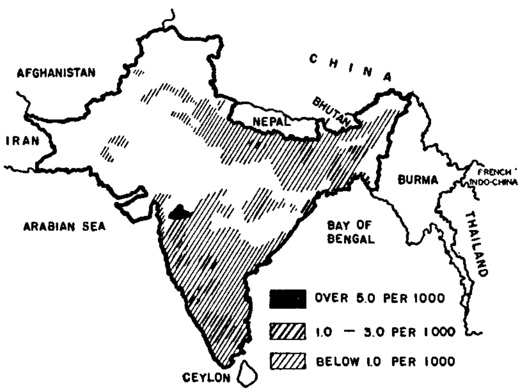
TABLE 11

Types of Bacillary Dysentery Isolated in Army Laboratories in India in 1940

Type of causative organism	Cases, no.	Per cent
Group A-1 B-Flexner-Andrew's strains V.W.X.Y.Z.	2,296	53
Group A-2 Boyd's strains, 103, 170 and 119	229	5
Group B Boyd's strains, 88, 288 D-1, 274	269	6
Group C B-Sonne	672	16
B Shiga	513	12
B Schmitz	345	8
Total	4,324	100

—*Annual Report on the Health of the Army in India for the Year 1940*, New Delhi, Government of India Press, 1941, vol. 3, pt. 1.

Cholera. Cholera is endemic in India and reports show that it tends to spread from its foci in the lower Bengal area along routes of travel into the northern and western, central and southern provinces in



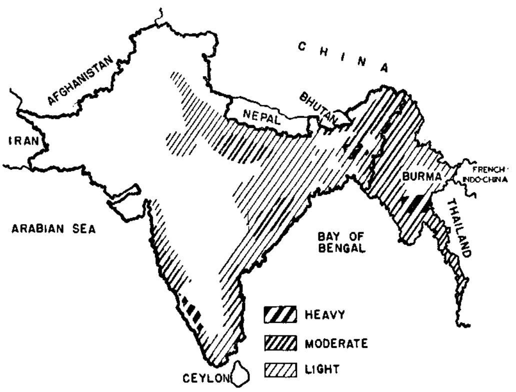
Cholera in India

cycles occurring every two to four years. The many religious pilgrimages have done much to spread this disease. From 1928 through 1937 the average annual number of deaths was 198,985 and during 1938, 236,143 deaths from cholera were reported in India. During 1937, 10,272 of the 442,375 villages were infected with cholera. During that same year, 5,170,097 anti-cholera inoculations were carried out. In the middle of 1942 an epidemic of cholera occurred in Madras, and from June 28 through November 21, 43,779 cases of cholera resulting in 20,868 deaths occurred in that area. During 1942 the city of Bombay reported 3,939 cases of cholera from July 11 through August 8. Calcutta reported 68 cases, with 21 deaths, from August 21 through December 5 of that year. The total number of reported cases of cholera for all India from January 1 through September 30, 1942, was 86,598. Cholera did not occur among the personnel of the British army in India during 1937, but one instance of it resulting in death occurred in 1940.

Common Diarrheas. These occur and in some cases are caused by bacteria of the genus Salmonella, many of which are pathogens of domestic animals and rodents. The so-called hill diarrhea occurs chiefly among Occidentals residing in the hill and mountain districts at elevations of 6,000 feet or more. This diarrhea tends to break out in epidemic form during the monsoon rains. The term "hill diarrhea" is popularly used to designate the true enteric diseases as well as the specific syndrome which is referred to as "hill diarrhea." This syndrome is characterized by abdominal distention, flatulence and the passage during the early morning of from one to several watery, frothy, inoffensive stools. The gross appearance of the stools has been likened to that of whitewash. During the early stages of the disease symptoms are relieved by the patient's return to the lowlands; but if the disease is neglected, it develops ultimately into typical sprue. In the past the relationship of the physical and climatic factors to the development of this diarrhea has been stressed, but there is recent evidence to suggest that in the main it is caused by bacterial infection. There is, however, no one organism that can be considered to be responsible for the epidemics of this disease, and it is believed that there is a large variety of pathogenic and potentially pathogenic organisms that are of etiologic significance. Staphylococcic and streptococcic toxins and the ingestion of rancid, not easily digested fats and oils also may be causative factors.

Helminthiasis. Helminthiasis is prevalent throughout India. Widespread pollution of soil and improper habits of hygiene and sanitation are factors favoring its prevalence.

INFECTION WITH HOOKWORM. Ideal conditions exist for the propagation of hookworm disease throughout many sections of



Hookworm in India

India. It is estimated that the incidence of infection with hookworm in the whole country will vary from about 40 to as high as 70 or 80 per cent. It is thought that at least 210,000,000 of India's people are infected. The highest rate of infection occurs in the tea-garden sections of Assam and Bengal and in the southern part of India in the tea and coffee plantations of Coorg, Travancore and South Kanara. Infection with hookworm is moderately endemic in the central part of Bihar, the eastern part of the United Provinces, along the foothills of the Himalaya Mountains, and in some areas of Madras. North-West Frontier province, Sind and other sections of northwest India are stated to be relatively free of this type of infection. Rates for infection with hookworm are high among the miners of the eastern part of India and also among the coolies engaged in the collection of night soil. *Necator americanus* predominates in the southern and eastern parts of India and is gradually replaced by *Ancylostoma duodenale* as the northwestern part of India is reached.

INFECTION WITH ROUNDWORM (*Ascaris lumbricoides*). This disease is common throughout India, especially among children, but statistics regarding its prevalence are not available.

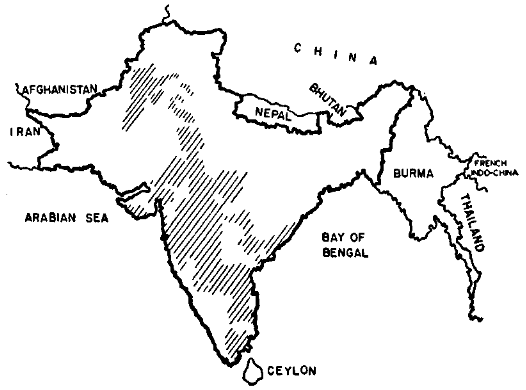
INFECTION WITH TAPEWORM. Infection with *Taenia solium* and *T. saginata,* although it occurs in India, is not very common because the Hindu as a rule does not eat beef or pork; however, infection with tapeworm does occur among members of the lower classes who eat meat. Several years ago infection with the cysticerci of *Taenia solium* frequently occurred among British troops in India. *Hymenolepis diminuta* and *Hymenolepis nana* occasionally are found among human beings in India.

TRICHINIASIS. Infection with *Trichinella spiralis* is commonly encountered among those who eat pork.

INFECTION WITH WHIPWORM (*Trichuris trichiura*) AND PINWORM (*Enterobius vermicularis*). These troublesome infections are of aesthetic rather than economic or medical importance. However, they formed a significant percentage of the conditions for which 4,604,691 patients were treated for parasitism in the government hospitals and dispensaries in 1938.

INFECTION WITH FLUKES. The intestinal fluke, *Fasciolopsis buski,* is reported from parts of eastern India. The pig is the normal host and acts as the reservoir for the infection in man. The infection results from the eating of raw ling, *Trapa bicornis* (a type of water nut), or the raw "water chestnut," upon the surface of which the cercariae of the flukes have encysted. The lung flukes, *Paragonimus compactus* and *P. westermani,* only occasionally are reported from India. They affect the dog, wolf, fox, panther and cat as well as human beings. The cercariae of these flukes pass through cycles of their development in various fresh-water fish and crustaceans; ingestion of these fish or crustaceans in a raw state or not thoroughly cooked predisposes to paragonimiasis. The fluke, *Gastrodiscoides hominis,* also is recorded from parts of India, especially Assam. Its normal host is the pig. This particular type of infection is of little importance, but paragonimiasis and infection with *Fasciolopsis buski* may cause serious disease.

DRACONTIASIS, OR INFECTION WITH GUINEA-WORM. Dracontiasis, caused by



Guinea-worm in India

Dracunculus medinensis, is widespread in certain restricted rural areas of India in which water from step wells and ponds is in general use. The infection is not found in well-watered areas like Bengal, Assam, Bihar or in regions with abundant waterfall, such as the western coasts of Madras, Cochin and Travancore. Low or moderate rainfall, rocky soil and a scanty water supply seem to favor its appearance. In most of the endemic areas there is a rainfall of between 20 and 30 inches (50 and 76 cm.), but the infection usually is absent in areas receiving more than 40 inches (101 cm.) or less than 10 inches (25 cm.) of rain per annum. Infection with guinea-worm is not usually fatal, but it often causes much suffering and incapacity. In Damoh in the Central Provinces the disease formerly was endemic, but it completely disappeared after the introduction of a system in which water is piped. The embryos of *D. medinensis* enter the *Cyclops quadricornis* or water flea. If this flea later is ingested, infection results.

Undulant Fever. Undulant fever is endemic, but is not common because of the widespread custom of boiling milk before it is consumed. During 1940, two soldiers among British troops in India contracted the disease, and in both cases the disease was thought to be due to the drinking of unsterilized milk while the men were on a railroad journey. During the same year this disease was diagnosed a total of 14 times by serologic methods in Army laboratories.

DISEASES SPREAD CHIEFLY THROUGH RESPIRATORY TRACT

Pneumonia. The mortality rate from pneumonia and influenza is extremely high. During 1938 respiratory diseases were responsible for 536,649 deaths, half of which probably were caused by pneumonia. In the cities of Madras province during 1937 there were 6,674 deaths from pneumonia, or a rate of 1.8 per 1,000 of population per annum, and in the cities of the United Provinces there were 16,655 deaths from pneumonia, or a rate of 3.07 per 1,000. Influenza is common and during 1937, 14 provinces of British India reported 1,057,373 cases, with 204 deaths. The rate of admissions to the hospital for influenza in the British Army in India for the same year was 16.4 per 1,000 with no deaths, and in 1940 the rate was 12.1 per 1,000.

Tuberculosis. Tuberculosis is widespread throughout India, and the incidence of the disease is increasing (Table 12). The growing industrialization of the country, associated with overcrowding in insanitary slums and the rapid exchange of population between urban and rural areas, are contributing toward wide dissemination of the disease. Some state that the prevalence of tuberculosis in the population in India today is midway between that among the virgin African races and that among the highly urban and industrialized races. At present, the majority of the cases are recorded in the urban areas. It is estimated that some 10 to 20 per cent of the "fever deaths" and 20 per cent of the deaths due to respiratory disease actually are caused by pulmonary tuberculosis. Use of the percentage of 20 in each case would produce

TABLE 12

*Pulmonary Tuberculosis as Treated in Class 1 to Class 7 * Hospitals and Dispensaries of India, 1929 through 1938*

Year	Inpatients Treated	Inpatients Died	Outpatients treated ‡
1929	26,866	3,390	100,377
1930	28,952	4,057	108,966
1931	30,626	4,380	118,686
1932	41,534	3,867	119,563
1933	28,799	4,151	130,002
1934	†	4,598	169,156
1935	†	4,491	186,878
1936	†	4,230	207,819
1937	†	4,139	201,204
1938	†	4,621	223,266
Total	156,777	42,524	1,565,917

* Explanation of classes: Class 1, state-public supported; Class 2, local fund supported; Class 3, private but aided; Class 4, state special; Class 5, railway hospital; Class 6, private and unaided; Class 7, subsidized.

† Reported as included in the total number of outpatients in designated years.

‡ Information as to the death rate among outpatients could not be obtained.

—Adapted from table in: *Statistical Abstract of British India, 1938*, Calcutta, Government of India Press, 1941.

a total of 884,000 deaths caused by pulmonary tuberculosis during 1938. Assuming a population of 350,000,000, this would mean a pulmonary tuberculosis death rate of 253 per 100,000 population, as compared with a rate of 44.6 for the United States for the same year. Thus, deaths due to pulmonary tuberculosis in India are more than 5½ times greater than in the United States. Tuberculosis of other types than of the lungs, that is, tuberculosis of bones, joints, skin and intestines, also is common. Tuberculosis control has only been started; in 1937 it was reported that the total number of beds set aside for tuberculous patients did not exceed 1,500. The Tuberculosis Association of India, a union of several organizations working in this field, dominates this work.

Meningococcic Meningitis. This disease is endemic, occurring in epidemic outbreaks from time to time. During 1940 the rate of admissions to the hospital per 1,000 for this disease among British troops in India was 0.2.

Psittacosis. This viral disease occasionally is recorded from India. In 1940 a British soldier who had been in contact with sick parrots and budgereegahs contracted the disease.

Miscellaneous Respiratory Infections. Smallpox occurs throughout India. Vaccination against this disease is compulsory in only about 75 per cent of the towns and in less than 50 per cent of the rural areas of British India, and even in those areas the law is not enforced. Defects in registration of births allow many children to escape vaccination. In many cases vaccination is poorly done and regulations in respect to revaccination are not enforced. During 1937 in British India, 48,812 deaths from smallpox were reported in rural areas and 5,998 from urban areas. About 45 per cent of the deaths were among children under 10 years of age. In 1938 British India reported 39,844 deaths from smallpox. Diphtheria, measles, mumps, chickenpox, poliomyelitis and encephalitis are endemic, and may be expected to occur in outbreaks or epidemics from time to time. Scarlet fever, however, is not a common disease in many sections of India. During 1937 a total of 598,135 patients who had rheumatic fever and rheumatism were treated in the government institutions in British India.

Diseases Spread by Contact

Venereal Diseases. All five of the venereal diseases, namely, syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale, occur in India. In 1932, of every 10,000 patients attending government hospitals and dispensaries in British India, approximately 90 had one or more of the venereal diseases. The provincial rates were: Bombay, 190 cases per 10,000 per annum; Madras, 140; Delhi, 130; Central Provinces, 90; Bihar and Orissa, 90; Bengal, 80; United Provinces, 70; Baluchistan, 40; and the North-West Frontier province, 40. The rates for the Punjab, Coorg and Assam were less than 40 per 10,000 per annum. The number of patients with syphilis treated annually in the government institutions in British India from 1929 through 1938 varied from 322,513 to 358,340. The number of patients with gonorrhea treated each year during this same period varied from 261,765 to 317,694. Chancroid, lymphogranuloma venereum, and granuloma inguinale are common diseases. Among the personnel of the British Army in India during 1937 the rate of admission to hospitals for venereal diseases varied from 9 to 50.1 per 1,000 per annum, the rate for all troops in India being 40.4 per 1,000. By the year 1940 the rate of admission for venereal diseases for all the troops in India had increased to 58.1 per 1,000 per annum, the rate for gonorrhea being 30.9 per 1,000 per annum, for syphilis 12.7, and for soft chancre 14.5. It would seem probable that the patients who are treated are predominantly male, and that the female group is largely untreated. Brothels are numerous in the cities and except for their restriction to certain sections of towns, they are operated openly and are not subjected to any form of supervision or control. The problem of venereal disease is further complicated by the fact that casual sexual contacts are easily arranged.

Yaws or Frambesia. This disease, caused by the *Treponema pertenue,* is found chiefly among the primitive peoples living in the rural sections of Assam, Bengal, Bihar, Orissa, Central Provinces, Bastar State and Madras. In many sections the disease has a local name; for instance, in Orissa among the Koya hill tribes it is known as "koya disease." During 1937, 2,607 patients were treated in the public health dispensaries and hospitals in Assam. Although the clinical manifestations of yaws are seen in all age groups, the disease is almost invariably acquired during childhood; primary infection during adult life is rare. It is probable that yaws is spread by contact and that houseflies, stable flies and eye gnats also serve as mechanical vectors of the disease. Yaws is rarely found among Occidentals.

Diseases of the Skin. Tinea infections, such as tinea cruris (dhobie or washerman's itch), tinea versicolor, tinea imbricata (Malabar itch) and ringworm of the feet, so-called Hong Kong or Singapore foot, are prevalent in India. Fungous infections of the ear, sometimes called "Singapore ear," are not uncommon. Unless these diseases are promptly treated serious complications are likely to develop; these include stenosis of the external auditory canal, secondary infection with pyogenic organisms and destruction of the structures of the internal ear. Occidentals who go to India often have chronic mild tinea infections, such as "athlete's foot"; under tropical conditions such infections are likely to become acute.

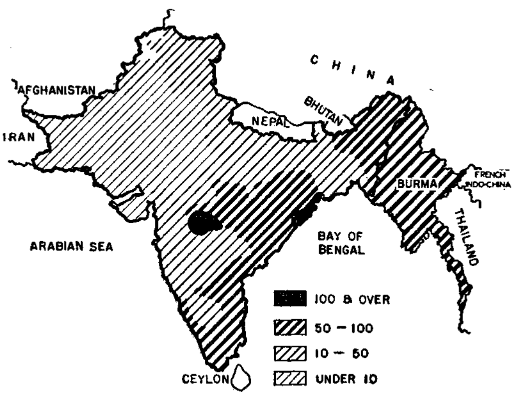
Tropical ulcer, common at times, is often caused by *Spirochaeta schaudinni.* In Assam it is called "Naga sore." Sometimes the ulcers occur in epidemics, as for example in Assam a few years ago, when large numbers of laborers on the tea plantations were affected. Deficient diets, causing lowered body resistance, are a factor in the increased prevalence of tropical ulcers. Impetigo and pemphigus contagiosus also are present. Prickly heat and boils are common, especially during the hot seasons.

Parasitic diseases, such as scabies and irritation of the skin caused by lice, are of common occurrence. In 1940 the rate of admissions to the hospital per 1,000 for British troops in India was 1.7; for Indian troops the rate was 16.8 per 1,000.

Cutaneous leishmaniasis or Oriental sore or Delhi boil is prevalent in the northern and western parts of India, especially in the United Provinces and Punjab. It is caused by *Leishmania tropica,* which in India is transmitted by *Phlebotomus papa-*

tasii. In all India the rate of infection with this disease among British troops in 1940 was 0.74 per 1,000, but among those soldiers stationed at Quetta in northwestern Baluchistan the rates for 1936, 1937, 1938, 1939 and 1940 were 43.75, 23.06, 43.16, 21.23, and 8.21 per 1,000, respectively. The decrease in incidence was achieved by means of measures for the control of sand flies, chiefly the spraying of barracks.

Leprosy. Leprosy in India has its greatest prevalence in the coastal section of



Leprosy in India

Orissa, in the southwestern parts of the Central Provinces and in the northern part of Hyderabad. It is less prevalent in the other areas of southern and western India, and in northwestern India, except for Kashmir, it is sparsely distributed. Dietary deficiencies among the people appear to predispose to the disease. It is estimated that there are more than 1,000,000 lepers in India. Existing religious and social conditions, along with the joint-family system, favor the persistence of the disease. Work in the control of leprosy is limited to the providing of accommodations and treatment in leprosaria, which can care for only about 10,000 patients.

Diseases of the Eyes. It is estimated that there are approximately 1,500,000 blind and 4,500,000 partially blind persons in India. The chief causes of blindness and defective vision are smallpox, trachoma, gonorrheal ophthalmia and syphilitic iritis. In some districts cataracts are common. In the northwestern part of India trachoma is said to be universal, and in Assam 75 per cent of all patients treated for diseases of the eyes are reported to have trachoma.

Epidemic Keratoconjunctivitis. This disease in India is of importance inasmuch as it may completely incapacitate large numbers of people for one to two weeks and result in various degrees of diminished visual acuity for six to 12 weeks. It is a potential danger most likely to be encountered in the industrial areas or in other areas in which people are brought into close and prolonged contact.

Tetanus. Tetanus is not uncommon, being most frequently seen among newborn infants and among mothers after parturition.

Leptospirosis. Leptospirosis, spirochaetosis icterohaemorrhagica or Weil's disease, caused by the *Leptospira icterohaemorrhagiae,* is encountered in many parts of India. Because of the great rat population it is probable that the disease is more prevalent than the number of reported cases would indicate.

Rat-bite Fever. This disease is caused by *Spirillum minus,* which is introduced into the wound made by the bite of the rat. Like Weil's disease, rat-bite fever infrequently appears in records of the incidence of diseases in India, but is known to occur.

Rabies. Rabies is endemic throughout India. In 1934 the six Pasteur Institutes and their associated antirabic centers treated 44,963 patients for rabies. Only 0.35 per cent of the treatments were failures (that is, death occurred in spite of treatment). The annual number of patients treated is more than 40,000 and it is estimated that several thousand other patients do not present themselves for medical treatment.

Madura Foot or Pseudomycosis. This condition is found in widely scattered districts, although large areas within those districts may be completely free of the disease. It is acquired chiefly in rural districts.

Among the more heavily infected places are Madura, after which the condition is named, Delhi, and sporadic foci in Punjab, Kashmir and Rajputana. This fungous disease affects principally the foot, occasionally the hand, and rarely the internal organs or other parts of the body. It has a chronic course which never terminates in spontaneous recovery. Unless the affected part is removed, death results after many years.

Diseases Spread by Arthropods

Malaria. Malaria is India's major health problem. It is endemic in many areas, hyperendemic in others, and also occurs in epidemic outbreaks in many sections of the country. It is more prevalent in the rural areas than in the urban districts. In 1938 no less than 3,883,627 deaths were reported from British India as being caused by "fevers," of which more than 1,000,000 were probably caused by malaria. The rest were caused by enteric diseases, tuberculosis, and other conditions. In Bengal it is stated that more than 60 per cent of the total population suffer from malaria every year, and in that area it is probable that among the deaths caused by fever the deaths due to malaria may be as high as 50 or 60 per cent. The number of patients with malaria treated in government institutions in British India from 1929 through 1938 has varied from 10,350,298 to 13,163,203 yearly. In rainy years the incidence of malaria is definitely increased. Authorities state that in ordinary years malaria causes more than 1,000,000 deaths, whereas in years in which severe regional epidemics occur the number of deaths may be increased to 1,250,000 or more. Furthermore, malaria, by its direct and indirect action, is said to be responsible for 2,000,000 or more deaths each year. It is also estimated that from 100,000,000 to 200,000,000 or more cases of malaria develop in India each year and one authority states that in some 15,000,000 of these cases the disease is man-made, in that rice-field irrigation, wells and the like are not subject to measures for the control of anopheline mosquitoes.

In Table 13 is shown the distribution of malaria throughout India. It will be noted in this table that in the provinces of Coorg, Bengal and Assam, malarious patients constituted a larger proportion of the total number of patients treated for all types of disease than was true in other areas. However, the number of malarious patients in the other provinces also is high. The admission rate for malaria among the personnel of the British Army as a whole in India for 1937 was 44.5 per 1,000 per annum, and the rate for 1940 was 73.4 per 1,000. In one district, Quetta in the northwestern part of Baluchistan, the admission rate was 194.7 per 1,000 per annum during 1937, but by 1940 it had decreased to 86.7 per 1,000.

TABLE 13

Malaria in Hospitals and Dispensaries During 1937

Province	Patients: Number	Patients: Per cent of total number treated *	Population
North-West Frontier Province	539,866	21.1	2,523,589
Punjab	1,568,000	9.7	26,069,627
Delhi	94,725	10.7	699,157
United Provinces	1,224,684	12.0	52,390,009
Bihar	1,302,498	17.4	34,695,892
Orissa	369,857	18.0	7,209,846
Bengal	3,798,933	32.1	52,195,805
Central Provinces	653,405	15.7	16,604,896
Bombay	588,751	15.3	19,383,756
Sind	242,485	23.3	4,237,554
Madras	1,107,937	6.0	47,201,665
Coorg	161,058	41.8	164,619
Assam	716,192	30.3	8,438,246
Baluchistan	113,204	17.0	868,617
Totals	12,481,595	15.2 avg.	272,683,278 †

* That is, treated for any type of disease; not for malaria alone.

† Total in this column is not constant throughout all tables, because in some a province or two has been omitted.

—Modified from table in: *Annual Report of the Public Health Commissioner with the Government of India for 1937*, New Delhi, Government of India Press, 1939, vol. 1.

Malaria occurs throughout the year, and it has a higher incidence during the late summer and fall, as a rule. However, in Assam and Bengal, in the majority of cases, it occurs during May, June, July and August, with the greatest number of patients being recorded in July. All three types of malaria occur. In the country as a whole, about 20 to 25 per cent of the malaria is of the estivo-autumnal type, about 70 to 75 per cent is of the tertian variety, and 0.25 to 1.5 per cent is of the quartan type. In the tropical areas the estivo-autumnal type is predominant, and in the cooler districts the tertian type is more common. In Assam from 50 to 75 per cent of the malaria is of the estivo-autumnal type. The quartan type is irregular in its distribution and occurs more commonly in the southern part of India. Malaria usually is not found at altitudes of more than 6,500 to 7,000 feet.

In 1937, 51,392 pounds of quinine and drugs containing quinine were issued in India by the government agencies. About three fourths of this supply was distributed free. Much work on the problem of malaria, including research, survey and control, has been carried out by the Government of India through the India Research Fund Association and the Malaria Survey of India. The International Health Division of the Rockefeller Foundation and the Ross Institute of Tropical Hygiene have aided in this work. Although much work in the control of malaria has been done, in general only a start has been made and the gross problem in respect to this disease has been scarcely touched. The immense reservoir of malaria among the native people, along with the enormous numbers of anopheline mosquitoes, makes the control of malaria the greatest single medical problem for persons residing in India.

BLACKWATER FEVER. This is a condition associated with the estivo-autumnal type of malaria, and is found in India, especially in Bihar, Assam, Darjeeling, the Terai, Dooars, Meerut and Amritsar.

Dengue Fever. Dengue fever, carried by *Aedes aegypti* and *A. albopictus* mosquitoes, is endemic in India and is especially prevalent in the Calcutta area. It also is found frequently along the coastal areas of south India, in central India, and across north India, with some endemic areas in Punjab. Its vectors, however, are widely distributed and the disease could easily appear in epidemic form in almost any section of India. During 1940 dengue was responsible for 6.7 admissions to hospitals per 1,000 among British troops in India. It occurs more commonly after the rainy seasons. The mortality rate of dengue is practically nil, but the morbidity rate is high among nonimmune persons in regions in which the disease is endemic.

Filariasis. Two types of filariasis, namely, that caused by *Wuchereria bancrofti* and that caused by *Wuchereria malayi*, occur in India. In general, filariasis is to be found in the southern two thirds of India from Sind across to the eastern part of Bengal, and appears to be more prevalent in the coastal provinces than in the interior provinces. The principal vectors of *Wuchereria bancrofti* are Culex mosquitoes, and the chief vectors of *Wuchereria malayi* are Mansonia mosquitoes. In a recent report from India it was stated that in Damda, a village in the Central Provinces with a population of 3,628, there were 80 cases of elephantiasis, and that the blood of 28 of 140 apparently normal persons examined contained microfilariae, all of the species *malayi*. In reports from Bombay and Bihar and Benares it is stated that filariasis in those areas is of the type caused by *Wuchereria bancrofti*. In Kashmir and most other sections of the northern part of India filariasis does not occur.

Yellow Fever. This disease has never been reported from India but its principal vector, the *Aedes aegypti* mosquito, and other mosquitoes capable of transmitting this disease are widely distributed throughout India. In view of the frequent air travel to India from the areas in tropical Africa in which yellow fever is endemic, a patient ill with the disease or infected mosquitoes could easily be brought into the country. However, strict quarantine measures are enforced and to date the disease has not been introduced into India or other parts of the Near, Middle or Far East.

Typhus Fever. Four types of typhus fever, viz., (1) the epidemic louse-borne and (2) the endemic flea-borne types, (3) the mite-borne type caused by *R. orientalis,* and (4) the tick-borne type, are found in India and are widely distributed. The epidemic louse-borne and the endemic flea-borne types are found throughout India, the louse-borne type being most common in the northern part of India. Mite-borne typhus fever has been reported only within the last few years, and occurs chiefly in the rural areas of the northern (especially in the Simla Hills), eastern and southern parts of India, among those working in or with grasses in the hill lands or in cleared jungle areas and on palm-tree plantations. The incidence of this fever usually is greatest during the autumn. Tick-borne typhus fever more commonly occurs in the northern and central part of India in the Kumaun Hills and in the northwestern part of India. During 1939 and 1940 there were 30 instances of typhus fever each year among British troops in India. In 1940 in the army laboratories 93 serologic diagnoses of typhus fever were made, in 44 of which the strain of *Proteus vulgaris* that was agglutinated was found to be the OX type, in 11 of which the strain was the OX_2 type, and in 38 of which the strain was the OXK type. It is probable that typhus fever is more prevalent than is indicated in Table 14.

Plague. Plague is endemic. The greatest number of deaths from plague in recent years was recorded in 1924, when about 530,000 persons died of this disease. During 1937, 28,169 deaths were reported from British India as being caused by this disease; about 92 per cent occurred in rural districts and the remaining 8 per cent in urban areas. During this same year the Indian states and agencies reported an additional 8,037 deaths. Of the 17,371 reported deaths caused by plague in British India for 1938, some 80 per cent occurred in the United Provinces. However, in other years the incidence may be higher in other districts. In general, most sections of India have the smallest number of deaths from

TABLE 14

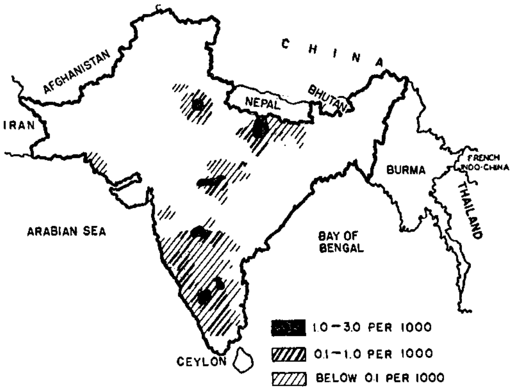
Cases of and Deaths from Typhus Fever in the Hospitals and Dispensaries of India in 1937

	Louse-borne		Tick-borne		Vector unknown		
Region	Cases	Deaths	Cases	Deaths	Cases	Deaths	Population
North-West Frontier Province	1	1	64	.	11	..	2,523,589
Punjab	126	1	1	.	212	10	26,069,627
United Provinces	121	1	30	5	414	2	52,390,009
Bihar	101	..	36	.	112	6	34,695,892
Orissa	84	..	3	.	12	..	7,209,846
Bengal	304	2	30	.	358	1	52,195,805
Central Provinces	44	1	5	.	25	1	16,604,896
Bombay	396	4	...	.	42	1	19,383,756
Sind	6	..	...	.	3	..	4,237,554
Madras	220	..	56	.	1,793	..	47,201,665
Coorg	.....	..	...	.	.....	..	164,619
Assam	.....	..	...	.	.....	..	8,438,246
Totals	1,403	10	225	5	2,982	21	271,115,504 *

* Total in this column is not constant throughout all tables because in some a province or two has been omitted.

—Modified from table in: *Annual Report of the Public Health Commissioner with the Government of India for 1937,* New Delhi, Government of India Press, 1939, vol. 1.

plague in October and the largest number in March. In most of the cases the disease is of the bubonic type, but the septicemic type also occurs. During 1937, 611,935 antiplague inoculations were carried out.



Plague in India

Relapsing Fever. Tick-borne and louse-borne relapsing fever occurs in India. The tick-borne type, said by some to be caused by what has been called *Spirochaeta persica,* is more prevalent in the northwestern part of India. The louse-borne type, caused by *Borrelia carteri,* is more common in the northern two thirds of India, although it does occur throughout the entire country. In 1922 extensive epidemics of the louse-borne type of relapsing fever occurred in the Central Provinces and in the North-West Frontier province. Relapsing fever in recent years has been a rare disease among British troops in India.

Sandfly Fever or Pappataci Fever. This disease is carried chiefly by *Phlebotomus papatasii,* and is found in many parts of northern and western India extending from Karachi across to the northern part of the United Provinces and to Bihar. The morbidity rates are especially high in northwest India, where, among British Army troops stationed at Peshawar in the North-West Frontier province, the total yearly admission rate was 179.7 per 1,000 per annum during 1937, and for all India the rate was 24.6. It occurs more commonly during the summer and early autumn. Sandfly fever rarely causes death, but like dengue fever, is the cause of high morbidity rates.

Kala-azar. Kala-azar, caused by *Leishmania donovani* and carried by *Phlebotomus argentipes,* is an important disease in Assam, Bengal, Bihar, Orissa, in the United Provinces as far west as Lucknow, and down through Madras to Tuticorin. It is most prevalent in the areas of Bihar south of Nepal and north of the Ganges River. It occurs among children and young adult persons more commonly than among older people. It is more prevalent in rural areas than in urban districts. New infections occur most commonly from April through November. In Table 15 is shown the distribution of this disease during 1937. The disease does occur occasionally among Occidentals. Prevention depends upon control of the sandfly.

TABLE 15

Kala-azar Treated and Deaths from It in Hospitals and Dispensaries in India During 1937

Region	Cases	Deaths	Population
North-West Frontier Province	....	...	2,523,589
Punjab	28	...	26,069,627
Delhi	36	...	699,157
United Provinces	701	9	52,390,009
Bihar	91,942	316	34,695,892
Orissa	63	2	7,209,846
Bengal	103,148	398	52,195,805
Central Provinces	7	...	16,604,896
Bombay	20	...	19,383,756
Sind	....	...	4,237,554
Madras	2,517	19	47,201,665
Coorg	....	...	164,619
Assam	6,712	66	8,438,246
Totals	205,174	810	271,814,661 *

* Total in this column is not constant throughout all tables because in some a province or two has been omitted.

—Modified from table in: *Annual Report of the Public Health Commissioner with the Government of India for 1937,* New Delhi, Government of India Press, 1939, vol. 1.

MISCELLANEOUS

Nutritional Diseases. These diseases, although they do occur throughout the country, are more prevalent among the rice-eating peoples of the eastern part of India. Keratomalacia (often associated with deficiency of vitamin A), pellagra, beriberi, scurvy, osteomalacia, dental caries and secondary anemia are common. Goiter occurs in isolated districts of Himalayan India. Epidemic dropsy, caused by the use of mustard oil which has been contaminated with *Argemone mexicana,* is to be found chiefly among the Bengalese. In 1938, 45,788 patients who had beriberi, actually representing only a fraction of the total number, were treated in the government institutions of British India. The wet type of beriberi and epidemic dropsy are commonly present in the same districts, and often the clinical distinction between the two conditions is not clear.

Injuries Caused by Heat. Heat stroke, heat exhaustion, heat cramps, prickly heat and heat boils occur in most parts of India during the hot season and are more common among Occidentals than among the native inhabitants. During 1937 heat stroke and heat exhaustion in the British Army in India occurred chiefly among troops that were stationed in the North-West Frontier province and in the northern part of the Punjab.

Infective Hepatitis. Sporadic instances of infective hepatitis have been reported among the natives and the personnel of the British and Indian armies in India. Among the British Army personnel in 1939 the rate of admissions to the hospital for "jaundice" per 1,000 per annum was 6.3, whereas in 1940 it had increased to 9.0. Among the personnel of the Indian army the corresponding rates were 3.4 for 1939 and 4.3 for 1940. This disease continues to be endemic.

SUMMARY

Public health, hospital and medical facilities in India are inadequate for the health and medical requirements of the people. Medical supplies and equipment are manufactured in limited quantities. Limited amounts of wheat, mutton, beef, fruits and vegetables are available, and most of the food and dairy products to be used by Occidentals have to be imported. Inspection of food and dairy products to ensure health protection is either lacking or is entirely inadequate. Water is plentiful in some areas and scarce in others, but regardless of its source, it should be considered to be unsafe for human consumption until it has been adequately treated. Systems in which sewage is water-borne are found in the largest cities. In most smaller municipalities and towns no community systems for the disposal of sewage are provided, although septic tanks, bucket systems or privies may be in use. In the rural areas, even though the government has encouraged the use of latrines, promiscuous defecation is common, and widespread pollution of the soil results. India abounds with mosquitoes capable of carrying malaria, dengue, filariasis and yellow fever, and there are other insects, including flies of various types, lice, ticks, fleas and mites. Centipedes, scorpions, leeches, monkeys, poisonous and nonpoisonous snakes, jackals, wild dogs, bears, leopards, tigers, and wild elephants are pests or potentially dangerous animals which vary greatly as to distribution.

The most important infectious diseases of India are malaria, cholera, plague, typhoid and paratyphoid fevers, dysentery, the venereal diseases, tuberculosis, hookworm, leishmaniasis, pneumonia and fungus infections of the skin.

BIBLIOGRAPHY

All-India Institute of Hygiene and Public Health: Annual Report, 1939. Calcutta, Govt. of India Press, 1940.

Biraud, Y.: Present-Day Problems of Yellow Fever. Epidemiol. Rep. League of Nations, **14**:103-175 (July-Sept.) 1935.

Biswas, K., and Calder, C. C.: Handbook of Common Water and Marsh Plants of India and Burma, 1936. Delhi, Manager of Publications, 1937 (Health Bulletin No. 24; Malaria Bureau No. 11).

Bradfield, E. W. C.: An Indian Medical Review. Delhi, Govt. of India Press, 1938.

Chandler, A. C.: New Schistosome Infection of Man, with Notes on Other Human Fluke Infections in India. Indian J. M. Research, **14**: 179-183 (July) 1926.

Charpurey, K. G.: The Snakes of India, 2d ed. Bombay, The Popular Book Depot, 1937.

Chopra, R. N., and Chopra, G. S.: The Present Position of Hemp-Drug Addiction in India. Calcutta, Indian Medical Research Memoirs, 1939 (Memoir No. 31).

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

Christophers, S. R., and Stinton, J. A.: A Malaria Map of India. Indian J. M. Research, **14**: 173-178 (July) 1926.

Covell, G.: The Distribution of Anopheline Mosquitoes in India, 2d ed., revised by I. M. Puri. Delhi, Govt. of India Press, 1936 (Health Bulletin No. 17: Malaria Bureau No. 8).

——: Critical Review of Data Recorded Regarding Transmission of Malaria by Different Species of Anopheles: With Notes on Distribution, Habits and Breeding Places. Indian J. M. Research (Memoir No. 7), 1-117 (July) 1927.

——: Lectures on Malaria. Delhi, Govt. of India Press, 1940 (Health Bulletin No. 5; Malaria Bureau, No. 1).

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Field Service Hygiene Notes, India, 1940. Delhi, Govt. of India Press, 1941.

Gangulee, N.: Health and Nutrition in India. London, Faber and Faber, Ltd., 1939.

Hehir, P.: Malaria in India. London, Oxford University Press, 1927.

India. Army. Medical Directorate: Annual Report on the Health of the Army in India for the Year 1940. Delhi, Govt. of India Press, 1941.

——: Dept. of Commercial Intelligence and Statistics: Statistical Abstract for British India, with Statistics Where Available, Relating to Certain Indian States, 1938. Delhi, Govt. of India Press, 1941.

——: Home Dept.: India in 1932-33. Delhi, Govt. of India Press, 1934.

——: Medical Dept.: Annual Report of the Public Health Commissioner with the Government of India for 1937. Delhi, Govt. of India Press, 1939, 2 vols.

Indian Year-Book and Who's Who, 1941-42. Bombay, The Times of India Press, 1942.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Kumm, H. W.: Geographical Distribution of the Yellow Fever Vectors. Baltimore, American Journal of Hygiene, 1931 (Am. J. Hyg. Monographic Ser. No. 12.)

League of Nations. Health Organisation: Health Organization in British India. Calcutta, 1928.

——: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers Relating to British India. Geneva, 1937.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr, 11th ed. Baltimore, The Williams & Wilkins Co., 1941.

Puri, I. M.: Synoptic Table for the Identification of the Anopheline Mosquitoes of India, 4th ed. Delhi, Govt. of India Press, 1941 (Health Bulletin No. 16; Malaria Bureau No. 7).

Rao, S. S.: Observations on Filariasis in Lakhipur and Binakandy Tea Gardens (Cachar District, Lower Assam). Indian J. M. Research, **30**:345-350 (Apr.) 1942.

Sinton, J. A.: What Malaria Costs India. Delhi, Govt. of India Press, 1939 (Health Bulletin No. 26; Malaria Bureau No. 13).

——, and Raja, R.: Man-Made Malaria in India. Delhi, Govt. of India Press, 1939 (Health Bulletin No. 22, Malaria Bureau No. 10).

Stamp, L. D.: Asia. An Economic and Regional Geography. New York, E. P. Dutton & Co., 1939.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942, 2 vols.

Swaminath, C. S., Short, H. E., and Anderson, L. A. P.: Transmission of Indian Kala-Azar to Man by the Bites of Phlebotomus Argentipes, Ann. and Brun. Indian J. M. Research, **30**: 473-477, 1942.

Topping, N. H., Heilig, R., and Naidu, V. R.: A Note on the Rickettsioses in India. Public Health Reports, **58**:1208-1210 (Aug. 6) 1943.

The Transmission of Kala-Azar. Indian J. M. Research, **30**:479-480 (July) 1942.

Young, T. C. M., and Chalam, B. S.: Two New Sandflies from Bombay. Indian J. M. Research, **14**:849-862 (Apr.) 1927.

7

Japan

GEOGRAPHY AND CLIMATE

The territory generally considered to be Japan proper as distinct from the empire is situated between 24 and 51° of north latitude and 123 and 157° of east longitude. It includes on the north the 47 Kuril Islands; on the south the 140 Ryukyu Islands, now the prefecture of Okinawa; and the main group of islands, Hokkaido, Honshu, Kyushu and Shikoku. On the west the boundary is the Sea of Japan; on the east it is the Pacific Ocean. The East China Sea bounds the southwestern border of Japan, or more specifically, that of the island of Kyushu. At the north the Soya Strait separates Hokkaido from Sakhalin (Karafuto), the southern part of which is owned by the Japanese. The area of the four islands of Japan proper is only about 148,000 square miles—less than that of California (158,297 square miles). In this relatively small territory live some 70,000,000 Japanese, of whom, on Honshu, there are no less than 420 to the square mile. It is believed that in 1941 there were not more than 29,000 Europeans in all Japan.

The physical features of Japan are complicated. Three great mountain chains form natural terrestrial divisions; the northern system, the Karafuto range, embraces Sakhalin Island, Hokkaido Island and the northern part of Honshu, and is characterized by low and rounded eminences which ascend in undulating succession. The Kuenlun system of mountains covers the southern part of Honshu Island, and Shikoku and Kyushu islands. Between these two massive systems lies a roughly mountainous region in which Fujiyama, a peak more than 12,000 feet high, is the loftiest point. This region apparently overlies a subterranean center of profound volcanic activity, since 58 of about 200 volcanoes in the region are periodically active.

Japan has no exceptional hydrographic features. It is true that rivers are numerous, but they are comparatively short, rapid and unnavigable. Lakes and lagoons are frequent in Honshu and Hokkaido. Thermal and mineral springs are found in several sections, but swamplands also are present. The varied coast line has provided a number of excellent harbors.

TABLE 16

Salient Climatic Data, Annual Figures, Certain Cities in Japan

City	Temperature, ° F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Abashiri	97	−21	42	33.3	78	W, ?	128
Fukuoka	99	17	59	64.0	78	E, ?	20
Hiroshima	101	17	59	61.3	74	N, ?	10
Ishinomaki	96	6	51.8	46.2	81	N, ?	148
Nagano	100	2	52	38.8	76	....	1,378
Tokyo	98	15	57	64.0	74	NW, 25	20
Yamagata	100	−5	52	48.9	80	....	509

The climate of Japan is famous for its temperate quality, although the northern sections may be covered by snow for from two to three months of the year. It has been said that a temperature of about 82° F. (27.7° C.) is average for August, and that in January, which is the coldest month, the average temperature is about 35° F. (1.6° C.). The salient climatic data, expressed in annual figures, are seen in Table 16, and are based upon from 15 to 52 years of record. As a general statement, it can be said that rainfall is greatest in the southwestern part of Japan, and that in the summer it is more abundant on the Pacific coastlines, whereas in winter it occurs more often on the coast along the Sea of Japan, to the west. The southwestern and northwestern coasts are washed by the warm Japanese current; the northeastern coast is affected by the cold Chishima current.

PUBLIC HEALTH

Health Services

Organization. The report on Japan by the Health Organisation of the League of Nations in 1937 is reproduced herein as it was printed:

In Japan, the official health services are administered as follows: general public health, by the Central Sanitary Bureau of the Department of Home Affairs; industrial hygiene, by the Bureau of Social Affairs of the Department of Home Affairs; school hygiene, by the Department of Education; military hygiene, by the Army and Navy Ministries.

Administrative organisation of public health:

Central Organisation for Public Health.

(a) *Central Administrative Organisation.*

The Minister of Home Affairs controls public health administration in general.

The Central Sanitary Bureau, which forms part of the Department of Home Affairs, is divided into the four following sections:

(*i*) Health preservation;
(*ii*) Chronic diseases prevention;
(*iii*) Acute infectious diseases prevention;
(*iv*) Medical.

(b) *Advisory Councils.*

The Advisory Councils, all of which are under the supervision of the Minister of Home Affairs, consist of the following:

The Central Board of Health.—Acts as an advisory organisation to the competent Ministers of State on public health and veterinary matters.

Board for the Investigation of Japanese Pharmacopœia.—Investigates matters relating to the revision of pharmacopœia.

Board for the Investigation of National Hygiene.—Acts as a body for the investigation of national health.

National Parks Commission.—An advisory organ on matters concerning national parks.

Opium Commission.—An advisory organ on opium and other dangerous drugs.

(c) *Laboratories.*

The laboratories include:

Government Hygienic Institute, under the administration of the Minister of Home Affairs, is an establishment for the examination of medicines and other products.

Government Institute for Infectious Diseases: under the joint administration of the Ministers of Home Affairs and Education and attached to the Tokio Imperial University; undertakes the investigation of infectious diseases.

Government Institute of Nutrition: established under the control of the Minister of Home Affairs for research in national nutrition.

(d) *Examining Bodies.*

These include Commissions for the examination of medical practitioners, dental surgeons and pharmacists.

(e) *Medical Relief Establishments.*

National leprosaria: establishments for treating and assisting leprosy patients.

A scheme for the establishment of national tuberculosis sanatoria is being prepared.

Moreover, it is intended to provide facilities for supplementary education of the personnel of the public health services in the National Institute of Public Health.

Local Organisations for Public Health Administration.

(a) *Chief Provincial Officials.*

The Governor of Hokkaido, the Inspector-General of the Metropolitan Police Board and the prefectural governors are the chief provincial administrative officials, and public health administration naturally comes under their control. Under the governors there are police departments, comprising health sections in charge of health matters.

In the Tokio Prefecture, public health administration is under the joint responsibility of the Prefectural Governor and the Inspector-General of the Metropolitan Police Board, through the prefectural Department of Education and the Health Department, respectively.

To each of these provincial offices are attached bacteriological, as well as hygienic, laboratories staffed with experts in various fields.

(b) *Chiefs of Police.*

The chiefs of police supervise public health affairs in districts under their jurisdiction in accordance with instructions received from the Governor of Hokkaido, the Inspector-General of the Metropolitan Police Board and the prefectural governors, to whom they are directly responsible.

(c) *Cities, Towns and Villages.*

Cities, towns and villages also have public health responsibilities of their own under laws and regulations. In large cities, there are also health departments with bacteriological, as well as hygienic, laboratories.

(d) *Quarantine Organisations.*

Quarantine is regularly carried out at the principal ports open to foreign trade—namely, Osaka, Kobe, Moji, Nagasaki, Tsuruga, etc. In these ports, the Customs authorities take charge of quarantine procedure and a harbour-master's office is provided in each Customs house for the purpose. In addition, there are quarantine stations under the supervision of local prefectural governors in the following ports: Hakodate, Karatsu, Nagoya, etc.

Relative Effectiveness. The public health system in Japan is well organized and comparatively efficiently operated; this is particularly true in the large and modern cities. However, in small towns, villages and rural districts, the public health system is less effectively organized and little is done to provide health and sanitary services in excess of those required to meet the minimal legal requirements. The scope and effectiveness of the Japanese system are limited by the fact that matters pertaining to public health are under the supervision and jurisdiction of the police, rather than in the hands of appropriately trained medical personnel. It should also be noted that in all echelons of the Japanese public health organization supreme authority rests with political rather than medical personnel. In general, conditions of public health and general health in Japan, as evidenced by birth rates, general death rates and death rates from selected causes, such as tuberculosis and diarrhea and enteritis, correspond to conditions that obtained in the United States in about 1900. There are some major problems of public health which are vigorously pursued, but others are only superficially treated. In general, it is characteristic of the Japanese system that when action is taken on important problems of public health, it usually is taken after, rather than before, the need for it has arisen.

Water Supplies

Water is found in abundant quantities in most parts of Japan; however, during the latter part of the summer there are likely to be shortages of it in certain areas. The majority of the existing waterworks obtain water from rivers; but some also secure it from springs, reservoirs containing collections of ground water, wells and lakes. In the larger cities adequate facilities for filtration (usually slow sand filtration) and chlorination of water are found. Bacteriologic examinations are made at regular intervals in the larger cities; however, available information indicates that in smaller towns and villages samples of water are taken for culture at infrequent intervals, if at all. In most of the rural areas water is taken from individual wells that frequently are subject to contamination by polluted ground water. It should be pointed out that it is almost a universal habit of the Japanese to drink boiled water or tea. Undoubtedly this practice materially reduces the incidence of water-borne diseases. The high rate of intestinal diseases indicates that, in many instances, the control of water supplies is not so efficient as governmental reports would indicate.

Sewage Disposal

Systems in which sewage is water-borne are found only in the large cities. Although little information is available concerning methods of treatment of sewage in these towns, modern toilet facilities are located in public buildings, office buildings, theaters, hotels and modern private homes. Night soil is of economic importance, so that in the rural areas, the smaller towns and even some of the larger cities, collection of night soil is the usual method of disposal of sewage. The government health service has attempted to institute a method of treatment of night soil, so that intestinal parasites and the enteric organisms will be removed thereby. A type of sanitary privy has been recommended, and it has been stated that if this privy is built to insure complete decomposition, it will produce an effluent that is practically free from both the intestinal parasites and the organisms causative of intestinal disease. In many of the towns, and even in the residential district of Yokohama, liquid wastes are emptied into open sewers.

Insects and Animals

Vectors of Disease. Mosquitoes. *Anopheles hyrcanus sinensis*, the most important vector of malaria in Japan, is found in low-lying districts of Kyoto, Niigata, Gumma, Tochigi, Miye, Aichi, Shizuoka, Shiga, Gifu, Aomori, Fukui, Kochi and Okinawa. This mosquito breeds in the stagnant water of pools, hill streams, irrigation canals, swamps and rice fields. *Anopheles lindesayi japonicus* is a less important vector of malaria in Japan. *Anopheles sineroides*, *A. koreicus* and *A. edwardsi* are reported, but their role as vectors of malaria in Japan is undetermined.

Dengue fever is carried by both *Aedes aegypti* and *Aedes albopictus*. The latter certainly occurs in Japan. *Aedes aegypti* has been reported only around seaports and possibly is not a normal inhabitant of this area. *A. togoi* is a vector of filariasis. Pestilential mosquitoes include *A. japonicus*, *A. dorsalis* and *A. vexans*.

Culex fatigans is the usual vector of filariasis, although *C. pipiens pallens* also is considered a vector. The latter and *C. tritaeniorhynchus* are experimental vectors of Japanese "B" encephalitis. *Culex hayashii*, *C. bitaeniorhynchus*, *C. sinensis*, *C. orientalis*, and *C. tipuleformes* are pestilential mosquitoes.

Lice. The body louse, *Pediculus corporis*, carries the epidemic form of typhus fever. It also carries spirochetes of the genus Borrelia which cause louse-borne relapsing fever, a disease which has the same geographic distribution as epidemic typhus fever. It likewise carries the micro-organism, *Rickettsia quintana*, the causative organism of trench fever. This latter disease has not been reported from Asia in many years, but it is a potential hazard, especially in wartime.

Flies. The common housefly, *Musca domestica*, by mechanical means carries the causative organisms of the intestinal diseases (typhoid fever, paratyphoid fevers, amebic dysentery, bacillary dysentery and cholera) from filth and fecal matter to the food of man. It is also believed that flies can spread cholera organisms by means of their droppings. Flies are extremely common in Japan, and constitute a serious menace to the public health.

Mites. Mites of the genus Trombicula are the vectors of a typhus-like disease in the Orient, and are found in association with rodents, particularly rats; with birds; and possibly in the flowers of certain palm trees. They are most commonly found in areas that are subject to flood, and are most numerous in the late spring and early summer. In Japan the field mouse is an important host of these mites. The kedani mite (*Trombicula akamushi*) is the vector of Japanese river fever or tsutsugamushi disease in the northern part of Japan, in Formosa, the Yangtze valley of China, Siam, French Indo-China and Malaya.

Fleas. In addition to being annoying, the rat flea, *Xenopsylla cheopis,* is the vector of at least two serious diseases affecting man; namely, plague and the murine (rat) type of typhus fever. Fleas found on rats commonly carry these diseases. The finding of dead rats or other rodents frequently indicates that these diseases, and especially plague, are prevalent among local animals. This is of importance because the fleas leave the dying rodent and seek new animal hosts, including man. Thus, by infesting human beings, they may transmit plague and the murine type of typhus fever. Fleas are distributed throughout all the regions of Japan.

Rodents. Rats are important in the spread of several of the typhus fevers and of plague, in that they are hosts of mites and fleas, which are the respective vectors of these diseases. The excreta of rats may contain the organisms causative of leptospirosis. The rats most frequently encountered are the common black house rat (*Rattus rattus*) and the brown rat (*Rattus norvegicus*). The vole, *Microtus montebelli,* is common, and, like the rat, may serve as a reservoir of some of the forms of typhus fever.

Snakes. The only poisonous snake encountered in Japan is the "mamushi" adder, *Agkistrodon (Trigonocephalus) blomhoffii.* Its bite usually is not fatal. Poisonous sea snakes are uncommon and there are no poisonous fresh-water snakes.

Measures of Control. In the urban areas of Japan some attempts have been made to institute measures for the control of insects, but little progress has resulted. The larger ports have facilities with which to combat rodents. In certain areas swamps have been drained and treated with Paris green in an attempt to eradicate mosquitoes.

Food and Dairy Products

Except for the staple articles of food, such as rice, wheat, barley, fish, certain fruits and vegetables, there is little food in excess of the needs of the Japanese people. Large quantities of other foods must be imported. The fertilization of farms and gardens with night soil is a common practice in Japan, so that all vegetables and most fruits must be thoroughly washed and cooked before they are eaten; otherwise, there would be great danger from the enteric diseases (typhoid fever, paratyphoid fevers, bacillary dysentery, amebic dysentery and even cholera) or one of the many forms of intestinal parasitism that occur in Japan. Various forms of shellfish and fish frequently are infected with flukes and other parasitic worms. The Japanese custom of eating fish raw is responsible for the spread of the fish tapeworm (*Diphyllobothrium latum*). Certain poisonous fish are found in the waters about Japan, such as the toadfish, *Tetraodon maculatum.* Each year several thousand cases of food poisoning are reported. Food poisoning caused by the eating of fungi and other poisonous plants is not rare, but more important is food poisoning caused by the eating of certain fishes and infected foods. Poisoning caused by fish is far more frequent than is poisoning caused by the ingestion of other types of food. The probable explanation rests in the fact that, as pointed out previously herein, the Japanese consume much fish, often in the raw state, but eat little meat which, when they do eat it, usually is well cooked. Other contributing factors include infected food handlers, lack of facilities for refrigeration and the improper preparation of foodstuffs. Cattle are raised primarily for slaughter. The dairy industry is confined to the environs of a few of the larger towns. Although there is some attempt at veterinary control of tuberculous animals, there are few pasteurization plants for the production of safe milk.

Miscellaneous Problems of Sanitation

Although sanitation in Japan proper is much better than that found in most other parts of the Japanese Empire, it does not compare with that of the United States. The Japanese are a cleanly people; but this is not generally true of peoples who are subject to Japan. Modern facilities for the treatment of water and for the disposal of sewage are found only in metropolitan areas. Transmissible diseases, and especially the enteric diseases, are common, indicating the lack of progress in sanitation. The general ignorance and poverty of the native population impede the introduction of modern sanitary measures. Although the newer parts of Japanese cities are well planned, all are surrounded by large areas of slums. The majority of the people are poor, and live in crowded, dirty and poorly constructed houses that are said often to be infested with vermin.

MEDICAL FACILITIES

Hospitals

Number of Beds. Hospital facilities in Japan are not sufficient to meet the needs of the people (19 beds per 10,000 people, as compared to the average for the entire United States of 97 beds per 10,000 people). Information concerning the average bed capacity of the various types of hospitals is given in Table 17. The greatest number

TABLE 17

Hospital Facilities of Japan, 1932

Institution	No.	Average capacity, beds
Public hospitals (50 in cities; 33 in towns; 4 in villages) ..	87	100
Private hospitals...........	2,351	28
Charity hospitals...........	36	99
Asylums for the insane.......	110	130
Tuberculosis................	69	82
Leprosariums................	15	289
Hospitals for prostitutes......	136	39
Hospitals for infectious disease	1,260	20
Isolation wards.............	7,473	9
Isolation houses............	83	23

of hospital beds (about three fifths) is found in the larger cities, whereas the rural areas have only small dispensaries. The larger hospitals, connected with the medical schools, compare favorably both in reputation and equipment with teaching hospitals in Europe; but in the smaller cities and towns hospitals are little more than rest homes.

Equipment. These smaller hospitals frequently are poorly managed and equipped, and the standards of cleanliness are low. Often, the ordinary hospital services and facilities to which persons in the United States are accustomed, such as nursing care and adequate diet, are not furnished.

Medical Personnel

Physicians. Private medical practice forms the basis of the Japanese medical system. To supplement the system of private practice, a number of government organizations for medical treatment, and nonprofit-making dispensaries for the diagnosis and treatment of specific diseases, such as infectious diseases, tuberculosis, venereal diseases, leprosy and mental diseases, have been established.

In recent years many changes in the number and distribution of medical practitioners have been caused by the exigencies of war, but specific information concerning these changes has not been available.

In 1936 it was reported that there were 53,376 physicians in the practice of medicine, a figure which produces the ratio of 7.7 physicians per 10,000 of population. About three fifths of this number practiced in cities; the rest practiced in the towns and rural villages. In certain remote districts where there had been no private practitioners, government physicians and dispensaries have been established. It is said that the quality of work performed by Japanese physicians compares favorably with that found on the continent of Europe.

Nurses. In 1935 there were 89,684 trained nurses working in the hospitals and dispensaries, and 5,000 public health nurses. The standards of training for nurses are not known.

Dentists. In 1935 there were 18,428 dentists, or an average of 2.66 dentists per 10,000 people.

Others. There were also 59,560 licensed midwives, who usually were trained in government schools.

Medical Institutions

In 1937 there were 14 government-controlled medical schools and 12 private medical schools. In the same year there were eight dental colleges. Diagnostic, research and biologic laboratories are almost exclusively government-controlled or operated. There are several charitable organizations in Japan that are interested in public health, most notable of which is the Red Cross.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoids. Typhoid and paratyphoid fevers are extremely common throughout Japan. Although instances of these fevers occur throughout the year, epidemics are most frequent in late summer and early fall. Ordinarily, a higher incidence of these diseases is reported from the cities and towns, rather than from the rural districts, the ratio being approximately 10 to 7. In the majority of cases the diseases are thought to be contracted as a result of the drinking of contaminated water or the eating of unclean food. Flies and human carriers also have been incriminated as being important in the spread of these diseases.

Although the Japanese Army has vaccinated its troops against typhoid fever and paratyphoid fevers for many years, it has been only in recent times that the vaccine has been made available to the general population. Vaccination of the civil population is not compulsory, and is carried out only upon request of the person concerned. So far as is known, campaigns for vaccination of the civil population have not been promoted. Recently, laws governing the examination of food handlers have been enacted, but the extent of the enforcement of these measures is not known.

Dysenteries. Amebic and bacillary dysentery are common, indicating a widespread contamination of food and of water. Human excreta are used as fertilizer throughout the East; this practice is responsible for the prevalence and wide distribution of the dysenteries. Carriers, by means of either direct or indirect contact, spread bacillary and amebic dysentery by contaminating food or water. In Japan bacillary dysentery is of more common occurrence than is amebic dysentery. Geographically, amebic dysentery usually is found in the interior of the country. The greatest number of cases is recorded during the early summer months, because at this particular time fresh vegetables appear on the market. In Japanese reports a dysentery-like disease of unknown causation, called *ekiri*, is referred to. It occurs most commonly among children. Apparently it is an acute and fatal form of endemic infantile diarrhea.

Cholera. The recorded incidence of cholera in Japan has decreased markedly during the past 50 years; but even so, epidemics of this disease have been reported as recently as 1932, 1937 and 1938. In 1932 the epidemic was confined to Tokio and Osaka. In 1937 and 1938 the disease was rather widely distributed throughout the southern provinces of the country. Cholera is considered to be endemic in the southern part of Japan, and there is the possibility that epidemic outbreaks of it may occur as the results of poor sanitary conditions and relaxed measures of control in time of war. Inasmuch as cholera is prevalent in parts of China occupied by Japan, it is also probable that carriers of the disease may return and disseminate it in Japan. The spread of cholera occurs in the same manner as the spread of other enteric diseases; namely, by means of contaminated food and water. Flies are believed to be of particular importance in the spread of *Vibrio comma.* The Japanese also believe that in certain instances fish may be responsible for the transmission of cholera.

Diarrhea and Enteritis. These are commonly reported in Japan. In many instances this classification wrongly includes instances of the more important enteric diseases which have been mentioned previously in this chapter. However, extensive outbreaks of food poisoning are of comparatively frequent occurrence in Japan. Bacteriologic investigations have been carried out in only a few of these outbreaks. Nevertheless, in most of them *Salmonella enteritidis, S. aertrycke, S. paratyphi* and *S. schottmuelleri* and *Proteus vulgaris* were the causative agents. On occasion, Sonne's bacillus, organisms similar to *Vibrio comma* and bacilli of the types which cause the dysenteries have been isolated. Outbreaks of food poisoning occur most commonly in the hot seasons, and especially in July. It is stated that contamination of foods is caused chiefly by extraneous agents, particularly house rats and human carriers. Other factors which contribute to the frequency of these outbreaks are the lack of proper facilities for the storage of foods, lack of proper supervision of food handlers and inadequate preparation of foodstuffs. Food poisoning caused by the ingestion of fish is very common. The probable explanation of this fact is that the Japanese consume much fish, but little meat. It is known that food poisoning caused by the eating of meat is of infrequent occurrence in Japan.

Food Poisoning. Cases of food poisoning caused by the eating of fish are said to account for approximately a third of the total number of cases. Of particular importance are those cases in which poisoning is the result of the eating of fish of the genera Tetraodon, Diodon and Triodon (toadfish, puffer fish, fugu and the like). The fatality rate among those persons poisoned by these fish varies between 30 and 50 per cent. The toxic principle is always found in the eggs, but occasionally the liver, bile, muscles and urine also are poisonous. Symptoms of this type of poisoning usually occur three or four hours after ingestion of the fish, and are characterized by the sudden onset of weakness, vertigo, headache, vomiting, diarrhea, paralysis and sudden death. Upon occasion death may occur as soon as four minutes after the appearance of the first symptoms.

Helminthiasis. Intestinal parasitism is common throughout Japan. Indiscriminate soiling of the ground by human fecal matter, carried out either as a means of disposal of sewage or for the purpose of fertilization of crops, as well as the other unclean habits of Japanese of the poorer classes, is directly responsible for the spread of these infections. Infection with hookworm is found mainly in the agricultural villages, where in some instances as much as 54 per cent of the people are infected. In the order of their frequency and importance, the intestinal parasites of Japan are: *Ascaris lumbricoides, Trichuris trichiura, Ancylostoma duodenale, Necator americanus, Trichostrongylus orientalis, Clonorchis sinensis, Metagonimus yokogawai, Paragonimus westermani, Enterobius vermicularis, Taenia saginata* and *Hymenolepis nana.*

Infection with the liver fluke, *Clonorchis sinensis,* is confined to the Sino-Japanese area. In this area men and animals have been found to be extensively and naturally infected. This disease occurs throughout Japan, but the heaviest focus of infection among human beings is in the prefecture of Okayama. In this area and throughout other areas in the central part of Japan there are certain districts in which 50 to 67 per cent of population are infected. Perpetuation of this infection results from the common practice of the eating of raw fish which harbor the cercariae. Snails of the species *Bulinus fuchsianus* as well as of other species are the primary hosts.

Paragonimiasis or endemic hemoptysis

(infection with the lung fluke, *Paragonimus westermani*) follows the ingestion of uncooked infected crabs or crayfish which serve as the second intermediate hosts. The primary hosts of this lung fluke are snails of the genus Melania. In some districts 40 to 50 per cent of the population are affected with this disease. In addition to human beings, pigs, dogs, cats, rats and various wild carnivores are found naturally infected. Infection with flukes of the species *Metagonimus yokogawai* occasionally is encountered. Infection of human beings with these flukes occurs after the ingestion of the hosts of the flukes, fresh-water fish, usually the carp. Infection also may occur after the drinking of water that has been contaminated by infected members of the genus Cyclops. The broad fish tapeworm, *Diphyllobothrium latum*, may be transmitted to human beings after the ingestion of raw fish. Practically all types of fish in the Far East are infected with this cestode, and infection with this worm is of common occurrence among human beings. Infection with *Sparganum mansoni* occasionally is encountered. Infection of human beings with these worms may follow the drinking of water contaminated by infected members of the genus Cyclops. There is evidence, however, to suggest that infection generally follows the application of infected frogs to the skin in the form of poultices. Application of these poultices to the face and eyes is responsible for much disease of the eyes in the localities in which this practice is followed.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. This disease occurs very extensively throughout every part of the Japanese Empire. Both the human and bovine types are encountered in the regions in which cattle are raised.

Miscellaneous. Diphtheria, influenza, smallpox, scarlet fever, cerebrospinal meningitis, measles, whooping cough, pneumonia, encephalitis lethargica and acute anterior poliomyelitis, occur throughout Japan. The incidence of these diseases is said to approximate that in the more backward sections of the United States. At times cerebrospinal meningitis has occurred in extensive epidemics.

Diseases Spread Chiefly through Contact

Venereal Diseases. Rates for venereal disease among the Japanese are about ten times those of the white population of urban areas in the United States. Syphilis, gonorrhea and chancroid are the only venereal diseases reported from Japan. Prostitution is said to be well controlled by the police, prostitutes being segregated in districts and required to undergo periodic health examinations by police physicians. In some localities these examinations are perfunctory, and are carried out only to meet the legal requirements. There are 136 hospitals with a total capacity of 5,381 beds set aside solely for the treatment of prostitutes who have venereal disease. In 1932 there were 49,825 licensed prostitutes, and during that year 62,450 instances of venereal disease were diagnosed among them. Although specific information is lacking, it is highly probable that there are also large numbers of irregular prostitutes and contacts who are neither registered nor under the surveillance of police.

Leprosy. This disease occurs with considerable frequency among the people of all parts of Japan.

Diseases of the Skin. Diseases of the skin, including the various fungous infections and scabies, are common. An unspecified type of tropical ulcer is reported to be a very important cause of morbidity in the southern part of Japan.

Trachoma and Diseases of the Eyes. Trachoma and various diseases of the eyes (frequently, gonorrheal ophthalmia) are very common among the people of Japan.

Tetanus. Tetanus is found throughout the Japanese Empire. There is no specific information available as to the incidence or distribution of it.

Schistosomiasis. Infection with *Schistosoma japonicum* is observed throughout the southern part of Japan. It is especially prevalent in the prefecture of Hiroshima and the village of Katayama. This disease is acquired by human beings who come into direct contact with water infested by the cercariæ. Snails which are known to serve as intermediate hosts of *Schistosoma japonicum* are various forms of Oncomelania, Katayama and Schistosomophora, but *Katayama nosophora* is the principal intermediate host in Japan. These snails are found in slowly moving bodies of water which contain a considerable amount of vegetation, such as pools, irrigation ditches and sluggish streams. Like *Schistosoma mansoni, Schistosoma japonicum* is adversely affected by changes of the hydrogen-ion concentration, and schistosomiasis is therefore unlikely to be contracted by ingestion of water that has been adequately treated. This particular type of schistosomiasis is readily contracted, however, by wading, bathing, swimming or washing in infested waters.

Anthrax. A few cases of anthrax are reported throughout the Japanese Empire each year.

Actinomycosis. From eight to twelve cases of actinomycosis are reported from Japan proper each year. Additional information as to the incidence and distribution is lacking.

Leptospirosis. Leptospirosis is common in Japan and is reported from practically all parts of the nation. The various types of this disease are chiefly contracted by persons who ingest food or water contaminated by the urine of infected rats or by persons who swim or wade in infected waters. Weil's disease, caused by *Leptospira icterohaemorrhagiae,* is the most common type encountered. Infection caused by *Leptospira hebdomadis* is the second most common type, and is variously known as "seven-day fever of Japan," "autumn fever," "nanukayami fever" and "sakushu fever." Jaundice is not a common feature of this disease; but in the past some of the clinical features, notably the "saddleback" temperature, have led to the erroneous inclusion of it among dengue and dengue-like fevers. A third type of leptospirosis encountered in Japan is that which is caused by *L. autumnalis.* This form of the disease is also known as "hasami disease," "autumn fever" and "akiyami disease." In the past it has been confused with that caused by *Leptospira hebdomadis.* Recently, however, the two diseases have been serologically distinguished. Hasami disease is most frequently reported from the prefecture of Shizuoka.

Rat-bite Fever. Rat-bite fever has been reported commonly in Japan, where it bears the name of *sodoku,* from *so* (rat) and *doku* (poison). Among human beings this disease is characterized by a relapsing type of fever which follows the bite of rats infected with *Spirillum minus.*

Diseases Spread by Arthropods

Malaria. Malaria occurs in practically all portions of Japan, but most commonly in the low-lying districts and shady lowlands of Kyoto, Niigata, Gumma, Tochigi, Miye, Aichi, Shizuoka, Shiga, Gifu, Aomori, Fukui, Kochi and especially in Okinawa prefecture (Ryukyu Islands). *Anopheles hyrcanus sinensis* is the most important vector and has the widest distribution. The incidence of malaria in Japan probably is comparable to that of the southeastern part of the United States.

Filariasis caused by the *Wuchereria bancrofti* is the only type reported from Japan. *Culex fatigans* is the principal vector; but *C. pipiens, Aedes togoi* and *Anopheles hyrcanus sinensis* have been reported to be capable of transmitting this disease. Filariasis is encountered most commonly in the prefectures of Nagasaki, Shizuoka, Kochi, Saga, Kumamoto, Kagoshima and Okinawa; but the disease has been observed as far north as the province of

Shantung in the northeastern part of China.

Dengue Fever. Dengue or breakbone fever occurs throughout Japan, and is conveyed by *Aedes aegypti* and *A. albopictus.* It is most prevalent in the southern coastal areas. Although this disease is rarely fatal, it is of great importance because of the fact that it occurs with dramatic suddenness in epidemic proportions, and is associated with high morbidity rates among nonimmune persons.

Yellow Fever. Yellow fever never has been reported from the Pacific area, but the vector of the disease, the *Aedes aegypti* mosquito, is widely distributed throughout Japan.

Rickettsial Diseases. In statistical reports from Japan there is usually no distinction between epidemic or louse-borne typhus fever and endemic or flea-borne typhus fever. During 1941 approximately 900 cases of typhus fever (type unspecified) were reported from Japan. It is believed that in the majority of cases, if not in all of them, the disease was of the endemic or flea-borne type, for it is reported that infected fleas and rats frequently are found around docks and warehouses and in rice storehouses. The fleas, *Xenopsylla cheopis* and *X. astia,* are the principal vectors of flea-borne typhus fever. Epidemic or louse-borne typhus fever has occurred in epidemic proportions in Japan in the past, especially in the colder months and in the mountainous districts. This disease, however, has not been reported from Japan in recent years. In view of the prevalence of lice among the rural population of mountainous districts, it is likely that the disease may be endemic.

Japanese river fever, or tsutsugamushi disease, is a rickettsial disease that is transmitted by the mite, *Trombicula akamushi.* In Japan this mite is called the "kedani" mite. It generally infests the ears of field mice (*Microtus montebelli*), but rats and other rodents also harbor these mites. Japanese river fever occurs most commonly during the summer and early part of autumn in the western portion of Japan, especially along the banks of the Shinano River, as well as about the flood basins of other rivers in this area. Japanese river fever is largely an occupational disease, and is observed most frequently among those who work along river banks in fields that are subject to inundation and that are infested with mice. The disease is not communicable naturally from person to person, but always follows the bite of the infected larval "kedani" mites. The fatality rate from Japanese river fever varies between 50 and 68 per cent in Japan, whereas in the Federated Malay States and the southern part of the Malay Peninsula fatality rates are between 3 and 8 per cent.

Plague. From time to time epidemics of plague have occurred in Japan; however, plague among human beings has not been reported since 1940. Sylvatic plague frequently is found in the southern part of Japan. The prevalence of flea-infested rats and rat-infested houses makes epidemic plague a potential hazard in Japan. This is particularly true in view of the conditions imposed on the nation by the war, whereby measures for the control of rats and quarantine are likely to be relaxed.

Relapsing Fever. This disease, caused by spirochetes of the genus Borrelia, is spread chiefly by the louse, and its distribution corresponds to that of epidemic typhus fever. No specific information is available as to the distribution of relapsing fever in Japan. Several cases of the disease are reported each year.

Miscellaneous

Japanese "B" Encephalitis. Small outbreaks of summer encephalitis have been noted since 1870, and have been frequent since 1901. They attracted little attention, however, until a large epidemic occurred in 1924. In 1935 the virus was isolated and was found to be similar to, but not identical with, the Saint Louis strain. Although isolated cases of "B" encephalitis have oc-

TABLE 18

Japanese "B" Encephalitis: Incidence and Mortality Rates, 1924-1937

Year	Cases	Case rate, per 100,000 population	Deaths	Death rate, per 100,000 population	Fatality, percentage
1924	6,125	10.4	3,797	6.4	62
1925	139	0.2	69	0.1	50
1926	864	1.4	583	0.9	67
1927	1,006	1.6	716	1.1	71
1928	72	0.1	50	0.07	69
1929	2,058	3.1	1,340	2.0	65
1930	499	0.8	360	0.6	72
1931	129	0.2	97	0.1	75
1932	689	1.0	391	0.6	56
1933	791	1.2	510	0.8	64
1934	278	0.4	171	0.2	61
1935	5,370	7.8	2,264	3.3	42
1936	1,305	1.9	696	1.0	53
1937	2,030	2.8	1,115	1.5	55
Total.....	21,355		12,159		57

curred elsewhere, epidemics have been confined to Japan.

The fatality rate is high, especially among persons more than fifty years old, among whom the disease is most frequently reported (excepting in Formosa and in the prefecture of Okinawa where in 1933 children were affected primarily). Between 1924 and 1937, out of 21,355 cases, there were 12,159 deaths, a fatality rate of 57 per cent. This rate is thought to be inaccurate in respect to the population as a whole, however, since the disease usually is so mild among children that many cases probably are not reported. "B" encephalitis is slightly more frequent among males than among females.

No cases have been reported from the northern island of Hokkaido. On the island of Honshu, where Tokyo is situated, the disease is widespread. It is especially common in areas between 30 and 40° of north latitude, and has the highest incidence along the Inland Sea, just south of the 35th parallel. It is also common in Formosa. In other areas isolated outbreaks have occurred. Such areas are certain eastern prefectures (1924), as well as Fukuoka in the west (1932), and Okinawa in the south (1933).

The disease exhibits a distinct seasonal periodicity which seems to be dependent on two climatic factors, heat and dryness. In areas along the Inland Sea in which the disease is highly epidemic, the climate is exceptionally hot and dry. Epidemics in all areas are usually serious, and tend to occur earlier in the summer during years when the mean temperature is high and the rainfall is light. Most outbreaks are sharply limited to the late summer and early fall, although the large Tokyo epidemic of 1935 continued after the onset of cool weather. In general, epidemics in Formosa and the Ryukyu Islands reach a peak in July. In southern Honshu the incidence of the disease is highest in August, whereas in the northeastern part of the island it is highest in September. In all generalized epidemics the peak has been reached in August, probably because most of the cases have occurred in the southern parts of Honshu. Since it has not been possible to establish direct transmission from prefecture to prefecture, outbreaks in the various areas are thought to occur independently.

The method of transmission of the virus

is uncertain. Some observers believe it is transmitted through droplets from the nose and throat of human carriers, since experimental animals readily contract the disease after intranasal instillation of the virus. The same animals do not contract it during contact experiments, however, and contacts between patients are rarely found. The majority of writers feel that "B" encephalitis is transmitted by mosquitoes, and possibly by other insects. They point out that there may well be animal reservoirs of the disease, since the serums of horses, sheep and other animals in epidemic areas possess specific neutralizing antibodies. It has been shown that *Culex tritaeniorhynchus* (the predominant mosquito in the prefecture of Okayama), *C. pipiens pallens* (common near Tokyo), and *Aedes togoi* can transmit the disease under experimental conditions.

SUMMARY

The Japanese public health service is well organized and comparatively efficient. During recent years advances have been made in the fields of preventive medicine, sanitation and personal hygiene; but in general, health conditions in Japan correspond to those which existed in the United States in about 1900. Water is plentiful, and is ordinarily obtained from rivers, springs, wells and collections of ground water. Adequate facilities for the treatment of water are found only in the larger Japanese cities. The collection of night soil is the customary method of disposal of sewage throughout a large part of Japan, although systems in which sewage is water-borne are found in the larger cities. The common practice of use of night soil as a fertilizer of crops predisposes to a high rate of enteric disease. Other factors contributing to the prevalence of enteric diseases are the lack of facilities for refrigeration and the improper handling and preparation of foodstuffs. The diet of the average Japanese is quantitatively but not qualitatively adequate. Little food is produced in excess of the needs of the native population, and many foodstuffs must be imported. Hospital facilities, except those represented by a few of the larger metropolitan hospitals, are grossly inadequate. Medical personnel is concentrated in the urban areas. Mosquitoes, lice, flies, fleas, and mites that are vectors of disease are widely distributed.

The diseases of especial importance include: enteric diseases, such as typhoid fever, paratyphoid fevers, amebic dysentery, bacillary dysentery and cholera; venereal diseases, such as syphilis, gonorrhea and chancroid; the insect-borne diseases, such as malaria, filariasis, dengue fever, plague, endemic typhus fever, Japanese river fever and louse-borne relapsing fever; several forms of leptospirosis; infections with many kinds of worms and flukes; dermatologic conditions, including the various fungous infections and scabies; schistosomiasis; leprosy; tuberculosis; actinomycosis; "B" encephalitis; and trachoma.

BIBLIOGRAPHY

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Encyclopaedia Britannica, 14th ed. London, Chicago, Encyclopaedia Britannica, Inc., 1939.

Federated Malay States: Hygiene and Public Health in Japan, Chosen and Manchuria. Report on the Conditions met with During the Tour of the League of Nations Interchange of Health Officers, by A. R. Wellington. Kuala Lumpur, 1927.

Gt. Brit. Army Medical Dept.: Memoranda on Medical Diseases in Tropical and Subtropical Areas. London, His Majesty's Stationery Office, 1941.

Herms, W. B.: Medical Entomology, 3d ed. New York, The Macmillan Co., 1939.

Huang, C. H., and Liu, S. H.: Acute Epidemic Encephalitis of Japanese Type; Clinical Report of Six Proven Cases. Chinese M. J., **58**:427-439, (Oct.) 1940.

Iwasaki, T.: Infant Mortality in Relation to the Climate of Japan (pt. 1). Kurasiki, 1934 (Reports of the Institute for the Science of Labour, Kurasiki, Japan. Report No. 23).

Japan. Dept. of Finance: Financial and Economic Annual of Japan, 1926. Tokyo, Govt. Print. Off. (1926).

——. Sanitary Bureau: Annual Report, 1932. Tokyo, 1934.

——. ——: The Sanitary Laws and Regulations of Japan. Tokyo, 1925.

——. ——: Sanitary Statistics (1913-1924). Tokyo, 1925.

The Journal of the Public Health Association of Japan. Tokyo, 2: (Jan., Mar.) 1926.

League of Nations: Annual Epidemiological Report. Corrected Statistics on Notifiable Diseases for the year 1937. Geneva, 1939.

——: The Prevalence of Epidemic Disease and Poor Health Organisation and Procedure in the Far East. Report Presented to the Health Committee of the League of Nations by F. Norman White. Geneva, 1923.

——: Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene, Preparatory Papers: Report of Japan. Geneva, 1937.

——: Health Organisation in Japan: Thirty-six Conferences given in Japan on the Occasion of the Interchange Study Tour organised for Medical Officers of Health from the Far Eastern Countries by the Health Organisation of the League of Nations, October to December 1925. Geneva, 1925.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr, 11th ed. Baltimore, Williams & Wilkins Co., 1941.

Matheson Commission: Epidemic Encephalitis; Etiology, Epidemiology, Treatment; Third Report . . . New York, Columbia University Press, 1939.

Ogonuki, H., and Ide, M.: Outbreaks of Food Poisoning in Japan. Proc. Pacific Sc. Congr. 1939, 6. Congr., 5:423-427, 1942.

Rogers, L., and Megaw, J. W. D.: Tropical Medicine, 3d ed. London, J. & A. Churchill, Ltd., 1939.

Statesman's Year-Book. London, The Macmillan Co., Ltd., 1942.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed., by R. P. Strong. Philadelphia, Blakiston Co., 1942, 2 vols.

Teruoka, Gito: Reports of the Research Station for Agricultural Labour of the Institute for Science of Labour, Kurasiki, No. 1. Organization and Function of the Research Station for Agricultural Labour. Kurasiki, 1934 (Reports of the Institute for Science of Labour, Kurasiki, Japan, No. 24).

8

Korea

CLIMATE AND GEOGRAPHY

The peninsula of Korea, an integral part of the Japanese Empire since it was annexed in 1910 as a province, is situated between 34 and 43° of north latitude and 124 and 131° of east longitude. It extends southward as a blunt peninsula for approximately 600 miles from the southeastern border of Manchukuo. On the east it is flanked by the Sea of Japan; on the south, by the Strait of Chosen; and on the west, by the Yellow Sea. To the north the Yalu River and the Tumen River are the boundary lines. In the extreme northeastern portion Korea faces the Union of Socialist Soviet Republics along a sector of about 11 miles. Korea has an area of 85,000 square miles, about that of the state of Utah (84,990 square miles). Its extreme width is only about 135 miles.

Korea is divided into 13 provinces and has a population of about 23,000,000, most of whom are Koreans. There are only about 630,000 Japanese and 95,000 foreigners, chiefly Chinese, and a very small number of Occidentals. The origin of the Koreans is not definitely known; presumably they are a mixed people of Mongoloid type. About 70 per cent of them are engaged in agricultural pursuits.

Korea is almost wholly mountainous, but numerous valleys and plains are interspersed, particularly in the south and west. On the northern frontier is a mountain range in which one eminence, Paik-tu San or Pei-shan, attains to an elevation of 8,700 feet. Several mountain spurs are from 4,000 to 6,000 feet high. From these mountains a range extends to the south, dividing the country into two unequal parts. Between this range and the eastern coast line lies a fertile plain; on the west the terrain is broken up by ranges and spurs into precipitous hills and valleys. The coast line of Korea, 1,740 miles in extent, is lined with some 200 islands, two thirds of which are uninhabited.

Korea is not exceptional hydrographically. From the western slopes of the eastern mountain range the Han River traverses almost the entire width of the peninsula, emptying into the Yellow Sea near Chemulpho, and is an important highway of commerce for about 150 miles. Other rivers are the Yalu, Tumen, Tai-dong, Nak-tong, and Mok-po.

It has been said that the climate of Korea is superb for nine months of the year, and that the remaining three months of rain, dampness and heat are not prejudicial to health. In almost all the country the mean temperature is below freezing for at least one month in the year. In the northern and central portions the summers are extremely hot and the winters are severe. At Keijo, on the Yellow Sea, the mean temperature in the summer has been about 75° F. (23.8° C.); the mean temperature in the winter has been about 33° F. (0.6° C.).

During July and August the western and northeastern coasts are swept by rainstorms; on the former the mean annual rainfall is about 30 inches (75 cm.) and on the latter it is about 35 inches (89 cm.). Rain occurs on the southern coast chiefly from April to July; there the mean annual rainfall is about 42 inches (1.07 meters).

PUBLIC HEALTH

Health Services

Organization. Public health is under the direction of the Sanitary Section of the Police Bureau of the Government General. Plans are made in the Office of the Government General and proceed through provincial and county officials to the local police. A civilian health officer and two assistants usually are assigned to each of the 13 provinces. One physician or more and a number of nurses are stationed at each provincial hospital, however, and work that is not handled by the local police and police physicians is carried on by this provincial health staff. The officially defined duties of the provincial health staff, working with the police, include arrangements for clinical tours by provincial hospital physicians, quarantine inspection at all ports, inspection of water, food and drugs, control of epidemic and endemic diseases, inauguration of measures for the control of opium and leprosy, and veterinary problems. In practice, although regular tours by the full-time provincial physicians actually are carried out at intervals through the year, the great majority of contacts with the masses of the population are made by police physicians. These physicians receive a small monthly salary for part-time official services and are allowed to carry on a private practice at the same time. Usually, the police physicians are found only in what correspond to county seats. Practically all physicians engaged in public health work in Korea are Japanese.

Relative Effectiveness. Although the Japanese have done much to control epidemics by the establishment of laboratories for the examination of water, food and drugs, by the enforcement of strict quarantine regulations and of vaccinations against smallpox, typhoid fever and cholera, by attempts at isolation of lepers, by the giving of health courses in schools and by improved sanitation, the program has still not reached the desired goal. Tuberculosis, venereal diseases, intestinal diseases and leprosy still are widespread. One of the chief faults has been that the program has been Japanese-directed, Japanese-enforced and Japanese-centered. The Koreans themselves have no part, and little has been done to improve their general health. One observer stated that if the Japanese were removed, the entire public health structure would collapse.

Water Supplies

Fresh water is plentiful in Korea. The rural communities and small towns use water from springs, wells, creeks and rivers. Since night soil is used as a fertilizer, this water usually is contaminated. Because of the tea-drinking habit, however, much of the water is boiled before it is consumed. In recent Japanese reports it is stated that 74 Korean towns now have modern water plants. Official statistics for 1938 regarding the 10 leading cities indicated, however, that the modern water supplies are available to only a fraction (24-61 per cent) of the population of those communities. All water, regardless of its source, must be considered as not safe for drinking, and should be consumed only after proper treatment or after repeated bacteriologic tests have proved that it is safe.

Sewage Disposal

The night soil from most homes in Korea is collected from pails and poorly protected privies and is stored in crude, leaky cisterns, whence it is removed from time to time to be used for fertilizer. Keijo, Fusan, Heijo and Chemulpho have systems in which sewage is water-borne, but these systems serve only a small portion of the population of the cities. The same is true of the other cities that have such systems. Often, however, even in houses connected with the sewers, the night soil is not discharged into these sewers, but is collected separately and taken to rural areas for use as fertilizer. There are only a few privately owned septic tanks. In some cities the night soil from inns and hostels is gathered each day, and material from the private homes in the cities is collected once every 10 days; this is stored and subsequently used for fertilizer. Such a system of disposal of night soil results in widespread pollution of the soil and in an increased prevalence of various insects.

Insects and Animals

Vectors of Disease. Mosquitoes. The few available reports concerning the types of anopheline mosquitoes found in Korea state that *Anopheles hyrcanus sinensis* is found there. This mosquito breeds in the stagnant water of pools, streams, irrigation canals and rice fields, and is found more commonly in the hilly regions. It is not only a vector of malaria but is also the principal vector of the larval form of *Wuchereria bancrofti,* the cause of filariasis. *Anopheles labranchiae atroparvus, A. pattoni* and *A. lindesayi japonica* also are probably present in Korea, inasmuch as they are reported from near-by Manchukuo, Siberia and Japan. The first species breeds in brackish, as well as fresh, water, and the last two are fresh-water species commonly found in the hills and mountains. *Anopheles lindesayi japonica* is not so important a vector of malaria as are the other three mosquitoes.

Aedes aegypti and *A. albopictus* are found in Korea. These two mosquitoes are vectors of dengue fever, and although dengue fever has not been reported from Korea in recent years, it could easily be brought there from the areas in southern China, Japan, or Formosa in which it is endemic. Yellow fever never has been reported from Korea or other parts of the Orient.

Culex fatigans, a vector of the larval stage of *Wuchereria bancrofti,* is present. Together with *Aedes aegypti,* it is also a vector of *Dirofilaria immitis,* which causes heartworm in dogs.

Aside from a few small projects in the vicinity of some of the large cities, no work in control of mosquitoes has been done.

Lice. The three varieties of lice that infest man are reported to be prevalent among the people of Korea. Louse-borne (epidemic) typhus fever, caused by *Rickettsia prowazeki,* is reported regularly from Korea, and relapsing fever, caused by spirochetes of the genus Borrelia, is carried by lice which are parasitic on human beings, is endemic in the area. These lice also may carry *Rickettsia quintana,* the causative organism of trench fever, a disease formerly reported from Korea.

Flies. The common housefly, *Musca domestica,* is reported as present everywhere, and acts as a mechanical vector of enteric diseases and diseases of the eyes, which are common in Korea.

Ticks. The brown dog tick, *Rhipicephalus sanguineus,* and the wood tick are found in Korea. Although ticks are capable of transmitting the spirochetes of relapsing fever, no reports of tick-borne relapsing fever have come from Korea.

Fleas. Several varieties of fleas are plentiful, the most important one being the tropical rat flea, *Xenopsylla cheopis.* This flea is the principal vector of plague, and it transmits *Pasteurella pestis* from rat to man, as well as from rat to rat. The rat flea, *Xenopsylla astia,* which transmits plague from rat to rat, and the flea which is parasitic on man, *Pulex irritans,* also capable of transmitting plague, are present. Dog fleas, *Ctenocephalus canis,* are reported. The last cases of plague were officially reported in 1919, but other data indicate that, although the disease is rare, it has occurred since then. Fleas also transmit endemic typhus fever, which occurs commonly in Korea and is spoken of as "Honan fever."

Rodents. Rats of various kinds are prevalent in Korea; included are the black house rat, *Rattus rattus,* the brown or Norway rat, *R. norvegicus,* the roof rat, *R. alexandrinus,* as well as several wild species. These rats serve as hosts for lice, fleas and mites, which spread various diseases. Their excreta may contain *Leptospira icterohaemorrhagiae,* which causes Weil's disease. *Spirillum minus,* the cause of rat-bite fever, may be transmitted by their bites.

Other Vectors. Mites are present in Korea. The most important one is *Trombicula akamushi,* which is the chief vector of *Rickettsia orientalis,* the causative agent of Japanese river fever or tsutsugamushi disease, a form of typhus fever. These mites live as ectoparasites of wild rats and birds, and are commonly encountered on grasses, especially in cutover land or areas that are subject to flood. They are more numerous in the late spring and early summer. The itch-mite, *Sarcoptes scabiei,* the cause of scabies, also is prevalent.

Snakes and Other Dangerous Animals. Two varieties of vipers are reported from Korea, but the scientific name of only one, *Agkistrodon blomhoffi,* a pit viper, and member of the family Crotalidae, could be found. It is stated that the venom of this snake is not extremely poisonous. Many species of nonpoisonous snakes are found in Korea.

Poisonous fish of the genus Tetraodon are found in Korean and Japanese waters. Poisoning by such fish is given the name of "fuguismus" (Japanese, *fugu*), and several deaths from this cause are reported yearly from Korea and Japan, where such fish are greatly relished as food. The poisonous principle seems to exist chiefly in the ovaries and testes; the eating of only one roe brings on serious illness within a few minutes, and possibly death within a few hours. The poisonous principle has a physiologic action somewhat like that of curare and is thermostable. Such fish have been used, particularly in Japan, for the purpose of committing suicide. Rays or *raii* fish of the type of *Trygon pastinaca* are found in the seas about Korea. They possess a long, flexible, whip-like tail, terminating in a bony spine, very sharp at the point and furnished with sharp cutting teeth. When the ray attacks, it winds its tail around some part of the victim and forces the spine into the flesh, thus causing a deep and lacerated wound. The spine is covered with a thick gelatinous substance thought to contain the toxic substance that is responsible for the delayed healing of such wounds.

Poisonous scorpions, spiders and centipedes also are present. Tigers are found in the hills and mountains of Korea, and stray dogs are involved in the spread of rabies.

Pests. Bedbugs, members of the family Cimicidae, are very frequent in Korea. Although the ability of the bedbug to transmit infectious diseases to man by biting is not established, it is pointed out by competent authorities that the crushing of infected insects on the skin or the ingestion of infected insects may infrequently be responsible for disease transmission.

Gnats are reported, but it is not known whether they are members of the Simuliidae (buffalo gnat) family or the Chironomidae family, which contains the midge flies.

Food and Dairy Products

The diet of the people of Korea consists largely of rice and fish, with a few vegetables, fruits and grain products added. Cattle and swine are raised and furnish supplies of meat. The cattle in normal times are numerous and of good quality. However, milk and dairy products are limited and of uncertain wholesomeness. Poultry and eggs are produced, but the supply is limited. Hence, locally produced food and dairy products are barely sufficient for local needs.

It is reported that laws pertaining to the inspection of food are inadequate and poorly enforced. Poisoning caused by uninspected and impure meat and fish is frequent. Since night soil is commonly used as a fertilizer, vegetables and fruits should not be eaten raw, and all foods should be well protected from flies. Precautions should be taken against the eating of raw or undercooked fish or seafood, since such food may contain the cercariae or plerocercoid larvae that cause infection with flukes and fish tapeworms.

MEDICAL FACILITIES

Hospitals

Number of Beds. In 1938, there were 149 hospitals in Korea. Four were large government institutions under the direct control of the Government General; 50 were public establishments, maintained by individual provinces or municipalities; approximately 20 were Christian mission hospitals; and the remaining ones were private institutions, at least two thirds of which were owned by the Japanese. The large government and mission hospitals are located in the few important centers, and the provincial and mission hospitals, along with the private institutions, provide a network of small but well-distributed plants throughout most of the peninsula. In addition to the hospitals mentioned above, there are numerous small, so-called hospitals scattered over Korea; they have no beds and are essentially physicians' offices or dispensaries. On the basis of a population of 24,000,000 there is 0.3 hospital bed per 1,000 of population (United States, 9.7 per 1,000 of population). Obviously, such a number of beds is grossly insufficient for the needs of the local people.

Equipment. The equipment of the large hospitals, and especially those associated with the four medical schools, was said to be excellent; it included modern operating rooms and x-ray machines, well-equipped laboratories and other equipment of such standards that practically any surgical or medical condition could be treated adequately. Most of the other larger hospitals, including the provincial, municipal, mission and private ones, were equipped with operating rooms and x-ray apparatus; the small hospitals had relatively little equipment. Electric power throughout Korea is supplied by an alternating current of 100 volts and 60 cycles.

Supplies. Practically all drugs and hospital supplies come from Japan, although a very small percentage, consisting largely of certain dental supplies, surgical catgut and seamless rubber goods, were imported from the United States.

Medical Personnel

Physicians. The official records show that in 1937 there were 2,906 licensed physicians in Korea, of whom 1,414 were Japanese, 1,470 were Koreans, and 22 were foreigners. Since 1937 more medical students have been graduated from the medical schools, and more Japanese physicians are reported to have gone to Korea from Japan. It is now estimated that there are approximately 3,250 physicians in Korea, equally divided between Koreans and Japanese, or 0.15 physician per 1,000 inhabitants (United States, 1 per 1,000 people). Roughly, a third of the Korean physicians received their medical education either in American or Canadian missionary medical colleges in Korea or in medical schools of the United States, Canada and Europe.

Nurses. It is estimated that there are 2,200 nurses in Korea, of whom 550 are Japanese, and the rest Korean. Most of the large hospitals have training schools for nurses.

Other Personnel. There are said to be 950 dentists—570 Japanese and 380 Korean —in Korea; the pharmacists number 550—330 Japanese and 220 Korean. The midwives number between 1,900 and 2,000.

Medical Institutions

Of the four medical schools, two are located at Keijo and one each in two other towns. A large central laboratory is maintained by the government at Keijo, chiefly for the production of vaccines and serums.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Intestinal infections are extremely prevalent throughout Korea. The widespread use of night soil as a fertilizer and the resulting pollution of soil and water, associated with the high number of human carriers, have been the chief factors in the common occurrence of these diseases.

Typhoid Fever. This is the most frequent of the enteric diseases in Korea, and is prevalent in the summer and fall. From 1929 through 1937 there were from 5,417 to 7,954 cases reported yearly, with a fatality rate of about 17 per cent.

Paratyphoid Fevers. From 1929 through 1937 there were from 309 to 707 cases of paratyphoid fever reported yearly, with fatality rates ranging between 7 and 8 per cent. It must be presumed that many other cases of this disease, as well as of typhoid fever, were not reported.

Dysentery. Both types of dysentery are prevalent, and from 1929 through 1937 the yearly number of reported cases varied from 1,912 to 4,584, with fatality rates varying from 19 to 21 per cent. The amebic type occurs more commonly than the bacillary type. The number of reported cases has been increasing, but this may indicate only an improvement in the methods of reporting. Locally grown fruits and vegetables are likely to be contaminated with the causative organisms of dysentery, and should not be eaten raw.

Cholera. In spite of the statement that cholera has not occurred in Korea in the last decade, the disease appears to be endemic. During the epidemic of 1919-1920 there were 44,000 cases of it, but in the succeeding four years no cases were reported. In 1929, only 18 cases, with 15 deaths, were recorded; and in 1933, only 70 cases, with 38 deaths, were noted. In 1937, a year in which the League of Nations reported cholera to be epidemic in Korea, the official statistics included only one case. The enforcement of strict measures of quarantine and the free use of vaccination against cholera by the Japanese have done much to reduce the incidence of this disease.

Helminthiasis. Intestinal infection with worms is widespread; it is estimated that from 95 to 98 per cent of the people are affected. The use of night soil as a fertilizer, associated with improper and uncleanly habits of personal hygiene, are the principal causes for this widespread distribution.

The roundworm, *Ascaris lumbricoides,* is reported to infect about 95 per cent of the people.

The hookworms, *Necator americanus* and *Ancylostoma duodenale,* occur in Korea, and it is estimated that 25 to 30 per cent of the people are infected. Such infection is responsible for malnutrition and secondary anemia.

The whipworm, *Trichuris trichiura,* and the pinworm, *Enterobius vermicularis,* occur but are of little importance.

Tapeworms of three types are reported from Korea. The most common is the fish tapeworm, *Diphyllobothrium latum;* infection is acquired by the eating of raw or undercooked fish that contain the plerocercoid larvae of the tapeworm. The beef tapeworm, *Taenia saginata,* and the pork tapeworm, *T. solium,* also occur.

Flukes. Infection with flukes is widespread in Korea because of the custom of eating raw fish and crustacea and because of the use of untreated water for purposes of drinking and bathing. Fish, crustacea and water may contain the cercariae that cause infection with flukes; the principal varieties are the lung fluke, *Paragonimus westermani* (*ringeri*); the liver fluke, *Clonorchis sinensis;* the intestinal fluke, *Metagonimus yokogawai;* and, very infrequently, the fluke *Schistosoma japonicum.* Paragonimiasis is widespread and causes much disability; it is characterized by pulmonary symptoms and by the appearance of rusty-brown sputum in which the characteristic eggs of the parasite are present. It is often associated with pulmonary tuberculosis.

Metagonimiasis is frequent but causes little difficulty; clonorchiasis is rare but may result in serious disease.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Many of the inhabitants of Korea are tuberculous, and reports indicate that the disease is increasing in prevalence. It is present in all forms, including nodular, cutaneous, bone and joint, intestinal and pulmonary, the last being the most prevalent. Crowding in homes, promiscuous spitting and undernourishment are the chief causes of the widespread occurrence of the disease. No statistics concerning its prevalence are available.

Pneumonias. Both lobar pneumonia and bronchopneumonia are said to be of common occurrence, but no statistics showing prevalence are available.

Smallpox. This disease occurs regularly, but the enforcement of country-wide vaccination by the Japanese has done much to reduce the prevalence of the disease. It is stated that 8,321 cases were reported in 1921. In 1936 there were 1,400 cases, with 371 deaths, and in 1937 there were 205 cases, with 44 deaths. The fatality rates have varied from 20 to 27 per cent. An epidemic is reported to have occurred in 1940.

Meningitis. Cerebrospinal meningitis is endemic. From 1929 through 1937 from 48 to 517 cases were reported yearly, with fatality rates varying from 50 to 60 per cent. The last major outbreak occurred during 1934-1935.

Miscellaneous Infections. Diphtheria is fairly prevalent. In 1937 there were 2,361 cases, with 608 deaths; the fatality rates for twelve years varied from 21 to 29 per cent. Scarlet fever also is frequent, and from 1929 through 1937 the annual number of cases varied from 937 to 2,190, with fatality rates of from 10 to 15 per cent. Anterior poliomyelitis and encephalitis occur, and in 1939 an epidemic of the latter was reported. The morbidity rate of whooping cough is high; mumps also occurs.

Diseases Spread Chiefly through Contact

Venereal Diseases. These diseases are prevalent through Korea, and licensed houses of prostitution are found in the cities. In Japan the prostitutes undergo regular examinations and treatment, but information concerning such practice in Korea is not available. It has been estimated that about 40 per cent of the people are syphilitic. Gonorrhea is prevalent and is thought by some to be increasing. Chancroid or infection with Ducrey's bacillus (*Hemophilus ducreyi*) is frequent; lymphogranuloma venereum occurs occasionally, but granuloma inguinale is rare.

Leprosy. There are between 20,000 and 25,000 lepers in Korea. A segregation law exists, but as yet facilities are not available for the isolation of patients in leper colonies. About 5,000 are in the government leper colony at Soroku-to or Little Deer Island, off the southern coast of Korea, and 1,400 to 1,500 are in the mission-operated colonies at Reisui, Fusan and Anto. Most of the lepers belong to the poor, beggar class.

Diseases of the Skin. Scabies, trichophytous infections and impetigo are reported to be prevalent among the Korean people.

Diseases of the Eyes. Trachoma is prevalent in Korea and the pannus, entropion, trichiasis and corneal ulcerations which it causes are responsible for many instances of poor vision and blindness. Other causes of poor vision and blindness are gonorrheal ophthalmia and smallpox. Other types of purulent conjunctivitis, such as that caused by Koch-Weeks bacillus (*Hemophilus influenzae*), also occur.

Rabies. Rabies is fairly common among the numerous stray dogs.

Leptospirosis. Weil's disease, caused by *Leptospira icterohaemorrhagiae,* is endemic. This disease is spread by the ingestion of food or water contaminated by the urine and feces of infected rats.

Miscellaneous Diseases. Tetanus occurs, particularly in the newborn and in recently delivered mothers. Anthrax is reported, but is infrequent. Kala-azar is not endemic in Korea, but occasionally it may be brought into the area from areas in the northern part of China, in which it is endemic. Rat-bite fever also has been reported from Korea.

Diseases Spread by Arthropods

Malaria. Malaria is reported to be of common occurrence in Korea, especially in the southern part of the country. However, no statistics are available concerning the incidence of this disease. The tertian type is the most prevalent, with a few cases of the quartan type and an occasional case of the estivo-autumnal type.

Filariasis. *Wuchereria bancrofti* causes the type of filariasis that is found chiefly in the southern part of Korea. Its principal mosquito vectors are *Anopheles hyrcanus sinensis* and *Culex fatigans.*

Dengue Fever. This disease is said not to have occurred in Korea in recent years. Yet the principal mosquito vectors of the disease, *Aedes aegypti* and *A. albopictus,* are present in Korea; in view of the frequent travel between this country and areas in the southern part of China, Formosa and the Philippine Islands in which dengue fever is endemic, the disease could easily become epidemic in Korea.

Yellow Fever. No cases of yellow fever have ever been reported from Korea or other parts of the Orient, but its chief vector, *Aedes aegypti,* is present.

Typhus Fever. Three types of typhus fever are reported from Korea: the flea-borne (endemic) type, known in Korea as "Honan fever"; the louse-borne (epidemic) type; and the mite-borne type, known as Japanese river fever or tsutsugamushi disease, caused by *Rickettsia orientalis.* The flea-borne type is reported to be the most frequent, the mite-borne the least frequent. From 1929 through 1937 the annual number of cases of the former varied from 890 to 1,683; fatality rates ranged from 11 to 13 per cent. In Japan the fatality rate for tsutsugamushi disease varies between 50 and 68 per cent, whereas in Malaya the rate is lower. Fatality rates for the mite-borne typhus fever of Korea are not available, but it is known that, in general, the mite-borne and louse-borne fevers are accompanied by higher fatality rates than is the flea-borne type.

Plague. This disease has not been reported officially since 1919, but professional reports from Korea indicate that plague occurs sporadically. Sylvatic plague is known to be endemic; under such conditions, occasional instances of human infection are to be expected.

Relapsing Fever. This disease, which is caused by spirochetes of the genus Borrelia, has been of uncommon occurrence in recent years. It is frequent in Manchuria and China and at any time may again become prevalent in Korea, especially since lice are so numerous.

Miscellaneous

Nutritional Diseases. Beriberi is said to be more prevalent among the Japanese than among the Koreans, probably because the Japanese are the more dependent on a diet of polished rice. Scurvy is sometimes observed, but pellagra is rare. Sprue occurs commonly among Occidentals as a sequel to chronic dysentery and dietary deficiencies. Nutritional anemia is often seen.

SUMMARY

Public health, hospital and medical facilities in Korea, as compared with those in the United States, are inadequate. Locally produced foods are barely sufficient for local needs, and the inspection given food and dairy products to ensure protection of health is inadequate. Water is plentiful but, regardless of its source, should be considered unsafe for human consumption until it has been adequately treated. The few systems in which sewage is water-borne in the large cities are used chiefly for the disposal of storm water and water containing kitchen wastes. The night soil from the cities, towns and rural areas is collected and used for fertilizer. Such a system results in widespread pollution of the soil. The housefly is an ubiquitous pest and an important carrier of intestinal diseases and infections of the eyes. Rats, mosquitoes, fleas, lice, mites and ticks are prevalent.

The diseases of greatest importance in this area are venereal diseases; the enteric diseases, including typhoid fever, paratyphoid fevers, amebic dysentery, and bacillary dysentery; typhus fever, predominantly the flea-borne and louse-borne types, and occasionally the mite-borne type; malaria, especially in the southern part of the country; cerebrospinal meningitis; pneumonia; and diseases of the skin, particularly scabies and trichophytous infections. Other endemic diseases include relapsing fever, plague, cholera, and rabies. Diseases of limited importance, except to the native population, include tuberculosis, helminthiasis, and infection with flukes.

BIBLIOGRAPHY

Byam, W., and Archibald, R. G., eds.: The Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1921-23, 3 vols.

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed., Philadelphia, Lea & Febiger, 1940.

Deering, M. C.: Chosen: Land of Morning Calm. Nat. Geog. M., **64**:421-448 (Oct.) 1933.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Japan-Manchoukuo Year-Book, 1940. Tokyo, The Japan-Manchoukuo Year Book Co., 1940.

Japan Year Book, 1939-40, Tokyo, The Foreign Affairs Association, 1940.

McKinley, E. B.: A Geography of Disease, Washington, George Washington University Press, 1935.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr, 11th ed. Baltimore, Williams & Wilkins Co., 1941.

Stamp, L. D.: Asia. An Economic and Regional Geography. New York, E. P. Dutton and Co., 1939.

Statesman's Year-Book. London, The Macmillan Co., Ltd., 1942.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942, 2 vols.

World Almanac. New York, New York World-Telegram, 1942.

9

British Malaya

GEOGRAPHY AND CLIMATE

British Malaya, which forms the most southerly projection of the continent of Asia, lies between 1 and 7° of north latitude and about 100 and 105° of east longitude. It is bounded on the north by the Thai possessions on the Malay Peninsula, on the west and south by the Malacca Strait, and on the east by the South China Sea and the Gulf of Siam. The Malay States, federated and unfederated, have an area of some 56,000 square miles, or about that of the state of Illinois.

The population of British Malaya is thought to be about 5,500,000. In the Unfederated Malay States of Johore, Kedah, Perlis, Kelantan and Trengganu the estimated mean population in 1939 was about 1,919,000. This figure included about 1,225,874 Malays, 505,067 Chinese, 150,359 Indians, perhaps 2,000 Europeans and 35,700 members of other nationalities or races. In 1940 the estimated population of the four Federated Malay States of Perak, Selangor, Negri Sembilan and Pahang was about 2,169,500, composed of 704,000 Malays, 967,000 Chinese, 465,000 Indians, 11,000 Europeans, 5,000 Eurasians and 17,500 others. The Straits Settlements, which include the Settlements of Singapore (Cocos Islands and Christmas Island), Penang and Province Wellesley, Malacca and Labuan, in 1940 were estimated to have a population of 1,406,000, consisting of 309,000 Malays, 17,500 Europeans, 13,000 Eurasians, 904,500 Chinese, 149,000 Indians and 13,000 members of other races. The total estimated population for the Federated Malay States, the Unfederated Malay States and the Straits Settlements, all of which will be considered in this chapter, is thus about 5,494,500, a figure which by no means should be considered as official.

Physically, the Malay Peninsula is characterized by a range of granite mountains which divides it into two main portions. That section lying to the west is the smaller; lesser mountain ranges and isolated spurs parallel the main range at numerous points. Between Pahang and Kelantan is a peak, Gunong Kerbau, which is 7,186 feet high. The western coastline is lined by mangrove trees in a belt that is many miles deep; the eastern coastline has been kept free of such trees by the force of the northeastern monsoon, and is broken by rocky headlands, well forested. Islands, of which Singapore itself is one, are numerous on both coasts, and include the Cocos Islands and Christmas Island, the latter not to be confused with the Christmas Island in the Pacific Ocean. The entire peninsula of Malaya has been described as being "one vast forest," since approximately 72 per cent of the terrain is so clothed.

British Malaya is exceptionally well watered. On the west the chief rivers are the Perak, the Bernam and the Muar. On the east the principal streams are the Patani, the Talukin, the Kelantan, the Besut, the Trengganu and several others. Not all of these rivers are navigable; as a matter of fact, only the Kelantan and the Pahang are navigable for as far as 250 miles, and then only by native craft.

The climate of British Malaya generally is recognized as being notorious for its excessive humidity. Yet, even at Singapore, on the southern tip of the Malay Peninsula where it is hottest, the temperature seldom is more than 93° F. (33.9° C.) in the shade, and the mean for the year at Singapore is only about 80° F. (26.6° C.) or less. On the mainland itself, particularly along the eastern coast, the temperature at night often is less than 70° F. (21.1° C.).

There are from 160 to more than 200 days of rainfall a year in British Malaya, and the amount of rainfall on an average is approximately 100 inches (2.5 meters) annually. On the western coast rainfall is between 65 and 115 inches (1.7 and about 3 meters) annually. On the eastern coast rainfall has amounted to as much as 235 inches (6 meters) a year, the increase being brought about by the action of the violent northeastern monsoon. Rainfall usually is most abundant in March, April, May, September, October and November.

PUBLIC HEALTH *

Health Services

Organization. Public health under the supervision of the British government was well organized in the Malay States. In the Straits Settlements the Director of Medical Services was the executive head of the department, whereas for the Malay States (federated and unfederated), which were decentralized, he was adviser, but exercised no executive control. He was officially known as the "Director and Adviser of Medical Services." His assistant was known as the "Deputy Director and Adviser of the Medical Services." The heads of the health departments of the Singapore, Penang and Malacca municipal governments were appointed to their positions, whereas the other medical officers working in the Malay States were members of the Malayan Medical Service. Each Malay state, whether federated or unfederated, had its own chief of its medical department, a member of the Malayan Medical Service. The head of each state medical department was directly responsible to the government of that individual state, but he could obtain the counsel of the Director and Adviser of the Medical Services. Co-ordination of health measures throughout the Malayan area was maintained through the office of the Director and Adviser of the Medical Services.

Relative Effectiveness. Practically all medical and health work in the Malay States was conducted or supervised by the British government through the Malayan Medical Service, which in 1937 was reported to have 186 members. They were assisted by a staff of 136 locally qualified physicians and by an auxiliary staff of nursing and health sisters, locally trained nurses, hospital assistants and sanitary inspectors. The service maintained the King Edward VII College of Medicine at Singapore, a Pathological Institute, an Institute for Medical Research, 87 hospitals and numerous dispensaries and clinics. There were two separate services; one concerned with curative medicine and the other devoted to public health. Both services were closely related and co-ordinated. The program of the Malayan Medical Service was considered to have been very effective, especially in the reduction of the epidemic diseases so prevalent in the southeastern part of Asia.

Water Supplies

Water for the municipal supply of Singapore was obtained from catchment basins located on Singapore Island and across the straits of Johore. This water passed through sand filters and was treated with chlorine before it entered the water mains. During 1938 an average of 22,704,000 gallons of water per day was used, and approximately 50 per cent of this water came from the Johore reservoirs. The plentiful water supply of Penang was obtained from mountain springs. The water was stored in

* Unless otherwise indicated, governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

the hillside reservoirs and then run directly into the water mains. This water was reported to be pure and of excellent quality. Water for the other larger cities was treated by sedimentation, filtration and in some instances by chlorination. In most of the rural areas water was obtained from wells, springs, rivers, canals and ponds. Spring water was especially abundant in the foothills, but in those areas malaria also was prevalent; consequently, special drainage systems were designed to prevent the breeding of mosquitoes and yet to provide wholesome water. In some of the villages protected wells were provided by the government. On many of the estates pure water, piped in from protected streams or wells, was provided. In some areas of Perak, in an effort to keep the inhabitants from using untreated water, plants for the purification of river water had been constructed and special tanks, placed on the banks of the lower reaches of the river, were filled with purified water each week by the water boats. It is estimated that about 35 per cent of the people of the Malay States were supplied with satisfactory water.

Sewage Disposal

The cities of Singapore and Penang had extensive systems in which sewage was water-borne, and these systems were being extended from year to year. In 1939 the Alexandra Road sewage disposal plant at Singapore received an average of 6,169,000 gallons of water-borne sewage and 31,000 gallons of night soil daily. In the area about these cities in which the sewers had not yet been extended and in other parts of the Malay States, septic tanks and various types of latrines, such as the common pit latrine, the bucket latrine, the over-stream latrine and the bored-hole latrine, were in use. The construction and use of the bored-hole latrines were especially encouraged by the government. In many sections night soil was used for fertilizer, particularly by the Chinese vegetable gardeners. In other districts the laws required that the collected night soil be buried in trenches. However, these trenches often were shallow and poorly covered, so that when the first downpour of rain occurred the night soil was distributed over the area. Refuse and other wastes of the larger towns and cities were reported to have been collected regularly and burned in incinerators. In some sections the waste material was dumped into swampy areas and covered with earth, whereas in other areas it was indiscriminately scattered about. Thus, in most places the disposal of night soil, garbage and wastes resulted in widespread pollution of the soil and in the increased breeding of various insects that are carriers of disease.

Insects and Animals

Vectors of Disease. Mosquitoes. Twenty-five species of anopheline mosquitoes have been reported from the Malay States. They are *Anopheles sundaicus A. maculatus, A. umbrosus, A. minimus minimus, A. hyrcanus nigerrimus, A. hyrcanus sinensis, A. barbirostris, A. aconitus, A. philippinensis, A. novumbrosus, A. aitkenii, A. brevipalpis, A. karwari, A. kochi, A. separatus, A. tessellatus, A. baezai, A. vagus, A. montanus, A. leucosphyrus, A. aitkenii bengalensis, A. aitkenii palmatus, A. annularis,* and *A. subpictus* var. *malayensis. Anopheles sundaicus,* which is one of the world's most important vectors of malaria, is found in the mangrove areas, where it breeds in brackish water. It prefers human blood and is found about human habitations. *Anopheles maculatus maculatus,* the next most important vector of malaria in Malaya, occurs in the coastal hills and in the areas in which rubber plantations are located. It prefers sunshine, and when the jungles are cleared it takes the place of *Anopheles umbrosus,* the jungle vector of malaria. *Anopheles umbrosus* is present in the jungle of the coastal plains, breeding in shady areas in stagnant water. *Anopheles minimus minimus* is found in the foothills; it breeds in the slow-running water of streams and in pools. The two subspecies of *Anopheles hyrcanus* are widely scattered through Malaya; *A. hyrcanus nigerrimus* occurs more commonly in the lowlands, and *A. hyrcanus sinensis* is seen most frequently in the highlands. These two subspecies, and *A. sundaicus, A. maculatus maculatus, A. minimus minimus* and *A. philippinensis,* have been found naturally infected with *Wuchereria bancrofti. Anopheles barbirostris* and *A. hyrcanus sinensis* and *nigerrimus* also have been found naturally infected with *Wuchereria malayi.*

Five species of Aedes mosquitoes are recorded from the Malay States, namely: *Aedes aegypti, A. albopictus, A. obturbans, A. caecus* and *A. albolineatus. Aedes aegypti* and *A. albopictus* are the chief vectors of dengue fever, a disease commonly occurring in the Malay States. *Aedes aegypti* also is the vector of urban yellow fever, which disease, however, has never been introduced into the Malay States or other parts of the Orient. *Aedes albolineatus* has been found naturally infected with *Wuchereria bancrofti,* and *Aedes aegypti* has been reported to be infected with *Dirofilaria immitis.*

Six species of Culex mosquitoes are reported from the Malay States. They are *Culex fatigans, C. bitaeniorhynchus, C. gelidus, C. tritaeniorhynchus, C. vishnui* and *C. fuscocephalus.* Although *Culex fatigans* is the principal vector of *Wuchereria bancrofti,* the other types of Culex mosquitoes also may transmit the filaria. This type of filariasis occurs more commonly in the towns and urban communities, because it is in this area that culicine mosquitoes are most numerous. *Culex tritaeniorhynchus* and *C. fatigans* also are natural carriers of *Dirofilaria immitis* (dog heartworm). *Culex fatigans* also has been found to be naturally infected with *Wuchereria malayi.*

Seven species of the genus Mansonia are indigenous in the jungle and swamp areas of the Malay States. They are carriers of *Wuchereria malayi.* The principal vectors of this type of filariasis are *Mansonia longipalpis* (a most efficient carrier), *M. annulata, M. annulifera, M. uniformis* and *M. bonneae annulipes.* In addition, *M. indiana* and *M. crassipes* are found. Because of the distribution of Mansonia mosquitoes in the swamps and jungles, this type of filariasis occurs largely in jungle villages. *M. longipalpis* and *M. indiana* also are carriers of *Dirofilaria immitis,* while *M. indiana* has been found to be a natural vector of *Wuchereria bancrofti.*

LICE. Several types of lice are found in the Malay States, including the body louse, *Pediculus corporis;* the head louse, *P. capitis;* and the pubic louse, *Phthirus pubis.* The body and head louse are vectors of *Rickettsia prowazeki,* the virus of epidemic typhus fever; however, this disease has not been reported from this area. The rat louse, *Polyplax spinulosa,* an important vector of endemic typhus fever among rats, is present.

FLIES. The common housefly, *Musca domestica,* is very prevalent in the Malay States. The blow fly, *Chrysomyia vesia,* which causes myiasis of the skin and wounds, and *Lucilia sericata,* which commonly breeds in dead bodies and also causes myiasis of wounds, are reported from Malaya. These flies are mechanical vectors of yaws, intestinal diseases and diseases of the eyes.

Horse flies or mango flies, members of the family Tabanidae, are found in Malaya. Included in this family are the genera Chrysops, Chrysozona and Tabanus. The five species of Chrysops found in Malaya are *C. fixissima, C. translucens, C. dispar, C. fasciata* and *C. cincta.* The eight species of Chrysozona reported from Malaya are *C. rubida, C. irrorata, C. splendens, C. lunulata, C. mediatrifrons, C. malayensis, C. javana* and *C. pachycera.* Twenty-eight species of the genus Tabanus are present. They are *T. rubidus, T. aurilineatus, T. birmanicus, T. rufiventris, T. bicinctus, T. albitriangularis, T. brunneus, T. malayensis, T. minimus, T. simplis-*

simus, T. uniformis, T. perakiensis, T. tinctothorax, T. flavothorax, T. optatus, T. ceylonicus, T. dissimilis, T. effilatus, T. fumifer, T. hirtistriatus, T. hybridus, T. immanis, T. khasiensis, T. lentisignatus, T. pratti, T. rarus, T. striatus and *T. significans.*

The only member of the genus Stomoxys that is reported is the stable fly, *Stomoxys calcitrans,* whose habits are in many ways similar to those of the housefly. It is attracted to sores and feeds readily on them, acting as a mechanical carrier, especially of yaws, and at times of cutaneous leishmaniasis.

Midge flies are present in Malaya. They are *Culicoides anophelis, C. daleki, C. orientalis, C. pungens, C. raripalpis, C. shortti, C. flumineus, C. boophagus* and *C. buckleyi.* Several species of Lasiohelea are reported; they are *L. lefanui* and others. They will bite viciously, attacking as a rule at dusk, when the wind is down, and also during the night. The species of Culicoides found in Malaya commonly feed on the blood of cattle, but they also attack that of man. The two species of Lasiohelia, however, are reported to enter houses to feed on man. The bites of these midges are especially irritating. In Malaya midges have not been identified as true vectors of any specific diseases.

One sand fly of the family Psychodidae is reported from Malaya. It is *Phlebotomus stantoni. Phlebotomus argentipes,* found in near-by Burma and India, probably is found also in Malaya. Sand flies are the vectors of sandfly fever and of the visceral and cutaneous types of leishmaniasis. However, leishmaniasis is not endemic in Malaya, although patients who have it are occasionally brought into the area. Sandfly fever is not recorded from Malaya.

Ticks. The ordinary brown dog tick, *Rhipicephalus sanguineus,* is common, but it has not been identified as a vector of disease in this area.

Fleas. Several varieties of fleas are present. They include the tropical rat flea, *Xenopsylla cheopis,* the principal vector of plague which transmits plague from rat to man as well as from rat to rat; the rat flea, *X. astia,* vector of plague from rat to rat; and the flea which infests human beings, *Pulex irritans,* which transmits plague from rat to man. Another rat flea, *X. brasiliensis;* the dog flea, *Ctenocephalus canis;* and the cat flea, *C. felis,* also are present. During 1939, 3,283 rats were killed in Singapore, but none was found to be infected with plague. The tropical rat flea, *X. cheopis,* in addition to being a vector of plague, is the vector of *Rickettsia mooseri,* the causative organism of endemic typhus fever, a disease which does occur in the Malay States.

Rodents. Rodents are common throughout Malaya: 37 species of rats and two species of mice are recorded. Other species found in Thailand and French Indo-China also may be present in this area. Included among them are the common Malayan urban rat, *Rattus diardi;* the Norway or brown rat, *R. norvegicus;* the rural rat, *R. jalorensis;* and the house rat, *R. concolor.* The mouse, *Mus musculus,* also is present. The storage of rice in the homes, shops and wholesale establishments has contributed to the increased prevalence of rats and mice. Rats and other rodents serve as hosts for lice, fleas and mites which are vectors of plague, typhus fever and relapsing fever. Their excreta may contain bacteria of the genus Salmonella as well as *Leptospira icterohaemorrhagiae* and a variety of ova and cysts. *Spirillum minus,* the organism which causes rat-bite fever, may be transmitted by their bite.

Mites. The three most important mites found in Malaya are *Trombicula schuffneri, T. akamushi* and *T. deliensis.* They are the vectors of *Rickettsia orientalis,* which causes the tropical scrub typhus fever of Malaya. The adult and nymph mites are parasitic on various plants, trees and grasses, and the larval forms which are the vectors of tropical scrub typhus fever feed on the blood of mice, wild rats and other rodents found there. It is believed that the Malayan rat is a reservoir of scrub typhus fever. The common itch mite, *Sarcoptes scabiei*, the cause of scabies, is a common parasite on many of the inhabitants.

GNATS. Eye gnats of the family Oscinidae are present in Malaya. The most common species of this family is *Siphunculina funicola signata*, which feeds on lacrymal secretions, sweat and exudates of wounds and of the conjunctiva. It is a mechanical vector of diseases of the eyes and yaws. Buffalo gnats, members of the family Simuliidae, are recorded from Malaya, but the species found there is not known. However, *S. indicum* is found in India, and it may also be the species that is present in Malaya. They are voracious bloodsuckers and bite during the daytime. The bites themselves are not very painful, but usually result in the formation of wheals and often in secondary infection. In Africa and Central America, species of these flies are transmitters of *Onchocerca volvulus*, a filarial worm which causes the disease, onchocerciasis. These gnats in the Malay States have not been found to be true vectors of any specific disease, but they do act as mechanical vectors of disease.

Snakes and Other Dangerous Animals. Many varieties of poisonous snakes are found in the Malay States. They are members of the families Colubridae and Viperidae. The Colubridae are divided into land snakes (Elapinae) and sea snakes (Hydrophinae). The land snakes in turn are separated into the cobras, kraits and coral snakes, so far as the Malay States are concerned. The Viperidae are divided into the pitless vipers and pit vipers. The venom of the land and sea snakes acts on the central nervous system, causing respiratory paralysis by its direct action on the respiratory center. The venom of the vipers causes vasomotor paralysis and prevents the clotting of blood, allowing hemorrhages to occur in various parts of the body.

The most important of the land snakes is the species *Naja hannah*, the king cobra or hamadryad. It is very aggressive and attacks human beings without provocation. The usual length for an adult snake of this species is about 12 feet (3.7 meters), but cases are on record in which it attained a length of 18 feet (5.5 meters). More numerous than the king cobra are the many varieties of the common or Asiatic cobra, *Naja naja*. These snakes seldom exceed a length of 6 feet (1.8 meters), but are almost as poisonous as the large king cobra. They live in all varieties of terrain excepting high mountains and mangrove swamps, but are reported to be more common near towns and villages than in true jungles. They are excitable and attack freely. Six or more species of the kraits, genus Bungarus, are reported in Malaya. The kraits, because of their nocturnal habit of prowling about human habitations and lying in the roads in the dust at night, are dangerous. In such places they are often stepped upon. Sometimes they crawl onto mantels or into the drawers of dressers, desks or other furniture. They are more common in populated areas than are the cobras. They are from 2 to 5 feet (61 cm. to 1.5 meters) long, with smooth, lustrous scales, dark brown or black, with pale cross bands, some vividly marked with yellow "rings." The banded krait, *B. fasciatus*, is common. The bite of the krait is almost as dangerous as that of the cobra, but is slower in effect. Coral snakes of the genera Hemibungarus, Calliophis and Doliophis are found in the Malay States. They are small snakes, attaining a length of some 18 to 24 inches (46 to 61 cm.). The most common species is *Doliophis intestinalis*, which is brown or black with narrow yellow stipes. Another is the "sunbeam" snake, *D. bivirgatus*. Its bite is quickly fatal to small birds and animals.

More than 50 species of sea snakes, the marine allies of the cobras and kraits, inhabit the brackish water about Malaya, particularly near the mouths of rivers. They never are found inland. They have wide, paddle-like tails vertically compressed. These snakes are never found in fresh water or on land. They are capable of some degree of underwater respiration, but must frequently come to the surface for air. Their venom is very toxic and each year many deaths among the fishermen result from the bites of these snakes.

The principal pitless viper is Russell's viper, *daboia* or *tic-polonga.* It attains a maximal length of about 5 feet (1.5 meters) and ranks with the cobra as one of the most deadly snakes of Malaya. The pit vipers are recognized by the flat, triangular head and sharply constricted neck and the pit between the nostril and the eye. They vary from 2 to 5 feet (61 cm. to 1.5 meters) in length. All of them are very poisonous, and even if the person who has been bitten by one of them escapes death, serious constitutional disturbances may follow which may continue for several months. Six species belonging to two genera occur. A member of the genus Agkistrodon, which has been found only in the north, can be distinguished from a member of the other genus, Lachesis, by the large symmetric shields, instead of small scales, which cover its head. It is heavily built and sluggish, of mottled grayish brown and frequently is found among dead leaves in undergrowth. Together with several allied species, it is called by Malays the *ular kopak daun* or "leaf-ax snake"—the word "ax" referring to the shape of the head. Members of the genus Lachesis also are thick-set snakes, usually with much green in the coloration, often varied with red, purple, yellow and black. *Lachesis wagleri* frequents the mangrove swamps, where it is much dreaded by Chinese woodcutters; it is green-mottled and starred with yellow and black, but no two specimens are alike in arrangement of pattern.

There are many nonpoisonous snakes in Malaya, the most prominent of which are the Pythons, incorrectly called "boa constrictors." One species, *Python reticulatus,* commonly called *ular sowa,* sometimes attains a length of more than 30 feet (roughly, 9 meters). It feeds largely on poultry and goats but will at times attack man. It is not poisonous, but kills its prey by constriction. However, it also possesses formidable curved teeth which can inflict dangerous, and at times fatal, wounds.

Poisonous and Dangerous Fish. The poisonous fish found in the seas about Malaya may be divided into two groups: those which are poisonous when eaten and those which poison by means of their sting or bite. The fish of the first group are members of the genus Tetraodon, and one of this group found in Malayan waters is the puffer or puffer-toad fish, *Tetraodon argenteus.* The toxin of this fish exists chiefly in the ovaries and testes. It exerts a physiologic action somewhat like that of curare, and is thermostable. It is true that at certain times these fish do not cause poisoning, but at other times they do. It has been noted that poisoning is particularly likely to occur during spawning. Among the fish of the second group, which poison by means of their sting or bite, are the morays, or tropical eels. They are members of the family Muraenidae and have well-developed hollow teeth through which the venom is introduced into the wound made by the bite. Their venom is markedly hemolytic and large doses of it produce practically instantaneous death. Smaller doses cause rapid and embarrassed respiration, violent cramps and convulsions. Other fish, members of the family Scorpaenidae, have poisonous glands connected with their dorsal fins. After puncture wounds or pricks of the fins have been inflicted, the poison enters the wound. Three species are reported from this area: *Synancea diabolus, S. verrucosa* and *S. brachio.* Persons in bathing who strike against these fins are more likely to be wounded than are the fishermen who handle the fish with caution. These fish also are more dangerous during the spawning period than at other times. Other poisonous fish possess a dorsal spine and two lateral spines which are covered by skin under ordinary conditions. When the fin is erected, however, the skin is stretched and the spine bursts through, allowing the poison to escape into the wound that is inflicted. They are members of the family Plotosidae, the principal species being *Plotosus arab* which in Malaya is called the *sanbilang*. Finally may be mentioned the sting ray, *Trygon sephen*. This fish possesses a long, flexible, whip-like tail, terminating in a bony spine, which is very sharp at the point and furnished with sharp, cutting teeth. When the ray attacks, it strikes its tail at some part of the victim and forces the spine into the flesh, causing a deep laceration which is very slow to heal because of the poison deposited in it.

Sharks are found in the seas about Malaya, and bathing in unprotected waters is dangerous. Twenty-three species of turtles are reported, some of which may attain a length of 8 or 9 feet (about 2.4 to 2.7 meters) and weigh almost 1 ton (about 800 kg.). However, the dangerous turtle is the soft turtle of the family Trionychidae, which inhabits the rivers. It is savage and can inflict dangerous bites.

SCORPIONS AND CENTIPEDES. Poisonous scorpions and centipedes are found in Malaya. However, scorpions never sting unless they are disturbed and their sting rarely is fatal. Centipedes often crawl into shoes left at the side of the bed. Their toxin, although not fatal, causes considerable discomfort.

CROCODILES. Crocodiles are numerous in Malaya, and they take a larger toll of human lives than does any other wild animal. There are three main species of crocodiles, the rare marsh crocodile, *Crocodilus palustris;* the Malayan gavial, *Tomistoma schlegeli,* found in the Perak, Pahang, and Selangor rivers and their tributaries; and the estuarine crocodile, *Crocodilus porosus,* which frequents the west coast primarily, probably because of the predominance of mangrove swamps on that coast.

OTHERS. Rhinoceroses, elephants and bison are found and may at times attack man. Also present are tigers, leopards, panthers and wildcats, which exact a considerable toll of injury and deaths among the natives.

Pests. LEECHES. Leeches are common in the Malayan jungles. The two most troublesome are the large "horseleech," or in Malay, *lintah,* and the ordinary small leech, in Malay, *pachat*. The small leeches are slender and black, and usually are not more than 2 to 3 inches (5 to 7.5 cm.) in length. Leeches are found commonly on the shrubs along jungle paths, where they stretch out to take hold of passers-by. They are most active between dawn and about 10 A.M., when the undergrowth is covered with dew, but are never active at night. They are more abundant in primary forests near streams and rivers and do not appear to have any seasonal frequency, although they are less active during the occasional short periods of dry weather than at other times. Leeches generally lodge on a person at or below the knee. They easily slip through eyeholes in shoes and through coarse stockings; often they are found climbing up the victim's legs, under shorts, and sucking blood from or near the genital organs. If small leeches are unsuspectingly taken into the mouth in raw drinking water, they may become attached to the mucous membrane of the nasopharynx, pharynx, epiglottis and esophagus, and during deep inhalation they may be carried into the larynx, trachea or bronchi, in which places they may cause serious trouble and even death.

BEDBUGS. The tropical bedbug, *Cimex hemipterus* (*rotundatus*), is present. The ability of the bedbug to transmit infectious diseases to human beings by biting is a disputed question; however, it is possible that if infected insects are crushed on the skin or are ingested, they may sometimes be responsible for the transmission of certain diseases.

ANTS. Many species of ants, including termites, are present in the Malay States. Unless precautions are taken, they are likely to cause considerable damage to various supplies and buildings. They will not attack teakwood.

MONKEYS. Many kinds of monkeys and gibbons are found in Malaya. The leaf monkey is perhaps the most common of all and is found practically throughout the area, from the coastal mangrove swamps to the jungle and in the mountains at elevations of as much as 6,000 feet. In addition to being pests, monkeys also are carriers of disease, principally filariasis.

LIZARDS. More than 75 species of lizards are known, most of which are small and inconspicuous. Two species of the large monitor lizards of the genus Varanus (*biawak*) are common. The largest of these lizards may attain a length of more than 7 feet (2.1 meters) and may be mistaken for crocodiles. One species lives along rivers, but the other is common around villages and lives on carrion, garbage and offal.

COCKROACHES. *Blatta orientalis* is present.

BEETLES. Several species of blister beetles are reported.

WILD DOGS. The wild dog, *srigala* or *anjung huten, Cuon rutilans,* is the only member of the dog family present. Wild dogs hunt in packs of considerable size, creating havoc among goats and cattle and even among buffalo. They are also involved in the spread of rabies.

POISONOUS PLANTS

In the jungles are various forest trees known collectively as *rengas,* belonging to such genera as Gluta, Melanochyla, Semecarpus and Sivintonia, that have a distinctly poisonous sap. The sap of several species of Mangifera, such as *M. caesia* (*binjai*), *M. odorata* (*kwini*), *M. kemanga* (*kemang*) and *M. foetida* (*bachang*) cause severe cutaneous eruptions; rarely, a person may be allergic to the common mango, *Mangifera indica.* Several of these "poisonous" species of Mangifera actually are cultivated for their edible fruits and occur about residences and in towns, but the local people are not inconvenienced by them. In places species of the nettle tree, Laportea, which bears stinging hairs, are found. Contact with these hairs produces intense pain which, however, is only temporary.

FOOD AND DAIRY PRODUCTS

Rice is the staple food of the people of the Malay States, but it is supplemented by many locally grown vegetables. Such locally produced supplies of rice and vegetables, however, were inadequate for local needs, and each year large amounts of rice and vegetables are or were imported from Burma, Thailand and Indo-China. Coconuts, bananas, pineapples, papayas, mangoes, oranges of poor grade, limes and other locally grown native fruits were eaten. Small amounts of coffee, tea and spices were grown; but most of such provisions were imported from India or the near-by Netherlands East Indies. Seafood, including the carp, catfish, shark, sting ray, inkfish, various kinds of turtles, mussels, long-tailed crayfish and short-tailed crabs, snails, slugs and edible worms, are plentiful. They furnish the principal sources of meat for the masses of the people. Beef, pork and mutton also are eaten, the kind and amount eaten depending upon the religious and economic status of the person concerned. The water buffalo and Indian cattle found in Malaya ordinarily are not eaten, and cattle brought in from Thailand furnish the usual supply of beef. In addition, much frozen beef was imported from Australia. Local supplies of pork and mutton also are inadequate. Each year from 150,000 to 200,000 hogs were brought in from the Netherlands East Indies, China and Thailand, and considerable supplies of pork, bacon and ham were imported from other areas. Goats and sheep shipped in from India furnished additional supplies of mutton. Chickens are the principal fowl found in the Malay States, and in 1933 it was estimated that approximately 6,000,000 were raised. They are of a small underfed, mongrel type, and are not good producers of eggs. Recurring epidemics of disease among the chickens often have resulted in the death of many of them in large areas of the country. Ducks and turkeys are raised, but furnish only a negligible supply of meat. The milk of the Delhi buffalo is used by the Indians, but it is of poor quality and there is little demand for it by the majority of the people. There are a number of dairies, but only the few under European management were considered satisfactory. Pasteurization is carried out in a few of the dairies, but tampering with bottles is common; therefore, no milk that is produced locally should be used without further pasteurization. The absence of foods containing adequate amounts of vitamins and other food essentials has resulted in the occurrence of beriberi and other nutritional diseases. Fish, crustaceans, beef and pork may contain the cercariae or plerocercoid larvae which cause infections with flukes and tapeworms. Vegetables and fruits often are contaminated with pathogenic bacteria, ova and cysts. During normal times, locally produced food and dairy products are not adequate for the local needs.

Miscellaneous Problems of Sanitation

The peoples of the Malay States are a heterogeneous group, differing from each other not only racially but socially, economically and in religious beliefs. These differences introduce complicating factors into any measures and programs concerning health and sanitation in any given area. Most of the people (the population is thought to be 5,500,000) live crowded together under insanitary conditions. Approximately 25 per cent of the total population live in the two large cities of Singapore and Penang. This crowding favors the dissemination of pulmonary tuberculosis and other diseases. The ventilation of the rural Malay home is not bad, but the lighting is very poor. The area beneath the house furnishes protection for the pigs, chickens and other domestic animals and in addition serves as a collecting place for various insects and animals that are carriers of disease. The Chinese home in Malaya is somewhat better, but still is not satisfactory. The bowls used commonly in temples for washing the hands and feet aid in the spreading of various diseases of the eyes and skin, as well as other diseases. The use of opium, morphine and other habit-forming drugs always has been a problem, even under British control.

The climate of Malaya is thought by some to have a direct relationship to the health of the people of the Malay States. The rainfall, which averages about 100 inches (2.5 meters) per year, varies from 65 to 235 inches (1.7 to about 6 meters) annually. Most of it occurs during the months of March, April, May, September, October and November. Thunderstorms and squalls may produce rapid changes in temperature, but in general the climate is monotonous, characterized by high relative humidity and uniform, unalternating temperature. In some people it produces boredom and depression. Whether the higher incidence of mental disease in the natives is caused by the monotonous climate or by some hereditary trait is not known; probably both are factors. The average white person in the Malay States escaped the monotony by going to the mountains or seashore for several weeks each year; or, if he did not, he probably found that by making certain other changes he could adjust himself to the climate of Malaya. In more recent years, air-conditioning of homes and offices has helped in this respect.

MEDICAL FACILITIES

Hospitals

All hospitals in the Malay States were maintained or controlled by the British government, through the Malayan Medical Service. The various rubber estates and mining companies were required to maintain hospitals for the treatment of their employees. In available records only two mission hospitals are referred to: one, which was to have been closed in 1941, situated in Singapore; and the other located in Penang. A mission dispensary was established at Sitiawan in Perak. In addition, there were several small maternity and general hospitals, all of which were supposed to meet the required standards of the health department.

Number of Beds. Available data on hospitals in the Malay States are incomplete; only two private hospitals are described, the number of estate hospitals is incomplete, and the number of beds in the military hospitals is unknown. However, the data do show that in 1937 there were 255 hospitals with a total bed capacity of 30,592, which produces the ratio of 61.0 hospital beds for each 10,000 of population. This number of hospital beds was inadequate for the needs of the people, and is more significant when it is realized that the rate of sickness for Malaya is much higher than that for the United States, where the number of hospital beds is 97 per 10,000 of population. However, when it is compared with India's number, 3 beds per 10,000 of population, the Malay States appeared to be relatively well equipped.

Equipment. The smaller government and state hospitals were equipped to care for only the less serious surgical and medical conditions. Patients who had more serious conditions were sent to the nearest large hospital which was equipped to give the usual surgical and medical care, including routine laboratory and roentgenologic diagnostic work. In the larger cities of Singapore, Penang and Malacca, the principal government hospitals and clinics compared favorably with the best of any such institutions in the British Empire. In addition to the hospitals mentioned above, the health services were equipped with 32 traveling automobile dispensaries and seven river motorboat dispensaries. The health service also conducted 76 outdoor dispensaries and 43 maternal and child welfare centers.

Supplies. Most hospital and medical supplies, with the exception of x-ray equipment, which was obtained from the United States, were imported from England. This source accounted for some 95 per cent or more of the supplies used, the remaining 5 per cent being imported from the United States, Japan and Germany. A few medical supplies, such as quinine, were imported from the Netherlands East Indies. The electric power supplied in the Singapore-Straits Settlements-Federated Malay States area was reported to be alternating current, of 50 cycles and 230/400 volts, whereas that in the Unfederated Malay States was direct current of 230 volts. Artificial ice plants were in operation in the larger cities.

Medical Personnel

Physicians. The list of medical practitioners published by the Medical Registration Ordinance in March of 1939 listed 767 physicians as then living in the Malay States and having licenses to practice medicine in the Straits Settlements and the Malay States. Of these, 135 were recorded as being members of the Malayan Medical Service, and 217 were members of the various state and local medical services. Twenty-two were members of the Royal Air Force medical services, and the others were engaged in private and contract medical practice. Members of the Malayan Medical Service were English; other physicians were of various nationalities, including Indian, Chinese, Japanese, Malayan, Dutch, American and Eurasian. It is estimated that there were approximately 1.4 physicians per 10,000 of population, whereas in the United States there are, normally, 10 physicians per 10,000 of population. Obviously the number of physicians is insufficient for local needs.

Nurses. The Malayan Nursing Service was composed of English nurses, and in 1937 had 176 members; 162 were regular medical or surgical nurses and 14 were public health nurses. Their chief duty was the organizing and maintaining of the nursing service throughout the Malay States. They were assisted by members of the local nursing services whose members were of other nationalities. In local nursing services there were 162 staff nurses, 56 public health nurses and 367 student nurses. The total number of nurses in the Malayan health department, including the student nurses, was 761. In addition, there were other nurses but no record was found concerning their number.

Others. In 1939, 380 dentists were reported to be licensed in the Malay States; and of these, five were members of the Malayan Medical Service, three were attached to the dental school, and six were employed by the local and state medical services. Some 1,076 laboratory, hospital and dresser assistants were reported to be employed in the government hospitals. Approximately 250 sanitary inspectors were employed.

Medical Institutions

The King Edward VII College of Medicine, in Singapore, gave full courses in medicine, dentistry and pharmacy. A pathology institute was maintained in association with the medical school at Singapore, with branch laboratories in Penang and Malacca. An institute for medical research at Kuala Lumpur in the state of Selangor conducted medical research and manufactured vaccines and serums.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Infections of the intestinal tract are extremely prevalent throughout the Malay States. Promiscuous defecation, the use of night soil as fertilizer, the great prevalence of flies and the high incidence of human carriers of these diseases are factors in their prevalence. The death rates at Singapore are shown in Table 19.

TABLE 19

Death Rates from Typhoid Fever, Paratyphoid Fever and Dysentery in Singapore Compared with Similar Rates in England and Wales, 1935 Through 1939

	Death rate per 100,000 in year				
Country	1935	1936	1937	1938	1939
England and Wales....	0.71	0.84	0.84	0.7	0.5
Singapore...	82.90	67.40	52.60	74.70	48.0

Typhoid and Paratyphoid Fevers. These diseases are common throughout the Malay States. The incidence of these diseases is shown in Table 20. Johore in 1937 reported 301 cases of typhoid fever with 70 deaths, and in 1938 there were 277 cases with 72 deaths. In 1935 at Singapore 415 cases were recorded; in 1936 there were 455 such cases; and 222 cases were recorded in 1937. The case fatality rate for Singapore was approximately 50 per cent, which probably means that only those cases in which the disease was serious were recorded, and that those cases in which the disease was mild were unrecorded. Results of examination of the blood of patients have shown that in about 95 per cent of cases in which the patients were hospitalized the disease was caused by *Eberthella typhosa;* in about 4 per cent of cases it was caused by *Salmonella paratyphi* and *S. schottmuelleri.* In the remaining 1 per cent of cases the disease was caused by *S. hirschfeldii.* Improvement in the water supply system and the general sanitary conditions, together with the increased use of the triple typhoid vaccines, has, through the years, reduced the number of cases of typhoid fever and paratyphoid fevers.

TABLE 20

Typhoid Fever and Paratyphoid Fever as Treated in Government Hospitals in Malaya, 1934 Through 1938

Year	Hospital admissions	Deaths	Fatality rate
1934	178	40	22.47
1935	282	64	22.69
1936	309	59	19.09
1937	334	65	19.46
1938	...	87	.....

TABLE 21

Patients with Dysentery Admitted to Hospitals in Malaya, 1937

	Region					
	Straits Settlements			Federated Malay States		
Dysentery, type	Patients admitted	Deaths	Fatality rate	Patients admitted	Deaths	Fatality rate
Amebic	313	46	14.69	900	86	9.55
Bacillary	287	96	33.45	385	62	16.10
Mixed	8	7	87.50	1	..	0
Unidentified	80	12	15.00	251	38	15.14

Dysentery. Both the amebic and the bacillary types of dysentery are common in the Malay States. They are more prevalent than published reports would indicate. In Table 21 the reported incidence of these diseases is shown.

During 1939 in Singapore 219 deaths were caused by dysentery, resulting in a death rate of 37 per 100,000 of population as compared to a rate of 0.33 per 100,000 in England and Wales during 1937. Thus, the dysentery rate for Singapore from 1937 through 1939 was 112 times that of England and Wales. The types of bacillary dysentery found in the Malay States are shown in Table 22. The data in Table 22 indicate that approximately 75 to 90 per cent of the bacillary dysentery in the Malay States is caused by *Shigella paradysenteriae* of the Flexner type, that about 5 to 10 per cent is caused by *Shigella dysenteriae,* and that the rest is caused by *Shigella paradysenteriae* of the Sonne type, and *Shigella ambigua* and other types of dysentery organisms.

TABLE 22

Results of Culture of Stools of Patients with Bacillary Dysentery, Various Regions of Malaya, 1935 Through 1937

Organism found, type	Cases, no.	Percentage *
2,724 specimens, Straits Settlements, 1937		
Shigella paradysenteriae (Flexner)	213	89.12
Shigella dysenteriae	10	4.18
Shigella ambigua	11	4.61
Shigella paradysenteriae (Sonne)	4	1.67
Salmonella typhimurium	1	0.42
Total	239	100.00
Specimens from Federated Malay States, 1935-1937		
Shigella paradysenteriae (Flexner)	104	74.29
Shigella paradysenteriae (Sonne)	16	11.43
Shigella dysenteriae	13	9.28
Shigella alkalescens	3	2.14
Other combinations	4	2.86
Total	140	100.00

* Of cases in which some organism was isolated; not of the total number of cases examined.

Common Diarrhea and Enteritis. These diseases are prevalent and most of them are caused by organisms of the genus Salmonella. Some of these organisms, for example *S. enteritidis* and *S. cholerae suis,* at times give rise to enteric-like fevers. Some of them are natural pathogens of domestic and household animals.

Cholera. Some years ago cholera was prevalent in Malaya. From 1907 to 1927 more than 3,000 cases with in excess of 2,000 deaths were reported from the Federated Malay States. However, in recent years quarantine measures, better water supplies and the increased use of cholera vaccines have caused the disease to become rare. In near-by India, Ceylon and China cholera is common, but no instances of it have been reported among the peoples of the Straits Settlements or the Federated Malay States since 1928. In 1937 there were 38 cases with 16 deaths; the victims were immigrants arriving from infected ports. These patients were held at the quarantine stations of the Straits Settlements and did not enter the Malay States while they were ill.

Helminthiasis. Infection with intestinal worms is widespread. The use of night soil as fertilizer, associated with the habits of promiscuous defecation and improper personal hygiene, is the principal factor in the prevalence of helminthiasis among the people.

Ancylostomiasis. Results of investigations among laborers on some of the estates have shown that more than 90 per cent of them are infected with hookworm. Examination of the stools of students attending the Malayan boys' schools in the area of Penang showed that 27.5 per cent of the urban students and 59 per cent of the rural students were infected with hookworm. In the Kuala Trengganu area, 29 per cent of the school students had this type of infection. Both the *Necator americanus* and the *Ancylostoma duodenale* types of infections occur.

Ascariasis. Results of examinations of the stools of students attending the Malay boys' schools in Penang showed that 80 per cent of the urban students and 76 per cent of the rural students had infection with roundworms. In the Kuala Trengganu district, 70 per cent of the students' stools contained roundworms.

Infection with Whipworm. Although in some areas, 58 per cent of the stools examined contained *Trichuris trichiura,* the clinical significance of such infection is relatively slight.

Infection with Pinworm. Infection with *Enterobius vermicularis* is reported, but is of little importance.

Infection with Tapeworm. Two types of this cestode, the beef tapeworm, *Taenia saginata,* and the pork tapeworm, *Taenia solium,* are recorded, but they are rare.

Dracontiasis. This disease is not common, but occasionally occurs among immigrants coming from India or the Dutch East Indies. The government hospitals of the Straits Settlements and the Federated Malay States reported six cases in 1936. During 1937 the Straits Settlements hospitals recorded 13 cases, with one death, and the Federated Malay States hospitals reported 11 cases, with no deaths. The infection is spread by the drinking of water which contains organisms of the genus Cyclops (the so-called water flea) that are infected with the larvae of *Dracunculus medinensis,* the guinea-worm.

Infection with Flukes. This type of infection, although it occurs, is not very common. Fish, crustaceans and untreated water may contain the cercariae which cause the type of infection with flukes found in Malaya; namely, infection with lung flukes, *Paragonimus compactus* and *P. westermani;* the intestinal flukes, *Fasciolopsis buski,* and *Gastrodiscoides hominis;* and the Oriental blood fluke, *Schistosoma japonicum.* Paragonimiasis and schistosomiasis cause severe disease, but in general very little disability is caused by fascioliasis and gastrodiscoidiasis. Most patients who are infected by flukes have come from areas of China, Japan, Indo-China, Dutch East Indies and India in which such infection is endemic. During 1936, two patients with schistosomiasis were treated in the government hospitals of the Straits Settlements and the Federated Malay States.

Undulant Fever. The record of only one case of undulant fever was found. In this case the disease occurred in the Straits Settlements during 1937.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. This disease is found throughout Malaya. It is present in all forms, including glandular, cutaneous, osseous, intestinal, and pulmonary; the last type is the most prevalent. The crowding in the homes, the promiscuous spitting and the general undernourishment of the people are the most important factors in the spread of tuberculosis. During 1937, 2,649 patients with pulmonary tuberculosis were treated in hospitals of the Straits Settlements. There were 879 deaths, or a fatality rate of 33.18 per cent. In the hospitals of the Federated Malay States 1,994 patients were admitted because of pulmonary tuberculosis; of these 791 died, resulting in a fatality rate of 39.8 per cent. Pulmonary tuberculosis is more common among the middle-aged Chinese in Malaya than among other groups.

Pneumonia, Influenza and Bronchitis. During 1936 the Straits Settlements and the Federated Malay States reported 2,808 cases of pneumonia with 1,274 deaths; for 1937, 3,624 cases with 1,707 deaths were recorded. Hospitals admitted 10,740 patients with influenza in 1937; of these, 48 died. For this same year institutions recorded 5,362 cases of bronchitis with 149 deaths.

Meningococcic Meningitis. During 1937 only 33 patients with this disease were admitted to hospitals in the Straits Settlements and Federated Malay States, and of these 19 died.

Miscellaneous Infections. Smallpox had become a rare disease in the Malay States because of compulsory vaccination of all children less than seven years old, and because of the laws requiring vaccination of immigrants or the presentation of a certificate proving recent vaccination. The last case of smallpox on record was reported from Singapore in 1937. Measles is said to occur, but epidemics are not common. Diphtheria, although it is rare, has in recent years been increasing in frequency, especially in the cities. During 1937 the Straits Settlements government hospitals treated 89 patients, of whom 35 died, and the government hospitals of the Federated Malay States treated 256 patients, of whom 62 died. In 1938 Singapore alone reported 262 cases of diphtheria. In 1939 the number of patients had increased to 328 and of these, 281 were treated in the Middletown (isolation) hospital, with a fatality rate of 20 per cent. Chickenpox is not uncommon and often occurs in epidemic form. Anterior poliomyelitis is rare. In 1937, six patients, of whom none died, were treated in the Straits Settlements government hospitals, and 10 patients, of whom two died, were treated in the government hospitals of the Federated Malay States. Encephalitis lethargica is rarely recorded. In 1939 two deaths from this disease were reported from Singapore. Streptococcic infections are not common. Whooping cough is rare, and no record of the occurrence of mumps in the Malay States was found.

Diseases Spread Chiefly by Contact

Venereal Diseases. All five of the venereal diseases, namely, syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale, are common in the Malay States, especially in the cities, where professional prostitutes are very numerous and clandestine contacts are easily made. There are no official or unofficial programs for the control of venereal diseases and reports indicate that these diseases are increasing in prevalence. The incidence of these diseases in Singapore is shown in Table 23. The Federated Malay States government hospitals during 1934 admitted 3,675 patients with venereal disease; during 1935, 3,761 patients; in 1936, 4,064 patients; and in 1937, 4,035 patients.

TABLE 23

Patients with Venereal Disease Treated in Singapore Government Clinics, 1933 Through 1937

Year	New patients	Re-attendances	Population
1933	23,256	227,095	1,038,927
1934	21,432	220,813	1,038,903
1935	20,444	198,192	1,117,023
1936	22,680	214,012	1,168,197
1937	22,814	184,548	1,245,739

Syphilis. During 1937 in the Straits Settlements government clinics, 5,382 males and 773 females were treated for syphilis. The increased prevalence of syphilis is shown by the following rates: in the Straits Settlements in 1937 the rate for syphilis was 49.4 per 10,000 of population, whereas the rate for England and Wales in 1936 was 1.7 per 10,000 of population; that for Holland in 1936 was 1.06 per 10,000; and that for Sweden in 1936 was 0.67 per 10,000. Thus, the rate of syphilis for Singapore was 30 times that of England and Wales, 47 times that of Holland, and 75 times that of Sweden.

GONORRHEA. In the year 1937, 5,729 males and 298 females were treated for gonorrhea in the Straits Settlements government clinics. The rate of gonorrhea for the Straits Settlements in the year 1937 was 48.4 per 10,000; that for Sweden during 1936 was 17.9 per 10,000; that for England and Wales in 1936 was 8.1 per 10,000; and that for Holland was 5.6 per 10,000 population. Thus, the rate for gonorrhea in Singapore was three times the rate for gonorrhea in Sweden, six times the rate in England and Wales, and nine times the rate in Holland.

CHANCROID. During 1937, 4,424 males and eight females were treated for this disease in the government clinics of the Straits Settlements. Hospitals of the Straits Settlements for the same year admitted 419 patients who had chancroid disease, and hospitals in the Federated Malay States admitted 851 such patients.

LYMPHOGRANULOMA VENEREUM. Lymphogranuloma venereum (tropical or climatic bubo) also occurs. During 1937, 180 and 218 patients were admitted to the hospitals of the Straits Settlements and Federated Malay States, respectively, because of this disease.

GRANULOMA INGUINALE. Granuloma inguinale, according to reports, appears to be more common than lymphogranuloma venereum. During 1937, 188 and 795 patients who had this disease were admitted to the hospitals of the Straits Settlements and Federated Malay States, respectively.

The aforementioned data indicate that the rates for venereal disease in the Malay States are from six to 30 times greater than those in England and Wales. It also seems evident that the majority of the patients treated are males, so that many of the females are untreated. Under the present circumstances venereal diseases probably are more prevalent than previously.

Yaws. This disease, known locally as *urru*, and caused by *Treponema pertenue*, occurs throughout the Malay States, but is more common in the rural areas. It attacks children more often than adult persons and is more common among natives than Occidentals. It is readily communicable, and is spread by contact and mechanical vectors such as eye gnats and houseflies. In 1937 216 persons who had yaws were treated as inpatients in the government hospitals of the Straits Settlements and Federated Malay States, and during the same year 45 patients with this disease were treated in the government hospital of Johore. In 1938 at Trengganu 114 patients with yaws, representing 3.01 per cent of the total hospital admissions, and 11,123 patients, representing 8.43 per cent of the total number of outpatients, were treated for this disease. In the same state in 1937, 2,909 school children were examined, 3.8 per cent having signs of yaws. In the next year, among a similar group, 2.61 per cent had signs of yaws. In the Straits Settlements government clinics 5,337 patients were treated during 1937 and 5,206 patients during 1938.

Leprosy. Leprosy occurs in the Malay States, and lepers are segregated by law. There were five leper hospital-cottage settlements, with accommodations for 3,875 patients. In these institutions research in the treatment of leprosy was being conducted.

Diseases of the Skin. Scabies, impetigo and various forms of Trichophyton infections, such as ringworm and dhobie itch, are common. In hot, wet tropical climates such infections are more prevalent, and chronic forms of the infections are likely to become acute. A form of acute Trichophyton infection of the foot, prevalent in Malaya, is known as "Singapore" or "Hong Kong" foot. Fungous infections of the ear, or "Singapore ear," occur and may cause obstruction of the external auditory canal and subsequent involvement of the middle ear. The incidence of so-called verminous head among Malayan school children is high, sometimes amounting to 90 per cent or more. Chronic ulcers are common.

Diseases of the Eyes. Trachoma is widespread among the native inhabitants and results in much poor vision. Gonorrheal ophthalmia is not uncommon. Epidemic keratoconjunctivitis has been reported from Malaya. It is of potential economic importance in that during outbreaks of this disease large numbers of people may be completely incapacitated for a matter of one week to three weeks; after the acute phase there may be varying degrees of diminished visual acuity persisting for from six to 12 weeks.

Tetanus. During 1937, 171 patients, of whom 146 died, were treated in the government hospitals of the Straits Settlements. In the Federated Malay States government hospitals, 183 patients, of whom 146 died, were treated. Tetanus frequently occurs among newborn infants.

Leptospirosis. In 1936 the government hospitals of the Straits Settlements treated five patients who had leptospirosis or Weil's disease, three of whom died. Five patients, none of whom died, were treated in the Federated Malay States government hospitals. During 1937, five patients, of whom two died, were treated in the government hospitals of the Federated Malay States. Two patients died in Singapore of this disease in 1939. Rats are numerous, and it is probable that the disease is more prevalent than the number of reported cases would indicate.

Anthrax. This disease is rare in Malaya. The record of only one case was found; in this case the patient died in Singapore in 1937.

Rabies. During 1937 there were 172 reported instances of rabies in human beings distributed as follows: Singapore, 122; Kedah, 34; Penang, Province Wellesley, 4; Negri Sembilan, 6; Kelantan, 3; and Perlis, 3. The many stray dogs present in Malaya form the principal reservoir of the disease. Rabies vaccine formerly was manufactured and supplied by the Institute for Medical Research located at Kuala Lumpur.

Rat-bite Fever. This disease, caused by *Spirillum minus,* which is introduced into the wound made by the bite of the rat, has been reported from the Malay States. Like Weil's disease, it probably is more common than records indicate.

Diseases Spread by Arthropods

Malaria. Malaria is the chief menace to the health and well-being of the people of the Malay States. The disease is hyperendemic and exists throughout the area. Its prevalence is only partially indicated in Table 24, in which it is shown that 55,519 patients with malaria were treated in the hospitals listed during 1937, with a fatality rate of about 4 per cent. These patients represent only those treated in hospitals; those whose condition was less serious were treated in dispensaries, in homes, or not at all.

The three principal types of malaria of human beings, namely, tertian, quartan and estivo-autumnal, occur. The estivo-autumnal, or tropical, type of malaria is the most prevalent, and the increased incidence of this type accounts for the high death rates from malaria in Malaya. Blood smears of 2,258 patients treated in the government hospitals of the Federated Malay States during 1937 showed that the predominant malarial parasite was *Plasmodium falciparum.* Malaria occurs throughout the year, with a slight decrease in incidence during February and March, followed by a gradual increase during the summer and fall months.

Through the years the Malayan health department has done much work in the control of mosquitoes and malaria, and this work has reduced the incidence of the dis-

TABLE 24

Malaria as Treated in Government and Estate Hospitals in Malaya, 1937

Region	No. patients treated in specified hospitals: Government	Estate	Total treated	Total deaths	Fatality rate *
Straits Settlements	7,926	unknown	7,926	1,185	14.95
Federated Malay States					
Perak	7,635	3,735	11,370	281	2.47
Selangor	4,862	5,370	10,232	189	1.85
Negri Sembilan	3,362	4,660	8,022	169	2.11
Pahang	4,399	1,393	5,792	161	2.78
Unfederated Malay States					
Perlis	1,691	unknown	1,691	19	1.18
Johore	10,486	unknown	10,486	326	3.11
Total	......	.....	55,519	2,330	4.19 av.

* Note that figures from estate hospitals in three states are absent from this computation.

ease, especially about the cities and on some of the estates. The actual and potential importance of malaria in the Malay States cannot be overemphasized. Blackwater fever is not uncommon and during 1937 three cases with one death were reported in the Straits Settlements. During the same year 23 cases with eight deaths were recorded in the Federated Malay States. In 1938 in Trengganu there were two deaths from blackwater fever.

Filariasis. Two types of filariasis affecting man occur. The first is that caused by *Wuchereria malayi*, the chief vectors of which are mosquitoes of the genus Mansonia. The second type is that caused by *Wuchereria bancrofti*, the principal vectors of which are mosquitoes of the genera Culex and Anopheles. Filariasis that is caused by *Wuchereria malayi* occurs chiefly in jungle villages, among the Malayans and Indians. In the Kedah district the rate of infection (in the estates) with *W. malayi* was 14.6 per cent; in the village districts the rate for such infection was 36 per cent. Filariasis caused by *W. malayi* is particularly endemic in the valleys of the Perak and Pahang rivers; in the latter valley it is reported that 30 per cent of the people have the disease. In most cases, filariasis caused by *Wuchereria bancrofti* occurs in Singapore among immigrants from areas in India and China in which this type of filariasis is endemic.

Dengue Fever. This disease, caused by a virus transmitted by *Aedes aegypti* and *A. albopictus* mosquitoes, occurs in epidemic form in Malaya. A total of 205 and 308 patients were admitted to the hospitals of the Straits Settlements and the Federated Malay States during 1936 and 1937, respectively.

Yellow Fever. This disease never has been reported from the Orient, but *Aedes aegypti*, the chief vector of the disease, as well as *Aedes albopictus* and other mosquitoes which can transmit the disease, is present. It is not impossible that infected Aedes mosquitoes or a person ill with the disease could be brought in by airplane from areas in Africa in which the disease is endemic; but in view of the distance and the present procedures of disinsectization, it would seem unlikely.

Typhus Fever. Two types of typhus fever are reported as occurring in Malaya. They are (1) the "K" or scrub typhus fever, identical with tsutsugamushi, or Japanese river fever, caused by *Rickettsia orientalis*, and (2) the "X_{19} or W" or "urban or shop" typhus fever, caused by *Rickettsia mooseri*. The "urban or shop" type of typhus fever is found more commonly among workers in grain shops, and the "scrub" type is found among rural workers, especially among those working in certain oil-palm estates and those handling or working with coarse grasses, such as are fed to cattle. In 1937, 122 cases of "urban" typhus fever, with a case fatality rate of 8.4 per cent, and 124 cases of "rural" typhus fever, with a case fatality rate of 6.4 per cent, were reported from the Straits Settlements and the Federated Malay States. It is interesting to note that in recent years there has been an increase in the number of cases of typhus fever that are reported. It is probable that this increase is a result of greater accuracy in diagnosis, rather than an actual increase in the prevalence of this disease. The epidemic louse-borne and the tick-borne types of typhus fever have not been reported from Malaya.

Plague. This disease, caused by *Pasteurella pestis* and carried chiefly by the tropical rat flea, *Xenopsylla cheopis,* is endemic among the rats of Malaya. However, plague of human beings in Malaya is rare. Plague among human beings was last recorded in Singapore in 1933.

Relapsing Fever. No records of the occurrence of this disease in Malaya were found, but since lice are common and ticks occur, it is possible that the disease could be introduced from other countries.

Myiasis. The type of myiasis which affects wounds and the skin is only occasionally reported, but it is likely that the condition is not at all uncommon.

Leishmaniasis. Kala-azar and cutaneous leishmaniasis are rarely observed in the Malay States, but are sometimes brought into the area by persons coming from areas of India or south China in which the diseases are endemic.

Miscellaneous

In parts of Malaya the name *demam* is given to a disease characterized by a long, continuous fever which could be typhoid fever or paratyphoid fever, typhus fever or malaria. In Trengganu during 1938 there were five deaths from *demam kepialu,* whereas in Perlis 58 deaths were caused by *demam butok.*

Nutritional Diseases. The most common nutritional diseases are beriberi and nutritional anemia. During 1939, in Singapore alone, 658 deaths were reported as being caused by beriberi. Beriberi is most common among dwellers in cities and towns and among pregnant women. The ingestion of diets low in protein and iron, associated with the widespread prevalence of infection with hookworm, have been the main factors causing secondary anemia. Dental caries is very common and occasional cases of pellagra and rickets have been reported. Scurvy is present but not common. In a few areas, such as in the upper regions of the Trengganu River, goiter is endemic.

Injuries Caused by Heat. Heat stroke, heat exhaustion, heat cramps and prickly heat occur, especially among the Occidentals and other lighter-skinned persons. Prickly heat responds readily to a lowering of the temperature; that is, removal of the person concerned to a cooler area, or his living in an air-conditioned house. The prophylactic use of sodium chloride has helped to reduce the incidence of heat cramps. The natives suffer less from the heat than the whites, largely because they have adjusted their living to the Malayan climate.

Mental Disease. The incidence of mental diseases is high in Malaya. The four government hospitals for the treatment of mental diseases had accommodations for 4,400 inpatients and usually were filled to capacity. The rates for admissions to hospitals were increasing so much that the hospital authorities were somewhat alarmed. The incidence of suicide and homicide also was high. At the Central Mental Hospital during 1935, 1936 and 1937, respectively, 963, 1,087 and 1,225 patients were admitted to the hospital. The highest rates for recovery were reported among patients who had "confusional insanity, dementia and manic-depressive states." It is thought by some that the monotony of the climate may be a factor in the high incidence of mental disease among the natives.

SUMMARY

Public health, hospital and medical facilities under the British régime, although they were efficiently organized and maintained, were inadequate for the health and medical requirements of the Malay States. Practically all hospital and medical supplies had to be imported. Locally produced foods, except for small amounts of fruits and fish, were insufficient for local needs. The sanitary inspections given food and dairy products were either lacking or were entirely inadequate. Water is plentiful, but regardless of its source, it should be considered to be unsafe for human consumption until it has been adequately treated. Systems in which sewage is water-borne are present in the larger cities, but in many areas night soil is collected and used as fertilizer, resulting in widespread pollution of the soil. Mosquitoes capable of transmitting malaria, dengue fever and filariasis are very numerous. Flies of various types, lice, fleas, rodents, mites and bedbugs are prevalent. Many snakes, poisonous and nonpoisonous, and dangerous animals are present in the rural and jungle areas.

The diseases of greatest importance in the Malay States are: malaria; typhoid fever; amebic dysentery; bacillary dysentery; intestinal helminthiasis; the venereal diseases (syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale); typhus fever; pneumonia; influenza; tuberculosis; dengue fever; filariasis; injuries caused by heat; and diseases of the skin, particularly fungous infections.

BIBLIOGRAPHY

Austen, E. E.: Some Siamese Tabanidae. London, H. M. Stationery Off., 1922.

Brower, H. A.: Practical Hints to Scientific Travellers. The Hague, M. Nyhoff, 1927.

Brunetti, E.: *Diptera Nematocera* (excluding *Chironomidae* and *Culicidae*). London, Taylor & Francis, 1942. (The Fauna of British India, Including Ceylon & Burma.)

Byam, W., and Archibald, R. G., eds.: The Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1923, 3 vols.

Chosen, F. N.: A Handlist of Malaysian Mammals. Singapore, Govt. Print. Off., 1940.

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Gt. Brit. Colonial Office: Annual Report on the Social and Economic Progress of the People of the Federated Malay States, 1938. London, H. M. Stationery Off., 1938-39 (Colonial Reports—Annual No. 1924).

——: Annual Report on the Social and Economic Progress of the People of the State of Kelantan (Unfederated Malay States). Report for 1938. London, H. M. Stationery Off., 1939 (Colonial Reports—Annual No. 1917).

——: Annual Report on the Social and Economic Progress of the People of Perlis, 1938. London, H. M. Stationery Off., 1939 (Colonial Reports—Annual No. 1912).

Handbook to British Malaya. London, Malay States Information Agency, 1937.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Johore, Malay States: Annual Report on the Social and Economic Progress of the People of Johore for 1938, by W. E. Pepys. Johore, Bahru, Govt. Print. Off., 1939.

League of Nations. Health Organisation: Enquiry into the Quinine Requirements of Malarial Countries and the World Prevalence of Malaria, Geneva, 1932.

——: Intergovernmental Conference of Far Eastern Countries on Rural Hygiene, Report of the Malayan Delegation. Geneva, 1937.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr, 11th ed. Baltimore, Williams & Wilkins Co., 1941.

McKinley, E. B.: A Geography of Disease. Washington, George Washington University Press, 1935.

Merrill, E. D.: Figments of the Imagination. Science, 97:41-42 (Jan. 8) 1943.

Simmons, J. S., and Aitken, T. H. G.: The Anopheline Mosquitoes of the Northern Half of the Western Hemisphere and the Philippine

Islands. Army M. Bull., Jan. 1942 (Special Issue), No. 59.

Sinton, J. A.: The Identification and Classification of the Species of the Genus *Phlebotomus* with Some Remarks on Their Geographical Distribution in Relation to Disease. Calcutta, 1929.

Statesman's Year-Book. London, The Macmillan Co., Ltd., 1942.

Stekhoven, J., and Schurmans, H.: The Blood-sucking Arthropods of the Dutch East Indies Archipelago, VII. *Tabanidae*. Utrecht, L. E. Bosch & Zoon, 1926.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942. 2 vols.

Straits Settlements: List of Medical Practitioners Registered Under the Medical Registration Ordinance Practicing within the Straits Settlements and the Malay States, compiled by R. D. Fitzgerald. Singapore, 1939.

Straits Settlements: Medical Dept.: Annual Reports of the Medical Department for the years 1933; 1935-37. Singapore, Govt. Print. Off., 1934; 1936-38.

Theodor, O.: On Sandflies (*Phlebotomus*) from Ceylon, Siam, and Malaya. Indian J. M. Research, **26**:261-269 (July) 1938.

Thompson, V.: Post Mortem on Malaya. New York, The Macmillan Co., 1943.

Trengganu. Annual Medical and Sanitary Reports for the Years 1932; 1934.

——: Annual Report on the Social and Economic Progress of the People of Trengganu for 1938, by A. E. Coope. Singapore, G. H. Kiat & Co. 1939.

U. S. Bureau of Foreign and Domestic Commerce (Dept. of Commerce): World Trade in Dental and Surgical Goods. Washington, U. S. Govt. Print. Off., 1939.

Winstedt, R. O., ed.: Malaya, the Straits Settlements and the Federated and Unfederated Malay States. London, Constable & Co., 1923.

10

Nampo Islands and Ryukyu Islands

GEOGRAPHY AND CLIMATE

In the area described between 124 and 155° of east longitude and 24 and 35° of north latitude lie the two groups of Japanese islands of Nampo and Ryukyu. They are considered to be an integral part of the Japanese Empire, but for the purposes of clarity will be considered separately.

Nampo Islands. The Nampo Islands extend for about 700 miles southward from the central part of Japan in a linear arrangement. They are divided into two groups, a southern group consisting of the Kazan Retto and the Ogasawara Gunto, and a northern group consisting of the Nampo proper group and the Izu Shichito. Marcus Island lies about 750 miles east of the Kazan Retto. The islands are uniformly small; the largest is scarcely more than 10 miles long. Some have a luxuriant growth of timber and vegetation, whereas others are very nearly barren. All are of volcanic origin. The population is essentially Japanese, and totals about 39,000, some 32,000 being concentrated in the northern group.

In the southern group of the Nampo Islands the average annual temperature is 75° F. (23.4° C.). In this section there are only two seasons: December to April, during which it is relatively cool; and July and August, during which it is warm. The maximal temperature in this group is 81° F. (27.2° C.), recorded in December and February. There are no well-defined wet or dry seasons; but the average humidity is 79 per cent; at Omura on Chichi Jima the greatest humidity is 85 per cent, registered in June. At Omura the annual precipitation is about 62 inches (1.6 meters).

In the northern section of the Nampo Islands the average annual temperature (at Ozato) is 64° F. (17.7° C.). The coolest months appear to be January and February, during which the average temperature is about 50° F. (10° C.). The maximal temperature is recorded in August, and is 91° F. (32.6° C.). Humidity is said to be greatest in June and July, when it may be as much as 87 per cent. The average is about 77 per cent. The southern section of the Nampo Islands receives twice as much rainfall as the northern section, the average annual precipitation being 135 inches (3.4 meters). There is no month in which rain does not fall, but precipitation is said to be least in December. West winds predominate during most of the year, and are stronger from December through March. Much of the time this section of the islands is overhung with clouds.

Ryukyu Islands. The Ryukyu Islands, also known as the "Nansei Islands," are composed of such larger land bodies as Okinawa, Tokuno, Ishigaki, Miyako and many smaller ones. There are about 140 islands in the entire group, and they extend, roughly, from the eastern coast of Formosa to the southern aspect of the island of Kyushu in Japan proper. The entire group now forms the prefectures of Okinawa and Kago Shima.

It is believed that the 140 Ryukyu Islands have a total area of about 1,850 square miles. At the time of the last report there were about 819,000 inhabitants in the group, most of whom are agricultural workers and subsist to a large extent on sweet potatoes and other easily produced vegetable products. They have been classified as being akin to the Japanese; originally they were of Malay and Mongoloid strains. It was said that only about 5,000 Japanese reside in the group. Japanese is used generally and is understood, but the islanders employ a dialect based on Japanese.

Most of the Ryukyu Islands are rocky, and are broken up into hills, valleys and plateaux. Those in the north are of volcanic origin, and nearly all are featured by peaks which ascend usually to 1,000 feet and sometimes to 5,000 feet. Coast lines are fringed with coral reefs or rocky ledges, and are difficult to approach. Such rivers as exist are short and swift.

There are no extremes of heat and cold in the Ryukyu Islands. The highest mean monthly temperature has been 82° F. (27.7° C.) in July and August; the lowest has been 57° F. (13.8° C.) in January and February. The mean annual temperature was reported as being 70° F. (21.1° C.). Throughout the group the maximal temperature was recorded as being about 97° F. (36.1° C.). Rainfall is excessive; there is in fact no dry season. The northeastern monsoons prevail from September until May, and typhoons occur in July and August, sometimes persisting into September and October. At Ishigaki the maximal annual precipitation was 113 inches (2.9 meters); in other sections it has varied from 88 to 124 inches (2.2 to 3.1 meters). Humidity is high.

PUBLIC HEALTH

Health Services

Organization. The activities in public health of the Nampo and Ryukyu islands are under the direction of the police bureau, a part of the Ministry of Home Affairs, the central offices of which are in Tokyo.

For administrative purposes, the Nampo Islands are under the jurisdiction of the Tokyo prefectural government; the northern group of the Izu Islands being included in the Oshima branch administration, and the southern group forming the Hachijo Jima branch administration, whereas Bonin, Kazan and Marcus islands form the Ogasawara branch administration.

The Ryukyu Islands are divided into two groups: those north of Yoron Jima, including Oshima Shoto and Tokara Gunto, are a part of the Kagoshima prefecture, and those to the south, namely, Sakishima Gunto, Okinawa Gunto and Daito Shoto, form the Okinawa prefecture. There is a civilian health officer, with physicians as assistants, for each prefecture, and the local health program is carried out by these police physicians, assisted by the local police. Official duties of the prefectural health staff include quarantine inspections at the principal ports, the control of epidemic and endemic diseases and the inspection of water, food and drugs in the large centers. There are two prefectural hospitals at Naha on Okinawa Jima.

Relative Effectiveness. The public health program has been directed chiefly toward the control of epidemic diseases, by the establishment of quarantine regulations, by some degree of enforcement of vaccination against smallpox and cholera, by attempts to isolate lepers and by a certain amount of antimalarial work in the Yaeyama Retto group of the Ryukyu Islands. It is not known how effective the program has been.

Water Supplies

Rain water, which is collected and stored in tanks, cisterns and other types of containers, furnishes the principal supply for most of the islands. On some of the large islands water from wells, springs and streams provides an adequate supply, but on a few of the small islands the supply of fresh water is entirely inadequate, and in some instances it must be brought in by boat. Night soil is used for fertilizer; therefore, most of the water from springs, streams and wells is contaminated. However, because of the inhabitants' habit of drinking tea, much of the water is boiled before it is consumed. On Kozu Shima in the Nampo Islands a municipal water supply exists, and in the Ryukyu Islands municipal water systems are found at Kuji on Amami Oshima, and at Naha and Shuri on Okinawa Shima.

Sewage Disposal

The night soil from the homes is collected from pails and poorly protected privies and is stored in crude, leaky cisterns, whence it is removed from time to time to be used as fertilizer. There is only one disposal system in which sewage is water-borne: in the city of Naha on Okinawa Shima. It has only three and a fourth miles of pipe, however, and can thus serve only a small portion of the people.

Insects and Animals

Vectors of Disease. Mosquitoes. In the Ryukyu Islands mosquitoes capable of carrying malaria are reported as being found on Kuchino Shima and Nakano Shima of the Tokara Gunto, on Ishigaki Jima, Iriomote Jima and Yonakuni Jima of the Yaeyama Retto, and on Minami Daito Jima and Okino Daito Jima of the Daito Shoto. The Bonin, Kazan and Marcus islands were reported to be free of anopheline mosquitoes. No information is available concerning the presence of anophelines in the Izu group of the Nampo Islands. However, it is possible that anopheline mosquitoes are present on most, if not all, of the islands. The chief vector of malaria of Japan and Formosa is *Anopheles hyrcanus sinensis*, and this mosquito is the principal vector on these islands as well. It breeds in pools, in stagnant water and in swamps, ponds, rice fields and irrigation canals, and remains in houses and cowsheds after feeding. It is also a vector of *Wuchereria bancrofti*, which is the cause of the filariasis reported in the Ryukyu Islands and from the Izu group of the Nampo Islands. *A. lindesayi japonicus* and *A. minimus* also are vectors of malaria in these islands. The former has been reported from Japan and Formosa, whereas the latter is found in Formosa. It is probable that other Formosan mosquitoes such as *Anopheles subpictus indefinitus*, *A. annularis*, *A. maculatus maculatus*, *A. gigas baileyi*, *A. splendidus*, *A. insulaeflorum*, *A. aitkenii bengalensis* and *A. jeyporiensis candidiensis* will be found in the southern group of the Ryukyu Islands.

Aedes aegypti and *Aedes albopictus* are found in the Ryukyu Islands. Both are vectors of dengue fever, which occurs sporadically in this area. *Aedes aegypti* also is a potential vector of yellow fever, a disease that has never been reported from the Orient.

Culex fatigans, a vector of *Wuchereria bancrofti*, has been reported from both prefectures of the Ryukyu Islands, and is also probably found on some of the islands of the Izu, Bonin and Kazan groups and possibly on Marcus Island.

Lice. Several types of lice are found, including the body louse, *Pediculus corporis*, the head louse, *P. capitis*, and the pubic louse, *Phthirus pubis*. The first two of these are the vectors of the epidemic form of typhus fever, caused by *Rickettsia prowazeki*, and also of relapsing fever, caused by spirochetes of the genus Borrelia. Both diseases have been reported from this area. Lice also may carry *Rickettsia quintana*, the causative organism of trench fever; however, this disease has never been reported in this area. The rat louse, *Polyplax spinulosa*, an important vector of endemic typhus fever among rats, also is present.

Flies. In the Ryukyu Islands records concerning flies are available from Yonakuni Jima of the Yaeyama Retto, from the Sento Shosho and from Okino Daito Jima of the Daito Shoto. Flies are reported from the Bonin group of the Nampo Islands. The flies found in the Bonin group probably are the green bottle flies, *Lucilia caesar* and *L. sericata,* of the family Muscidae. Both are capable of causing body myiasis. The flies from the other islands probably are of these same types. The common housefly, *Musca domestica,* also occurs. Flies act as mechanical carriers of enteric and ophthalmic diseases, which are frequent on some of the islands.

TICKS. No information concerning the presence of ticks was found, but it is probable that the common dog tick, *Rhipicephalus sanguineus,* occurs on some of the islands.

FLEAS. Rats are plentiful on many of the islands. It is to be expected that they are infested with the tropical rat flea, *Xenopsylla cheopis,* which transmits *Pasteurella pestis* from rat to man, as well as from rat to rat. There are no reports of plague in these islands, but prior to 1928 plague was reported regularly from near-by Formosa. The rat flea also is capable of transmitting *Rickettsia mooseri,* the organism of endemic typhus fever.

RODENTS. Nine varieties of rats are found on certain islands, including the black rat, *Rattus rattus;* the brown rat, *Rattus norvegicus;* and the roof rat, *Rattus alexandrinus.* Eight varieties of mice are reported. Rats and mice are reported as being found on Chichi Jima of the Bonin group of the Nampo Islands, on 32 of the Ryukyu Islands, and to be fairly well distributed from southern Japan to the islands north of Formosa. Rodents are reported as being absent on Izu, Kazan and Marcus.

OTHER VECTORS. Mites are found on some of the islands. The most important one is *Trombicula akamushi,* which is the principal vector of *Rickettsia orientalis,* the causative agent of mite-borne typhus fever, also called Japanese river fever or tsutsugamushi disease. These mites live as ectoparasites of wild rats and birds and are commonly encountered on grasses, especially in cutover land or areas that are subject to flood. They are encountered most commonly in the late spring and early summer. The itch mite, *Sarcoptes scabiei,* the cause of scabies, is a frequent parasite on many of the inhabitants of the islands.

The tropical bedbug, *Cimex hemipterus,* is found on most of the islands. Although its ability to transmit infectious disease to human beings is a moot question, it is pointed out by competent authorities that the crushing of infected insects on the skin or the ingestion of infected insects may infrequently be responsible for the transmission of disease.

Snakes and Other Dangerous Animals. In the Nampo Islands snakes of unstated species are reported to be present on Kozu Shima of the Izu group, and on Haha Jima in the Bonin group a snake resembling a viper is found. Information regarding the presence of snakes on the Kazan Islands and Marcus is not available. It is said that snakes occur on 34 of the Ryukyu Islands, excluding the Daito Shoto group, and that poisonous species are found on 16 of these islands. Five poisonous snakes are reported; some are members of the genera Agkistrodon and Trimeresurus of the family Crotalidae and some are of the family Hydrophidae. *Agkistrodon blomhoffi,* called *mamushi* in Japanese, is also found. It has habits similar to those of the North American copperhead and varies from 2 to 5 feet in length. The three members of the genus Trimeresurus are *T. flavoviridis, T. okinavensis* and *T. elegans.* All are called *habu* in Japanese, and are said to be somewhat similar to the palm vipers. Sea snakes, members of the family Hydrophidae, also have been reported from the waters about the Ryukyu Islands. They have wide, paddle-like tails which are vertically compressed, and their poison is very deadly.

Poisonous fish of the genus Tetraodon, often spoken of as the "puff-toad fish," are found in the waters about some of the islands. Poisoning brought about by such fish is called "fuguismus" or "fuguism" (Japanese, *fugu*). The poisonous principle seems to exist chiefly in the ovaries and testes, and the ingestion of one roe often brings on serious illness in a few minutes, and possibly death in a few hours. The poisonous principle has a physiologic action somewhat like that of curare, and is thermostable. Sting rays of the type of *Trygon pastinaca* also are reported. These rays possess a long, flexible, whip-like tail, terminating in a bony spine, sharp at the point and furnished with sharp cutting teeth. When a ray attacks, it winds its tail around some part of the victim and forces the spine into the flesh, causing a deep and lacerated wound. The barbed spine is covered with a thick, gelatinous substance that is thought to contain a poisonous substance which is responsible for the delayed healing of such wounds.

Poisonous scorpions, spiders and centipedes also are found on some of the islands.

Leeches are reported from Ishigaki Jima of the Yaeyama Retto in the Ryukyu Islands. They are said to be so numerous in the northern part of the island in summer that travelers are greatly inconvenienced and are in fact advised not to visit the area. They probably are present on other islands. They cause some loss of blood and considerable discomfort and frequently the wounds become secondarily infected. If they become attached to the larynx and trachea, they may mechanically obstruct the air passages and cause death by suffocation.

In the Ryukyu Islands wild boars are present on Okinawa Jima of the Okinawa Gunto, and on Ishigaki Jima and Iriomote Jima of the Yaeyama Retto. They are spoken of as being so troublesome that, on Iriomote Jima, stockades had to be built around the settlements for protection against them.

Food and Dairy Products

Sweet potatoes, locally grown, constitute the principal food of the people living on the Izu group of the Nampo Islands and the Ryukyu Islands, whereas rice, shipped from Japan, forms the chief food for the people living on others of the Nampo Islands, such as the Bonin, Kazan and Marcus islands. The sweet potatoes and rice are supplemented by fish and green vegetables and by small amounts of barley, obtained chiefly from Japan. Only the middle and upper classes of the Izu and Ryukyu islanders can afford to eat rice, and beriberi is frequent among this group. Cattle and hogs raised on the large islands, especially those of the Izu (Nampo) and Ryukyu groups, furnish beef and pork. In the Nampo Islands there are very few cattle and hogs on the Bonin and Kazan islands, and goats and wild pigs supplement the usual diet of fish. Chickens and other fowl are stated to be numerous. Milk and eggs are not well liked by the Bonin and Kazan islanders, but are used regularly by the peoples of the other islands. Many marine forms, including the whale, tuna, bonito, shark, green turtle and oyster, are used for food. Vegetables and fruits, including sweet potatoes, squashes, watermelons, cucumbers, taro, eggplants, tomatoes, legumes, cabbage, bananas and oranges, are raised on most of the islands. Some dry field grains are produced on the Izu group; sugar cane is raised on the Bonin and Kazan groups; and rice is produced on some of the Ryukyu Islands. Tea is imported.

In the Nampo Islands the diet of the Izu islanders is reported to be well balanced, even more so than that of the average person living in Japan, but the diet of the Bonin and Kazan islanders is not so adequate. Beriberi is reported to occur more frequently in the southern Ryukyu Islands than in the others. Locally produced food supplies are barely sufficient for the local inhabitants. Since night soil is used as a fertilizer, vegetables and fruits frequently are grossly contaminated. The eating of raw or undercooked fish or crustaceans which may contain the cercariae or plerocercoid larvae of flukes and fish tapeworms, should be avoided.

MEDICAL FACILITIES

Hospitals

There are six general hospitals and a leper-colony hospital in these islands; however, no information concerning the size and facilities of these institutions is available. In view of the distances between islands and the difficulties entailed in interisland communication, these hospitals are not in excess of, if indeed they meet, the needs of the native inhabitants. Furthermore, it seems likely that, with the exception of the prefectural hospitals, their equipment is inadequate.

No drug and hospital supplies are available locally; all must be imported. Plants for the manufacture of artificial ice are reported at Mitsune and Yaene on Hachijo Jima and at Nii Jima in the Izu group, at Omura on Chichi Jima in the Bonin group and in the large cities of some of the Ryukyu Islands.

Medical Personnel

Physicians. In 1934 it was said that there were 201 physicians on these islands. This number probably is incomplete, for in 1933 it was reported that there were 818 physicians on the Ryukyu Islands alone. However, this latter figure probably included midwives and irregular practitioners. Based on a figure of 500 physicians and a population of 900,000, there were 0.55 physician per 1,000 of population, or, based on the more conservative and probably more nearly accurate figure of 250 physicians, there were 0.28 per 1,000 (United States, 1.0 per 1,000 people).

Nurses. No data are obtainable on the number of nurses.

Others. One dentist was reported in 1934 to be at Hachijo Jima in the Nampo Islands, and there were probably several others in the large cities of the Ryukyu Islands. Midwives were well distributed throughout the islands, reports indicating five on the Izu group and two on the Bonin group of the Nampo Islands and nine on Ishigaki Jima of the Ryukyu Islands. One pharmacist was reported at Oshima, and three were said to be at Okinawa Jima.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. In the Ryukyu Islands dysentery of both the bacillary and amebic types is reported as being prevalent on Ishigaki Jima, Iriomote Jima and Yonakuni Jima of the Yaeyama Retto and on Minami Daito Jima and Okino Daito Jima of the Daito Shoto. The type found on Minami Daito Jima is said to be especially difficult to cure. In the Nampo Islands paratyphoid fever has been recorded from the Bonin group, and it is probable that typhoid fever and paratyphoid fevers occur in the Ryukyu Islands. Common diarrheas also are present. The widespread use of night soil as a fertilizer, the large numbers of human carriers, the prevalence of flies on some of the islands and the lack of screens have been the chief factors in the high incidence of these diseases.

Cholera. Cases of cholera have never been recorded in these islands; but two cases were reported from Formosa during 1941. In view of the frequent travel between these islands and Formosa and other areas in which the disease is endemic, it could be introduced at any time.

Helminthiasis. Intestinal infection with worms is widespread throughout the islands; it is estimated that 90 per cent of the native inhabitants have one or more species of worms. The use of night soil as a fertilizer, promiscuous defecation and improper habits of personal hygiene have been the principal causes of the prevalence of helminthiasis.

The roundworm, *Ascaris lumbricoides*, infects many of the local inhabitants. Infection with hookworm is frequent, and both *Necator americanus* and *Ancylostoma duodenale* are reported; they are responsible for much malnutrition and secondary anemia among the native inhabitants. The whipworm, *Trichuris trichiura,* occurs but is of little importance, as is the pinworm, *Enterobius vermicularis.* Three types of tapeworm are present in the islands: the fish tapeworm, *Diphyllobothrium latum;* the beef tapeworm, *Taenia saginata;* and the pork tapeworm, *Taenia solium.* Infection results from the eating of raw or undercooked meat, fish, beef or pork.

INFECTION WITH FLUKES. Diseases caused by flukes are reported from Japan, China and Formosa, and undoubtedly occur in some of these islands. They are largely due to the widespread custom of the eating of raw fish and crustaceans and to the use of untreated water for purposes of drinking and bathing. These infections include schistosomiasis, due to *Schistosoma japonicum;* clonorchiasis caused by the liver fluke, *Clonorchis sinensis;* paragonimiasis, due to the lung fluke, *Paragonimus ringeri* or *Paragonimus westermani;* and metagonimiasis, caused by the intestinal fluke, *Metagonimus yokogawai.* An occasional instance of fasciolopsiasis, caused by the intestinal fluke, *Fasciolopsis buski,* may be found. Paragonimiasis may produce much disability. Metagonimiasis causes little trouble, but schistosomiasis, clonorchiasis and fasciolopsiasis may result in serious disease.

DISEASES SPREAD CHIEFLY THROUGH RESPIRATORY TRACT

Tuberculosis. Tuberculous infection occurs in some of the islands, and although present in all forms, including glandular, cutaneous, bone, joint, intestinal and pulmonary, the last is the most prevalent. Crowding in the homes and lack of isolation are chief causes of its common occurrence.

Miscellaneous. Diphtheria has been recorded from the Bonin group of the Nampo Islands and influenza has been reported from some of the others. No further reports are available.

DISEASES SPREAD CHIEFLY BY CONTACT

Venereal Diseases. Syphilis, gonorrhea, chancroid, lymphogranuloma venereum and granuloma inguinale are reported from the Ryukyu Islands and also may be present on some of the other islands. In 1939 it was stated that the police board had decided to permit brothels on Chichi Jima, one of the Bonin group in the Nampo Islands, because of an increase in sexual offenses on the islands.

Diseases of the Skin. Scabies, impetigo and infections with tinea commonly occur among the native inhabitants. These conditions are likely to affect Europeans in tropical regions, since chronic fungous infections have a tendency to become acute and new infections are readily acquired.

Diseases of the Eyes. Trachoma is prevalent and is the cause of much poor vision and blindness. Gonorrheal ophthalmia is commonly reported.

Leprosy. Lepers are found on the islands, and at Kanokawa Wan on Iriomote Jima in the Yaeyama Retto of the Ryukyu Islands there is a colony of lepers. No figures concerning the prevalence of this disease are available.

Miscellaneous. Leptospirosis or Weil's disease, caused by *Leptospira icterohaemorrhagiae,* occurs. Rat-bite fever, caused by *Spirillum minus,* which is introduced into the wound with the bite, is found on those islands where rats are numerous.

DISEASES SPREAD BY ARTHROPODS

Malaria. This disease is one of the principal hazards to health in the southern group of the Ryukyu Islands, where it is endemic throughout the year. It is chiefly of the estivo-autumnal type, and causes severe cerebral complications and a high mortality rate. In the Ryukyu Islands it occurs mainly in the Yaeyama Retto of the Sakishima Gunto, where it is known as "Yaeyama fever" and in the Daito Shoto, where it is called "Daito fever." In 1934, on Ishigaki Jima, which at that time had a population of 22,193, 469 cases were reported. In 240 of these cases the disease occurred in a hyperendemic area in which there was a population of 977. Although the disease occurred throughout the year, the peak was reached in the months from July through November. In 1934, on Iriomote Jima, 254 cases in a population of 4,094 were reported, with essentially the same seasonal distribution. In 1934, the people living on Yonakuni Jima were reported as being almost entirely wiped out by malaria, whereas on Miyako Jima, one of the Miyako Retto group, malaria was reported to have been eradicated by 1938. On Minami Daito Jima, which lies 190 miles east of Okinawa Jima, malaria of the severe estivo-autumnal type is reported. Malaria also occurs in Okino Daito Jima, which lies about 80 miles south of Minami Daito Jima. Farther north in the Tokara Gunto group are Kuchino Shima and Nakano Shima, on which anopheline mosquitoes have been found. Anopheline mosquitoes probably occur on other groups of the Ryukyu Islands and it is likely that malaria is more widely distributed than has been noted above.

No reports of malaria occurring on the Izu, Bonin, Kazan and Marcus groups of the Nampo Islands were found.

Filariasis. This disease has been reported from the Ryukyu Islands, and also from the village of Toriuchi on the island of Ko Jima, one of the Izu group in the Nampo Islands. It is of the type caused by *Wuchereria bancrofti,* the chief vectors of which are the mosquitoes, *Culex fatigans* and *Anopheles hyrcanus sinensis.* Since these mosquitoes are reported also from other islands of the Izu, Bonin and Kazan groups in the Nampo Islands and from the Ryukyu Islands, the disease is to be expected there as well.

Dengue Fever. Dengue fever occurs sporadically in the Ryukyu Islands, but no records of its occurrence in the Nampo Islands can be found.

Yellow Fever. This disease has never been reported from these islands or from the Orient, but its chief vector, *Aedes aegypti,* is found in the Ryukyu Islands and possibly on some of the others.

Typhus Fever. This disease has been reported during recent years from the Bonin group of the Nampo Islands; in the Ryukyu Islands, from Yonakuni Jima and Iriomote Jima of the Yaeyama Retto and from Minami Daito Jima and Okino Daito Jima of the Daito Shoto group. The precise type is not recorded, but it is known that the three types occur in this area. Since rats are reported as being absent from some of the islands, the disease on those islands is probably limited to the louse-borne or mite-borne types, whereas on the other islands, it may also include the flea-borne type. The mortality caused by mite-borne typhus fever in this area is usually much higher than that caused by the flea-borne type, whereas the mortality of the louse-borne type lies between that of the first two.

Relapsing Fever. No cases of relapsing fever have been recorded in the islands, but since the disease is reported to occur frequently throughout Formosa and since lice are common pests, especially on some of the southern Ryukyu Islands, it is probable that this disease, caused by organisms of the genus Borrelia and transmitted by lice, occurs endemically.

Plague. This disease has not been reported from the islands; however, it occurred regularly on Formosa prior to 1928 and is endemic in many parts of the Far East. Rats are prevalent on many of the islands and probably are infested with the flea, *Xenopsylla cheopis,* the common vector of *Pasteurella pestis,* the causative organism of plague. This disease should be considered to be a potential hazard until it has been proved that no endemic foci exist on the islands.

Miscellaneous

Nutritional Diseases. Beriberi is reported from Yonakuni Jima and Minami

Daito Jima in the Ryukyu Islands, and it probably occurs on other islands. It is found chiefly among those who subsist on a diet consisting largely of polished rice.

Injuries Caused by Heat. Heat cramp, heat stroke and heat exhaustion occasionally occur.

SUMMARY

Public health, hospital and medical facilities on the Nampo and Ryukyu Islands, as compared with those in the United States, are inadequate. Locally produced foods are barely sufficient for local needs. The inspection given food and dairy products to ensure protection of health is unsatisfactory. Fresh water is scarce on most of the islands but is plentiful on some; all water, regardless of its source, should be considered unsafe for consumption unless it has been properly treated. Only one system in which sewage is water-borne exists, and throughout the area night soil from the cities, towns and rural areas is used as a fertilizer. This practice results in widespread pollution of soil. Rats, mosquitoes, flies, fleas, lice, mites, snakes and leeches are prevalent on most of the islands.

The diseases that are of greatest importance on these islands are malaria (especially in the southern Ryukyu Islands); the enteric diseases, including amebic dysentery, bacillary dysentery, typhoid fever and paratyphoid fevers; venereal diseases; typhus fever; dengue fever; and diseases of the skin. Other important diseases are tuberculosis, helminthiasis, filariasis, infection with flukes, leptospirosis, leprosy, diseases of the eyes and nutritional diseases.

BIBLIOGRAPHY

Aoki, B.: A Hand-list of Japanese and Formosan Mammals. Annot. Zoo. Japon., Tokyo, **8**:261-352 (July) 1913.

Bodley, R. V. C.: The Drama of the Pacific. Tokyo, The Hokuseido Press, 1934.

Byam, W., and Archibald, R. G., eds.: The Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1921-23, 3 vols.

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Esaki, Teiso: A Preliminary Report on the Entomological Survey of the Micronesian Islands under the Japanese Mandate, with Special Reference to the Insects of Economic Importance. Proc. Pacific Sc. Congr. 1939, 6 Congr. **4**:407-415, 1942.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Kuroda, N.: Distribution of Mammals in the Japanese Empire. J. Mammal., **20**:37-50, 1939.

——: A List of the Japanese Mammals. Tokyo.

——: Mammals Collected in the Islands of Okinawa and Yaeyama in the Ryukyu Islands. Trans. Biogeogr. Soc. Japan, **3**:65-69, 1938.

——: On New Mammals from the Riu Kiu Islands and the Vicinity. Tokyo, published by the author, 1924.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr, 11th ed. Baltimore, Williams & Wilkins Co., 1941.

Salwey, C. M.: The Island Dependencies of Japan. London, E. L. Morice, 1913.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942, 2 vols.

11

Thailand

GEOGRAPHY AND CLIMATE

The independent kingdom of Thailand is situated, roughly, within the area described by 6 and 21° of north latitude and 97 and 106° of east longitude. Thailand is bounded by French Indo-China on the northeast, east and southeast, by the Gulf of Siam and British Malaya on the south, and by Burma on the west and northwest. A small sector of the western coast of Thailand, on the Malay Peninsula, is situated on the Bay of Bengal. The area of Thailand is about 200,000 square miles, or less than that of Texas (265,896 square miles), and the official census of 1937 indicated that the population was 14,464,489. Perhaps 11,000,000 of the total are Thais or Laos; 450,000 are Chinese; 380,000 are Indians; and the rest are reported to be Cambodians, Burmese Indians, Annamese and other racial groups. In 1937 the religious population consisted of 13,752,091 Buddhists, 626,907 Mohammedans, 69,227 Christians; the rest were members of diverse obscure faiths.

Physically, Thailand has been divided into four main parts. The first is a region in the north of about 60,000 square miles; it is largely a series of parallel ranges which in the south are gentle slopes but which in the north are beetling masses. The second has the form of a great basin of approximately 70,000 square miles, and the floor of this basin is only about 200 to 300 feet above sea level. The plain itself is sandy and somewhat barren, flooded during the rainy season and parched by drought in the hot season. Third is the central portion of Thailand: about 50,000 square miles in extent, an alluvial plain of great fertility and wealth, bordered by high mountains on the west, descending gradually to the sea on the south and around the inner part of the Gulf of Siam, and flanked again by a long sector of mountainous seaboard to the southeast. This is the most important region in Thailand from the economic point of view. Finally, an area of about 20,000 square miles occupies that portion of the Malay Peninsula which belongs to Thailand. It is extremely narrow in the north but widens at the southern end, which is the most habitable part of the territory. Dense forests of valuable timber carpet part of this peninsular area, and one peak, Kao Luang, rises to more than 5,000 feet.

The hydrographic features of Thailand are varied. The Menam River (or Menam Chao Bhraya) is the longest river in Thailand; its branches, such as the Noi and Lopburi, are short, navigable only by native boats. The Suphan, Nam Sak, Nam Si and Mun are other streams of very little commercial value. It has been said that much of the lowland country of central Thailand is under water for fully three months of the year.

The climate of Thailand is exceptionally humid by comparison with the climates to which Europeans are accustomed. From May to October the wet season obtains, in which the average temperature ranges between 65 and 75° F. (18.3 and 23.8° C.) during the day. When the northeastern monsoon begins in November the climate is cool; temperature then ranges between 40 and 50° F. (4.4 and 10° C.) at night and is seldom more than 90° F. (32.2° C.) during the day, although the eastern part of

Thailand is subject to the full force of the northeastern winds. After the month of February the temperature of the interior of Thailand gradually increases, but although it may reach 100° F. (37.7° C.) and more, the extreme heat of continental India is not experienced. Data concerning rainfall are few, but it has been said that precipitation at Bangkok is about 50 inches (1.3 meters) and at Chiengmai is approximately 42 inches (1.1 meters).

PUBLIC HEALTH *

Health Services

Organization. Public health work in Thailand was carried on by a Public Health Department and was organized according to the political divisions of the country. The Ministry of Health of Thailand came into being in 1918 by royal decree as the Public Health Department of Thailand. The health department had the benefits of advice and other types of assistance from a National Health Council and a National Medical Council. The National Health Council was organized in 1928: it was composed of members who represented the Public Health Department, the Army Medical Service, the Navy, the Minister of Public Instruction, the Royal State Railways, the Siamese Red Cross, the Rockefeller Foundation and the American Presbyterian Mission. The Director General of Public Health served as president *ex officio* of this national council.

The duties of this council were: (1) coordination of the normal activities of various state health organizations and their agencies so that unnecessary duplication could be avoided; (2) preparation of schemes for the prevention and suppression of epidemic or other diseases; (3) formulation of plans to be carried out in the event of public calamities which result in sickness or injury; and (4) consideration of and submission of opinions with respect to any matter concerning the public health which may be referred to the council for advice.

The National Medical Council consisted of eight men, with the Director General of Public Health as the president *ex officio*. These men represented various divisions of the national government, the Red Cross, the Thailand Medical Association and the medical school at Chulalongkorn. This council was executive and managerial, and was very powerful in obtaining personnel and outlining all policies of the program of public health in Thailand.

The health department of Thailand reached the people through a number of sanitary boards. A sanitary board was a local organization which administered public health measures and sanitation in a commune in a province. It usually was composed of five official members and four head men, presided over by the governor of the province, who apparently could serve more than one sanitary board in such a capacity. In smaller areas a sanitary board had three official members and two head men, with a district officer as chairman. Expenses for the board were paid with certain funds which the board was empowered to collect.

The health department of Thailand had a Director General of Health, 191 health and medical officers, and five engineers and architects. The field staff consisted of 127 medical officers and 173 other employees, such as nurses, midwives, sanitary inspectors, clerks and others. Fifteen full-time public health immigration officers were on duty but were not under the jurisdiction of the Ministry of Health. Health inspection at ports was carried out by men from the Ministry of Health who were under the control of the Ministry of Public Instruction.

In general, the organization of the Ministry of Health could be summarized by the statement that there were 70 provincial first-grade health units, each in charge of

* Unless otherwise indicated, governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

a medical officer. These health units functioned in association with several second-grade health units in each province, and each of these second-grade units was in charge of a medical assistant, of which there were 206. The sanitary boards, mentioned *supra*, functioned in conjunction with the health units and often were one and the same organization. Two mobile units were maintained for control work during epidemics. It was planned to erect a first-grade hospital of 200 beds in each of the four sections or divisions of the country, and at the time of the last report two hospitals had been completed. It was planned, likewise, to erect a second-grade hospital of 100 beds in several of the larger provincial centers, and two of these had been completed at the time of the last report. Finally, it was planned to erect a third-grade hospital of 50 beds in each of the provincial capitals, and at the time of the last report five such hospitals had been completed.

Relative Effectiveness. The percentage of the total budget of Thailand that was devoted to public health in that nation ranged from 1.5 in 1935 to 1.8 in 1939, or, expressed in American money, from 4 cents *per capita* in 1935 to 6 cents *per capita* in 1939. These amounts were inadequate for the work which had to be carried out. The local health units functioning in the communes as a rule had to obtain their funds by the process of local collection, and these amounts were not included in the published summaries of the budget. In addition to the limited funds, the public health organization of Thailand lacked even fairly well-trained personnel. Public appreciation as to the needs of public health procedures was absent. In such a country, because of the nature of the minds of the natives, it would be necessary to have a well-organized program of treatment associated with the public health program, since the natives can appreciate curative or therapeutic medicine, but cannot easily understand preventive medicine. If a hospital were established, for instance, so that the sick among them actually were being treated, the natives would understand and value these tangible services. A preventive measure, such as the oiling of a pond, might mean to them only that the water had been made unfit for use. Again, facilities for communication in Thailand were most primitive. Some 10,000,000 inhabitants lived in rural areas, where roads, railways and navigable streams were likely to be absent. Telegraph systems existed only in the larger cities. The government of Thailand owned all the railways in the land, and such highways as were constructed were laid out so that they depended largely on the railway system. Many sections of Thailand had nothing more than footpaths as means of communication, and it was not easy to find trained physicians who would consent to work in such sections.

On the other hand, several advantages were associated with the public health system of Thailand. The leaders in the work were cognizant of the defects in the system and knew what had to be done to remedy them. The leaders themselves were well trained, and many of them had been trained abroad. They had set machinery in motion whereby many other trained Thai medical and sanitary personnel were to be aided further in advancing their education. The degree of success that had been attained by the hospitals and dispensaries, as well as that secured in campaigns against hookworm, cholera, smallpox and plague, was sufficient to warrant the belief that the usually suspicious Thai were modifying their hostile attitude toward the purely preventive aspects of the public health program.

Water Supplies

Systems of water supply in Thailand were of two general types: urban and rural. The water supply of Bangkok, for instance, was derived from the river Chaupaya, and the water was stored in a large open reservoir, from which it was conveyed to the water mains by a large open canal with banks of earth. The water was treated by sedimentation and rapid filtration, and in 1930 chlorination was added to the treatment process. Bacteriologic analysis was done monthly. In 1930 the daily consumption of water varied from 15,000 to 22,500 cubic meters, and the peak of consumption was reached in April and May, the dry season. Many of the residents of Bangkok (perhaps a third) were not served by this system, and used water taken untreated from canals.

Other large cities in Thailand obtained water from artesian wells or rivers. Water from artesian wells of course was preferable to that of rivers, but in the northern part of Thailand water in general is hard, requiring treatment before it is potable. In the outlying parts of Thailand people commonly took water from rivers, swamps and canals. This practice greatly favored the spread of cholera and other water-borne diseases, for in the rural districts treatment of water was unknown. When an epidemic of cholera broke out the natives were apprised by the government of the proper means of treating water, and this advice was gratefully received. In many sections rain water was collected for purposes of drinking. This water often was contaminated, but even so, it was safer than water from most other sources. Concrete jars were made in large quantities and sold at a low price to encourage the practice of collection of rain water. In certain small communities villagers as a group constructed reservoirs in which rain water was stored and then sold at low prices to the people in times of need. Such a system, however, never was adequate for the requirements of an entire village, and individual families had to collect their own supplies of water, relying on the community supply only when their own became exhausted.

In other sections, and particularly mountainous or hill country, the government constructed covered cement or brick wells fitted with pumps. Such systems were excellent, but when a pump broke down no one in a village was able to repair it, with the result that all the villagers obtained water by dipping their buckets into the wells indiscriminately, with resulting contamination. The dug well, lined with bricks, was said to be widely used in Thailand.

Sewage Disposal

Sewage disposal was a matter of prime importance. Infection with hookworm was widespread in Thailand for years prior to 1917, at which time the International Health Division of the Rockefeller Foundation carried out an intensive campaign against this form of parasitism. Cement cesspools were built and deep flyproof boxes which could be flushed with a bowlful of water were distributed and set up by the thousands. Latrines, however, were poorly constructed, so that superstructures invariably were destroyed by the termites and the ravages of the weather. In some areas in which privies were never used, fecal matter would be washed into the open wells at the beginning of the rainy season, and outbreaks of dysentery often followed. In some of the larger cities the collection of night soil for use as fertilizer was a regular practice. Generally, it can be said that no concerted, effective attempt at the proper disposal of night soil was made in Thailand.

The disposal of refuse never was a serious problem in Thailand, because there usually was only a small quantity of it. The Department of Agriculture had emphasized the value of garbage and refuse as fertilizer.

Insects and Animals

Vectors of Disease. Mosquitoes. The following anopheline mosquitoes, most of which at one time or another have been proved to be vectors of malaria, are reported from Thailand: *Anopheles aconitus, A. annularis, A. barbirostris barbirostris, A. culicifacies, A. fluviatilis, A. hyrcanus nigerrimus* and perhaps *A. hyrcanus sinen-*

sis, A. karwari, A. minimus, A. sundaicus, A. maculatus maculatus, A. maculipalpis indiensis, A. minimus, A. philippinensis, A. subpictus subpictus, A. tessellatus, A. vagus vagus and *A. splendidus.*

That part of Thailand which lies in the Malay Peninsula harbors *A. sundaicus,* a mosquito which lives near the brackish waters not disturbed by tides. The most important vectors of malaria are *A. culicifacies* and *A. aconitus,* which are found in the plain country leading to the foothills. Dangerous vectors of malaria are *A. minimus* and *A. fluviatilis,* both of which are encountered in the foothills of the mountains, as was the less important *A. philippinensis. A. sundaicus* inhabits the open plains and occurs in the vicinity of Bangkok, but apparently is not of importance as a vector of malaria in these sections or elsewhere. *A. annularis, A. hyrcanus nigerrimus* and *A. aconitus* probably are the most important vectors of malaria in the central portion of Thailand. *A. fluviatilis, A. minimus* and *A. culicifacies* are the most formidable vectors of malaria in the hills of the northern and northeastern parts of Thailand, whereas *A. fluviatilis* is important as a vector in the eastern part of the country. Some anopheline mosquitoes, such as *A. aconitus,* breed during the early part of the dry season, so that it is possible that malaria will occur throughout the year wherever this species is found.

Mosquitoes of the genus Aedes have not been studied extensively in Thailand. *Aedes aegypti* has been found in Bangkok and Chiengmai, and it is possible that it occurs throughout Thailand. It is known to be notable as a vector of dengue fever, and the fact that it can transmit yellow fever makes it of additional moment. *A. albopictus* was reported from Bangkok and the island of Koh Chang. This mosquito is a vector of dengue fever.

Seven different Culex mosquitoes have been definitely described from Thailand, and five more culicine types have been reported so often from regions contiguous to Thailand that they doubtless occur in Thailand also. Among these is *Culex fatigans,* which is a common vector of filariasis.

Lice. Three kinds of lice which commonly are parasitic on man are found in Thailand. *Pediculus corporis,* the body louse, is most often responsible for transmission of epidemic typhus fever, which, however, has not been reported from Thailand. This louse also is the vector of one form of relapsing fever which has been reported from Thailand. *P. capitis,* the head louse, is perhaps the most common of all lice in the land; almost all the people become infested with it at some time in their lives. *Phthirus pubis* has been reported, but is not believed to be important.

Flies. Thailand abounds with flies of all kinds. The common housefly, *Musca domestica,* is ubiquitous and is particularly dangerous because of its ability to spread dysentery. Control of this fly is exceptionally difficult because of the natives' practice of depositing night soil in the areas to which flies have unimpeded access, and because in Thailand flies are able to breed for eight months of the year. Horse flies of the family Tabanidae inflict bites which cause great discomfort; two notably troublesome species are *Tabanus rubidus* and *T. striatus.* A fly which causes much economic damage is *Povilla corporaal,* the nymphs of this fly bore into wooden structures, such as boats and docks, but do not attack bamboo. Sand flies are numerous. Such species as *Phlebotomus barraudi siamensis, P. bailyi campester, P. stantoni* and *P. squamipleuris* have been identified, and it seems possible that *P. argentipes* occurs there because it is known to be common throughout southeastern Asia. Definite reference to it in Thailand has not been found. Sandfly fever and leishmaniasis, which have been reported from Thailand, can be disseminated by sand flies.

Ticks. Many kinds of ticks are known to occur in Thailand, but they do not seem to have been studied. Tick-bite fever has not been reported from Thailand.

FLEAS. The tropical flea of rats, *Xenopsylla cheopis,* is present throughout Thailand. Doubtless it is responsible for the spread of plague there, but *X. astia* is more common than *X. cheopis* in certain parts of the land, and had been identified as the vector of plague in certain localized outbreaks of the disease. Since *X. astia* apparently is not so efficient a vector of plague as is *X. cheopis,* and since it predominates in many parts of the country, these two facts might explain the low incidence of plague in Thailand. The common flea of dogs, *Ctenocephalus canis,* is very common. The flea of rats, *Polyplax spinulosa,* is important in the transmission of murine typhus fever from rat to rat.

MITES. If it is true, as has been reported, that typhus fever breaks out whenever an area in a forest is cleared, it seems probable that mites of the genus Trombicula are present. Very little has been done in the study of mites in Thailand.

RODENTS. Many different kinds of rats are reported from Thailand. *Rattus rattus, R. norvegicus* and *R. concolor* are the most common, but the large bamboo rat, *Rhyzomys sumatrensis,* the bay bamboo rat, *R. bradus,* and the white-toothed gray rat, *Rattus berdmorei,* have been identified. Field mice have been reported, and they may play a part in the transmission of mite-borne typhus fever in Thailand.

OTHERS. Bedbugs are universally present in Thailand, but it has not been proved that they are vectors of disease. Cockroaches are numerous.

Snakes and Other Dangerous Animals. Most snakes which are common to Asia occur in Thailand. Two genera of vipers have been described. One, Agkistrodon, is composed of snakes gray or red-brown above, with large, paired dark-brown spots along the back. The other genus, Trimeresurus, has six species, the most common of which is *T. gramineus,* the common green viper or bamboo viper. The kraits (Bungarus), the coral snakes (Calliophis and Doliophis), and the cobras (Naja), are well known. The banded krait, the Indian krait and the yellow-headed krait have been described; the small, spotted coral snake and the belted coral snake comprise the better known coral snakes. The common Indian cobra, *Naja naja,* which does not attain a length of much more than 5 feet (1.5 meters); and the king cobra, *Naja hannah,* which can become 12 to 15 feet (3.6 to 4.6 meters) long and which is the most dangerous of all animals in Thailand, causes numbers of deaths annually, particularly among native children. *Vipera russellii,* or Russell's viper, has been identified as occurring in Thailand. It is extremely poisonous, but is not aggressive unless it is disturbed.

The wild elephant, tiger, leopard, panther, bear, wild cow and boar are known to be present in Thailand, but it is said to be very difficult to encounter one of them. Yet a single wild or rogue elephant on a so-called rampage can kill many people and destroy much property. As a rule, when such an event occurs, ample warning is provided by frightened natives long before the beast appears.

Pests. Blood-sucking land leeches of the genus Haemadipsa cause much discomfort throughout the lowlands of Thailand during the rainy season. They cling to grass or weeds along paths and near water holes, where they wait for a passing man or animal. They can affix themselves to a victim with great agility, and their bites cause much distress. Such bites seem peculiarly susceptible to infection.

FOOD AND DAIRY PRODUCTS

The food supply of Thailand has been insufficient for years. Much rice was exported to other parts of the world, and it is thought that the supply of this staple foodstuff has been much reduced in recent times. The supply of meat in Thailand was better than similar supplies in Burma and French Indo-China. Fruit and vegetables were subject to seasonal effects upon quantity, and were never produced in excess of the needs of the people. Fish for years has been the chief article of food of people in many parts of Thailand, but in many sections the supplies of fish have recently been less abundant.

Milk never was used much by the people of Thailand in former years, but it had been consumed in increasing quantities at the time of the last report. This was true to such an extent that the supply was not sufficient to meet the demand, so far as fresh milk was concerned. The difficulty seemed to be a lack of enough persons to serve as milkers and a lack also, of incentive toward improvement of stock which would make increased production of milk a profitable business enterprise. As a result, dried, evaporated and condensed milk was imported in increasing amounts each year. Yet it would be possible to establish an adequate supply of fresh milk in Thailand in a surprisingly short time, because the buffaloes which are kept in Thailand yield from 6 to 8 quarts of milk a day, whereas a yield of 2 quarts from a cow (Bos) would be considered exceptional. It has been said that buffalo milk is richer than cow's milk, and that it is less likely to contain *Mycobacterium tuberculosis*. There is no evidence that the buffalo is more resistant to tuberculosis than is the cow (Bos).

MEDICAL FACILITIES

Hospitals

Number of Beds. There were from 45 to 50 hospitals in the kingdom of Thailand at the time of the last report. This figure did not include the military hospitals, concerning which no detailed information could be had. The total capacity of the 45 to 50 hospitals was said to be from 2,500 to 3,000 beds. Five leper colonies were maintained, and at one of them, conducted at Chiengmai by the American Presbyterian Mission, almost 500 lepers were cared for. More than 1,000 lepers were being treated in surrounding centers as outpatients of the colony at Chiengmai; these outpatient centers as a rule were manned by persons whose leprosy had been arrested, and who were extending to other lepers the treatment they had learned to administer to themselves. Another colony, conducted by the Ministry of Health of Thailand, which received it as a gift from the Red Cross, was situated at Bangkok. Another was located in the southern part of Thailand, and was maintained by the American Presbyterian Mission. Data as to the remaining two were not available.

It should be pointed out that the American Presbyterian Mission, which had been working in Thailand for at least 100 years, operated 11 hospitals in Thailand. The Seventh-Day Adventists had two hospitals, and the Roman Catholic church conducted a hospital at Bangkok. The Red Cross maintained two of the largest hospitals in Thailand: the King Chulalongkorn Memorial Hospital and the Somdej Hospital, both at Bangkok. The first-named had 365 beds; the capacity of the second is not known.

Equipment. More than half of the hospitals in Thailand, it can be assumed, were not adequately equipped. Not more than 5 or 10 hospitals had roentgenologic apparatus, and such equipment as was in use was imported. There were two electric power plants in Bangkok and some 48 other provincial power stations. Forty-five of these provincial stations provided 12-hour service, and three of them were in operation 24 hours daily. Voltages and wattages are not known.

Supplies. So far as is known, little or no medical and surgical equipment was produced in Thailand.

Medical Personnel

Physicians. Physicians in Thailand were divided into three classes. First were those who had undergone complete and thorough training. This class included those who had been graduated from the medical school at Bangkok. It is thought that in this class there were between 200 and 300 physicians.

The second class was composed of men who had received some degree of training in hospitals or with physicians, and who understood the administration of simple drugs. This class included what were called "junior physicians," who had been trained for from six months to two years in hospitals by means of lectures and clinical demonstrations. The status of this plan of training in Thailand is not clear: it is believed that the plan was approved by the Ministry of Health, but not by the Ministry of Public Instruction. It would appear to be the only means by which the vast number of villages in the outlands could be supplied with men who know at least something about practical medicine. Outside Bangkok, for example, there were only a few qualified practitioners of medicine in all Thailand.

The third class of physicians was composed of herb doctors, spirit doctors, quacks and other persons who pretended to know how to treat illness. They were registered in order that some sort of control of their activities might be maintained, and it had been planned either to eliminate them gradually or to train them in better methods of practice. Many of the men in this class were Chinese.

Eighteen fully qualified physicians were employed by the Ministry of Health of Thailand in 1936, and it also employed 123 assistant physicians. More recent figures are not obtainable.

Nurses. There were some 400 nurses of various grades of training in Thailand. In 1936 the Ministry of Health employed 131 male and female nurses and 19 assistant nurses, who were women.

Dentists. There were less than 10 properly trained dentists in Thailand, and all of them had located in Bangkok. In many villages, however, there were so-called dentists, who knew how to pull teeth and to put gold caps over healthy teeth.

Others. Analysis of data published in 1936 shows that in that year there were two pharmacists, 10 assistant pharmacists, two veterinary surgeons, eight assistant veterinary surgeons, five chemists, 146 sanitary inspectors and 206 assistant sanitary inspectors in Thailand. It was not possible to ascertain the degree of training or the extent of the duties of these persons.

Medical Institutions

The most important medical institution in Thailand was the medical department of the Chulalankarana University. The medical department, which had existed as a school since 1889, became a part of the aforementioned university in 1923, at which time a four-year course was inaugurated. Two years of collegiate work were required before the candidate could begin the four-year medical course. In 1929 the first class of 19 students was graduated. Both men and women were admitted, and 166 persons had been graduated with the degree of doctor of medicine by 1937. The medical department, at the time of the last report, had 44 instructors and professors and a library of 3,600 volumes.

Nurses were trained at the Siriraj Hospital, associated with the medical school at Bangkok, and at a hospital conducted by the Red Cross in the same city. The McCormick Hospital at Chiengmai, conducted by the American Presbyterian Mission, offered a three-year course for nurses based on American standards of instruction. Midwives were trained in the maternity sections of various hospitals, and meager training in public health work was available in a very few centers. Dentists, as has been intimated, were trained only by virtue of their experience in the service of other dentists, who may have known not much more than the men they were trying to teach.

A Pasteur institute, at one time operated at least in part by the Red Cross, was known as the Savaobha Memorial Institute, and manufactured a polyvalent antivenin which was said to be effective against the toxins of the cobra, Russell's viper and krait. This institute also produced antigens for use against typhoid fever, paratyphoid fever A and B, cholera, plague and rabies. Smallpox vaccine and diphtheria and tetanus antitoxins were also prepared at the Institute. Chaulmoogra oil was produced for use against leprosy. Other laboratories were maintained in the medical school of Chulalankarana University in Bangkok and at the McCormick Hospital at Chiengmai.

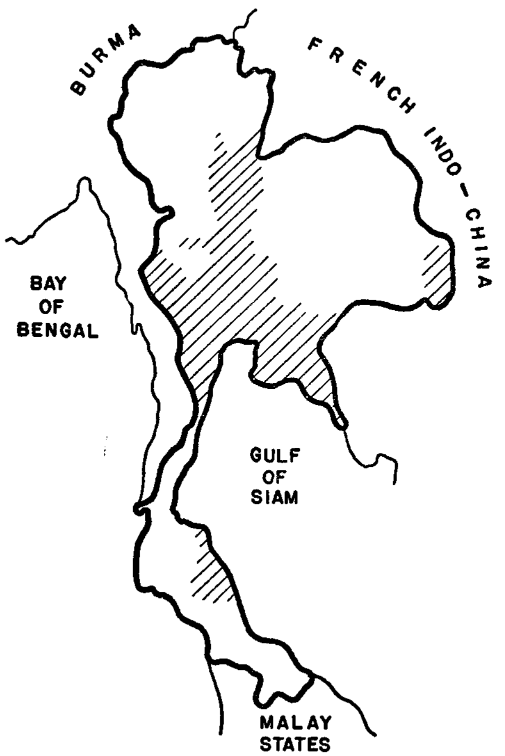
Social Services. The work of the Siamese Red Cross was considerable. In 1935 this organization had a budget of about $200,000. In the same year this society had the names of 238 physicians (mainly Army) and 316 nurses on its lists of reserve workers to be called upon in case of disasters and other emergencies. It also had several ambulances for first-aid work in emergencies, and it had some connection with the scientific work of the Pasteur institute. The health section of the society, which once carried out campaigns against infection with hookworm, later developed programs for the training of public health nurses, and it also operated several health centers.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysenteries. Amebic dysentery and bacillary dysentery, next to malaria and tuberculosis, constituted the most important cause of death in Thailand. The two diseases were prevalent throughout the kingdom, but the incidence was the highest in the hill country during the rains. In Bangkok the incidence of dysentery was highest during the dry season, when water was of poor quality. In 1935, 18,101 deaths were caused by "diarrhea or intestinal infections," and in the same year 5,721 deaths were said to have been caused by dysentery of unspecified type. Although some of these deaths undoubtedly can be attributed to typhoid fever, paratyphoid fever and cholera, most of them probably were caused by dysentery.

Cholera. Cholera has appeared from time to time in Thailand in serious epidemics. In 1937, 9,105 cases of cholera and 5,957 deaths were reported, and in 1938 only three cases and three deaths were reported. These figures probably are not reliable.



Cholera in Thailand

Typhoid Fever. Typhoid fever was widely prevalent among the natives. Water supplies were easily contaminated and flies were ubiquitous. The native practice of eating food that is kept for several hours before it is served favored the spread of typhoid fever by means of flies. During the dry season in the plains almost all the water consumed was taken from the badly contaminated canals.

Intestinal Parasitism. Almost every native Thai who lived outside a large community or a city was said to have intestinal parasites. In the examination of 2,410 stools in 1936 evidence of hookworm was found in 52.8 per cent, of ascariasis in 12 per cent, of whipworm in 3.6 per cent, of threadworm in 0.2 per cent, and of tapeworm in 3.5 per cent. From 1917 to 1929 the International Health Division of the Rockefeller Foundation carried on a study of the problem of intestinal parasitism in Thailand, and during that period administered 1,766,274 initial treatments for intestinal parasitism in general and 1,307,152 initial treatments for hookworm. Analysis of 722,453 stools for evidences of intestinal parasitism demonstrated that 65.2 per cent contained evidences of ascariasis and 9.2 per cent exhibited evidences of trichuriasis.

Infection with Intestinal Flukes. The trematode fluke, *Fasciolopsis buski,* is acquired by the eating of raw water-plants, such as the water chestnut, *Trapa natans* or *T. bicornis* or the Chinese sedge, *Eleocharis tuberosa.* The infection has been encountered among the Thai peoples.

Infection with *Schistosoma spindale.* *Schistosoma spindale* is a trematode inhabitant of the mesenteric veins of sheep, goats and cattle in India and the Federated Malay States. The cercariae of this organism are free-swimming, and when they attack the skin of bathers they cause marked irritation. It seems likely that this type of parasitism has penetrated to Thailand.

Melioidosis. The occurrence of the "glanders-like disease of Rangoon," melioidosis, was reported once from Bangkok. It is caused by the contamination of food with the urine or feces of infected rats.

Seven-day Fever. "Seven-day fever" is the term applied to a condition resembling a mild form of Weil's disease. It is said to be caused by *Leptospira hebdomadis,* which is carried by the field mouse, *Microtus montebelli.* This mouse contaminates food by means of its bites, urine or feces, and if such food is ingested the fever may result. It has been reported that 18 per cent of soldiers in the Thai army had the fever.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis was one of the chief causes of death. In the 1937-1938 health report, 10,548 deaths from tuberculosis were recorded. It was said that very little work had been done in the prevention or control of the disease.

Pneumonia. Pneumonia was a common disease. It seemed to appear during the cold season, and malnutrition and outbreaks of influenza contributed to the toll taken by pneumonia. In 1936 it was said that 2,561 deaths were caused by "lung infections," most of which infections doubtless were pneumonia. Yet the case fatality rate for pneumonia in Thailand was low.

Influenza. Influenza occurred most often at the beginning of the cold season, when certain Buddhist festivals are held, to which many Thai people come. At the festivals the opportunities for the spread of contagious respiratory diseases are excellent. In 1936, 2,270 deaths were reported to have been caused by influenza.

Smallpox. In 1937-1938 smallpox was reported from seven provinces, but in only two provinces were there more than 50 cases. The disease had been practically eradicated by means of vaccination. In 1935 vaccination of 1,620,078 persons was carried out, and in 1936 the same was done for 1,460,413 people. It has been said that more than 80 per cent of the people in Thailand were vaccinated.

Scarlet Fever. This disease is found occasionally, but is not serious.

Diphtheria. Diphtheria was said to have been increasing in frequency, and it probably occurred more frequently than reports indicated. Nineteen cases and 19 deaths were recorded in 1935.

Cerebrospinal Meningitis and Poliomyelitis. It was reported that meningitis occurs every year in Thailand. Seven cases and one death were recorded in 1936. Poliomyelitis has not been encountered, but this disease exists in Burma and French Indo-China, so that it would be logical to assume that it occurs in Thailand.

Others. Measles was reported to be one of the most common communicable diseases in Thailand. Mumps and chickenpox ranked next in importance. Whooping cough is reported to have killed a large number of children.

Diseases Spread Chiefly by Contact

Venereal Diseases. Gonorrhea, chancroid and syphilis occurred in all the large communities in Thailand. In 1936 it was reported that 13,042 Kahn tests had been performed and that 4,556 of them gave positive reactions. In the same year 12,303 Wassermann tests were carried out, and 4,155 of them gave positive reactions. The hill sections of Thailand were said to be relatively free from disease. Once a village in the hills became infected, however, the disease spread rapidly.

Yaws. In 1935, 6,474 cases of yaws were reported. Professor Zimmerman's examination of 9,428 Thai in the rural regions disclosed that 6.6 per cent had yaws. The greatest incidence of this disease was in the northeastern and southern sections of Thailand. The disease was rare in the north.

Leprosy. Leprosy was one of the serious chronic diseases of Thailand. Estimates which placed the total number of lepers in the country at 50,000 probably were too low. Incidence of the disease was highest in the northern regions. Measures for the prevention and control of leprosy were carried out by the government and by the American Presbyterian Mission in five leper colonies which had more than 1,000 lepers. An additional 1,000 lepers were treated in outpatient centers.

Diseases of the Skin. Scabies was present in all areas. The hill tribes seem to have an advanced stage of the condition. But in one survey of the disease only 2 per cent of children studied were infected. Conditions caused by Trichophyton, Epidermophyton and other related types of fungi occurred in all parts of Thailand. Tropical ulcer was not common, but was restricted to no particular part of the country. One investigator said that *Leishmania donovani* was found in 2 per cent of the tropical ulcers which he saw.

Tetanus and Gas Gangrene. Tetanus and gas gangrene had been noted throughout the kingdom. Wounds often were infected. Infection of the cord of the newborn with tetanus was said to have been a frequent cause of infant mortality. Tetanus in the mother after childbirth was not rare.

Trachoma. Trachoma was common throughout the kingdom. It was most extensive in those sections of Thailand which adjoined China and French Indo-China.

Rabies. Rabies was common among dogs, and pigs had been found in a rabid state. The wild pariah dog also was a source of rabies. Considerable demand for treatment seemed to exist, since in 1935 alone 259,800 cc. of antirabic vaccine was prepared in Thailand.

Rat-bite Fever. Rat-bite fever was known to occur throughout Thailand. This disease is caused by the bite of a rat which happens to be infected with a microorganism called variously *Spiroschaudinnia morsusmuris, Spirochaeta morsusmuris* and *Spirillum minus.* The disease responds readily to treatment with arsenical preparations.

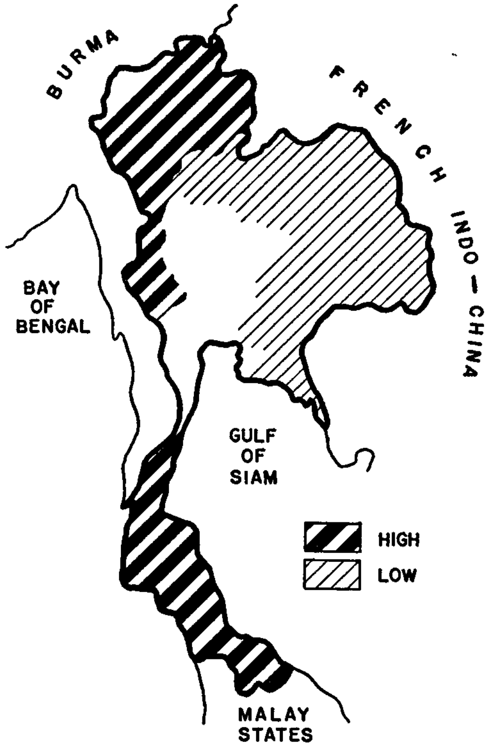
Anthrax. Forty-three cases of anthrax, with 11 deaths, were reported from Thailand in 1934.

Foot-and-Mouth Disease. Epizootic stomatitis occurred with considerable frequency among cattle in the rural sections of Thailand. Nothing was done to prevent or control it. The possibility of the infection of human beings was present.

Gnathostomiasis. The nematode, *Gnathostoma spinigerum,* has afflicted human beings in Thailand, but in such instances it seems probable that the worms were immature, and not adult, forms of this parasite, which is exceptionally rare. The worms occur as gastric tumors in tigers, wild and domestic cats, snakes, pigs and eels, but among humans form skin abscesses. A creeping type of eruption follows. Infection is thought to be caused by the eating of infected raw meat.

Diseases Spread by Arthropods

Malaria. Malaria is the greatest cause of sickness and death in Thailand. Exact fig-



Malaria in Thailand

ures concerning the total number of cases cannot be given here, because the majority of villages had no physicians. When reports were forthcoming, they were submitted by the head men of the settlements, and hence could not be expected to be accurate. It has been estimated, however, that about 35,000 persons died of malaria annually in Thailand, a figure which is frankly an estimate. In 1929, for instance, 40,265 deaths were attributed to malaria, whereas in 1936 the figure had decreased to 28,448. In a report issued by the League of Nations in 1932, it was estimated that the morbidity rate of malaria in 1929 in Thailand was 359 per 100,000 of population, or perhaps more than 50,000 cases of malaria a year. Distribution of the disease in Thailand is varied. In the southern sections, where there is relatively more moisture than elsewhere, the incidence of malaria is very high, and this is true also of certain districts in the east. The central section of Thailand, as mentioned previously, is flat and dry, a condition which contributes to the lower incidence of malaria in that region. If the country were to be considered in three main sections, the first section might be the southern peninsular portion of Thailand. Along the eastern coast of this peninsula the incidence of malaria is low. The chief vectors seemed to be *Anopheles sundaicus*, *A. hyrcanus nigerrimus*, *A. vagus vagus*, *A. fluviatilis* and *A. minimus*, and in certain areas malaria was widely prevalent. The second section might be the central part of Thailand, where irrigation ditches, which are often flushed in such a manner as to destroy the larvae, actually retarded rather than assisted the development of anopheline mosquitoes. Yet many anophelines were present, and outbreaks of malaria, rare in Bangkok, had been reported from outlying villages after the rainy season. *Anopheles aconitus* has appeared in this part of Thailand after the rains. In one area in this division 70 per cent of the school children examined had splenomegaly and 60 per cent of adult persons examined had the condition. The third division of Thailand might be the northern and eastern portions. There, as the plain country gradually rises into foothills, the streams become clear, so that dangerous anopheline vectors of malaria find ideal breeding places. *Anopheles fluviatilis*, *A. minimus*, *A. culicifacies* and *A. maculatus maculatus* occurred, and spleen rates were reported to be from 80 to 96 per cent. All three forms of malaria were reported from this area, but the quartan type apparently was not common. In the province of Chiengmai, of

2,700 persons examined, 821 or 30 per cent had malaria.

Blackwater Fever. Blackwater fever occurred chiefly in the northern part of Thailand and also in the south; but it was pointed out that this disease could appear anywhere in the country.

Measures of Control. Work in control of malaria was conducted by the Ministry of Health by means of committees, associated with four antimalarial units. Careful studies of the types of mosquitoes present and the nature of the malaria were made, and preventive measures best suited to the situation at hand were initiated. Eradication of mosquitoes was attempted by oiling, draining or spraying of streams with Paris green. Natives were urged to use mosquito netting at night, and drugs such as totaquina, quinine or atabrine were distributed to the sick.

Filariasis. Filariasis is common throughout Thailand, but it is not commonly a fatal disease and is not regarded as being serious enough to hospitalize the victims of it. It is unfortunate that no statistical reports as to the actual number of cases in Thailand could be discovered. *Wuchereria bancrofti* is the causative organism. *Culex fatigans* is the principal as well as the most common vector in Thailand. *Wuchereria malayi* has not been reported from Thailand, although it seemed likely to some observers that some types of filariasis were caused by this organism, on the basis of the clinical symptoms encountered.

Dengue Fever. Dengue fever was reported from the southern and eastern parts of the country. Actual figures pertaining to incidence are not obtainable, but it has been noted that the disease broke out each year in epidemic form.

Typhus Fever. Results of laboratory studies of typhus fever in Thailand have not appeared, but it is thought that the disease occurred there. In certain reports it was said, without confirmation, that mite-borne typhus fever broke out in epidemic proportions when forested areas were cleared. It would seem wise to assume that both endemic (murine) typhus fever and scrub (mite-borne) typhus fever exist in Thailand. There is, however, no evidence of epidemic (louse-borne) typhus fever.

Plague. Almost every year plague occurred sporadically in Thailand, but the measures of control that were applied by the Ministry of Health seemed to have kept the incidence of the disease low. Plague vaccine was distributed by the scientific section of the Siamese Red Cross Society whenever the need arose. Only three patients with plague were treated in Chiengmai in 1939, but it seems likely that in a number of cases plague occurred but was not reported.

Relapsing Fever. The louse-borne form of relapsing fever apparently was encountered in Thailand, but so far as is known the tick-borne type has not occurred.

Leishmaniasis. Leishmaniasis or kala-azar was recorded only in isolated instances. Vectors of this disease, sand flies, were known to exist in Thailand.

Nutritional Diseases

Beriberi. Beriberi occurred all over Thailand. In a survey made in 1930 the disease was found to be most common in the northeastern and central sections of Thailand. In the year 1937-1938, 1,950 deaths were reported as having been caused by beriberi. At the McCormick Hospital in Chiengmai about 250 patients with beriberi were treated annually.

Pellagra. Pellagra was not so common as beriberi, but it was encountered throughout the country. Other deficiency states, such as rickets, scurvy and others, were prevalent, but figures concerning these conditions could not be secured.

Miscellaneous Conditions

Allergic States. Allergic states were fairly common. The pollens of bamboo and sugar cane exert an effect similar to that of pollens of grasses of the Occident, and persons susceptible to the effects of such pollens would be much distressed in Thailand.

Alcoholism and Addiction to Drugs. In Thailand alcohol was made from rice. Alcoholism was present, but was not an important problem. Opium was used chiefly by Chinese in Thailand. Strict laws against the cultivation and indiscriminate traffic in opium were in effect, and the Thai people as a rule did not use the drug, with the exception of a few of the wealthier people and those among the hill people who actually raised the poppies.

SUMMARY

Responsibility for the public health of Thailand was shared by the newly created Ministry of Health and the local sanitary boards. The Ministry of Health was assisted or advised by the National Medical Council and the National Health Council. The sanitary boards were locally constituted but functioned under central direction and supervision, and were responsible for local public health and medical programs. As in neighboring Burma and French Indo-China, public health problems in Thailand were a distinct impediment to the progress of the country. Many of these problems had their origin in poverty, ignorance and certain customs protected by tradition.

Water was contaminated almost everywhere, because of primitive means of disposal of wastes. As a result, intestinal diseases were widespread, resulting in very high rates for sickness and death. Mosquitoes, lice and flies abounded, and caused much illness. Supplies of food as a rule were inadequate. Undernutrition and deficiency states were common. Infant mortality rates were high.

Hospital and medical facilities for the general population were grossly inadequate. Few hospitals had roentgenologic equipment and it was necessary to import all supplies. Except for a group of about 200 well-trained physicians, nearly all of whom practiced in Bangkok, most physicians in Thailand had received only limited training. Herbalists, spirit doctors and other primitive types of practitioners served large areas. Dentists were virtually unknown.

Malaria was the chief problem of public health, and was the greatest cause of illness and death. Although it was found in all parts of Thailand, it was most prevalent in that section of the kingdom which occupies the Malay Peninsula, adjoining the Federated Malay States and in the northwestern corner of the country, adjoining Burma. In some of these regions from 80 to 95 per cent of the population had given evidence of malaria in the form of enlarged spleens. Intestinal diseases, such as typhoid fever, dysentery and cholera, were second only to malaria in importance. Typhoid fever and dysentery appeared to be present constantly, and cholera broke out intermittently. Pneumonia, filariasis, plague, dengue fever, fungous infections of the skin, venereal diseases, heat stroke and, possibly, typhus fever were conditions of considerable importance.

BIBLIOGRAPHY

Anigstein, L.: Malaria and Anophelines in Siam. Quart. Bull. Health Organ., League of Nations, **1**:233-308 (June) 1932.

Austen, E. E.: Some Siamese Tabanidae. Bull. Entom. Res., **12**:431-455, 1922.

Barnes, M. E.: Anopheline Mosquitoes with Special Reference to the Species Found in Siam. J. Nat. Hist., Siam, **6**:65-80, 1923.

——: Notes on the Anopheline Mosquitoes of Siam. Am. J. Hyg. **3**:121-126 (Mar.) 1923.

Barraud, P. J., and Christophers, S. R.: On a Collection of Anopheline and Culicine Mosquitoes from Siam. Records of Malaria Survey of India, **2**:269-285 (June) 1931.

Boyce, R.: Yellow Fever and Its Prevention; A Manual for Medical Students and Practitioners. London, J. Murray, 1911.

Buxton, P. A.: The Recorded Distribution of Certain Fleas. Bull. Entom. Res., **32**:119-122 (Aug.) 1941.

Byam, W., and Archibald, R. G., eds.: The Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1923. 3 vols.

Cochran, D. M.: Poisonous Reptiles of the World: A Wartime Handbook. Washington, Smithsonian Institution, 1943 (Smithsonian Institution War Background Studies, No. 10).

Daensvang, S.: The Life Story of *Gnathostoma spinigerum* Owen. J. Nat. Hist., Siam, **12**:161, 1939.

Davey, T. H., and Gordon, R. M.: Estimation of Density of Infective Anophelines. Ann. Trop. Med. **27**:27-52 (Apr.) 1933.

Deignan, H. G.: Siam, Land of Free Men. Washington, Smithsonian Institution, 1943 (Smithsonian Institution War Background Studies, No. 8).

De Moor, C. E., Soekarnen, and van de Walle, N.: Melioidosis auf Java. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **21**:206-222, 1932.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Ellis, A. G.: The Service to Medicine in Siam Rendered by H.R.H. Prince Mahidol of Songkla. Bull. Inst. Hist. Med., **4**:165-198 (Feb.) 1936.

Far Eastern Association of Tropical Medicine, 8th Congress, Bangkok, 1930, Siam, General and Medical Features. Bangkok, Bangkok Times Press, Ltd., 1930.

Flower, S. S.: On the Mammalia of Siam and the Malay Peninsula. Proc. Zool. Soc. Lond., Pt. **2**:306-379, 1900.

Gairdner, K. G.: Notes on the Fauna and Flora of Ratburi and Petchabut District. J. Nat. Hist. Soc. Siam, **1**:27-40 (Feb.) 1914; 131-156 (Mar.) 1915.

Harding, W. A.: Description of Some New Leeches from India, Burma and Ceylon. Ann. & Mag. Nat. Hist. (Ser. 9), **14**:489-499, 1924.

——, and Moore, J. P.: *Hirudinea.* London, Taylor and Francis, 1927. (The Fauna of British India, including Ceylon and Burma.)

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Kumm, H. W.: The Geographical Distribution of the Malaria-Carrying Mosquitoes. Baltimore, American Journal of Hygiene, 1929 (Am. J. Hyg. Monographic Ser. No. 10).

——: The Geographical Distribution of the Yellow-Fever Vectors. Baltimore, American Journal of Hygiene, 1931 (Am. J. Hyg. Monographic Ser. No. 12).

Ladejinsky, W. I.: Thailand's Agricultural Economy. Foreign Agriculture (U. S. Dept. Agr.), **6**:165-84 (May) 1942.

Landon, K. P.: The Chinese in Thailand. New York, Oxford University Press, 1941.

League of Nations: Monthly Epidemiological Report of the Health Section. Geneva, 1927, 1928; 1930-1936.

——: Health Organisation: Enquiry into the Quinine Requirements of Malarial Countries and the World Prevalence of Malaria. Geneva, 1932.

——: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Report of Siam. Geneva, 1937.

McKinley, E. B.: A Geography of Disease. Washington, George Washington University Press, 1935.

Mendelsohn, R. W.: Tropical Diseases Observed in Siam. J.A.M.A., **72**:1199-1205 (Apr. 26) 1919.

Moore, J. P.: Leeches from Borneo and the Malay Peninsula. Bull. Raffles Museum, Singapore, **10**:67-79 (Oct.) 1935.

Meyer, K. F.: Ecology of Psittacosis and Ornithosis. Medicine, **21**:175-206 (May) 1942.

Schütt, R.: Heutiger Stand unserer Kenntnisse über viscerale Leishmaniosen (Epidemiologie, Klinik und Behandlung). Ergebn. d. Hyg., Bakt., Immunitätsforsch. u. exper. Therap., **23**:64-124, 1940.

Siam. Public Health Dept.: Report for Year 1936. Bangkok, 1939.

Siamese Red Cross: Summary of the Annual Report (April 1935-March 1936). Bangkok, Bangkok Times Press, Ltd., 1936.

Smith, M. A.: Note on a Rare Sea Snake (*Thalassophis anomalus*) from the Coast of Siam. J. Nat. Hist. Soc. Siam, **2**:176-177 (Dec.) 1916.

——: Occurrence of the Krait (*Bungarus candidus*) and the Small-spotted Coral Snake (*Callophis maculiceps*) in Siam. J. Nat. Hist. Soc. Siam, **1**:123-125 (Aug.) 1914.

——: On Sea Snakes from the Coasts of the Malay Peninsula, Siam and Cochin-China. J. Fed. Malay States Museum, **10**:1-63, 1920.

——: Reptilia and Amphibia. London, Taylor and Francis, 1935. (The Fauna of British India including Ceylon & Burma.)

——: The Snakes of Bangkok. J. Nat. Hist. Soc. Siam, **1**:5-18, 1914.

——: Two Vipers New to Siam. J. Nat. Hist. Soc. Siam, Suppl. **7(3)**:194 (Sept.) 1928.

Stanton, A. T.: The Mosquitoes of Far Eastern Ports with Special Reference to the Prevalence of *Stegomyia fasciata.* F. Bull. Entom. Res., **10**:333-344, 1920.

——: Notes on Malayan Culicidae. London, J.

Bale, Sons & Danielsson, Ltd., 1926. (Studies from the Institute for Medical Research, Kuala Lumpur, Federated Malay States, No. 20.)

Summers, S. L.: Description of a New Species of Simulium from Siamese Hills. Ann. and Mag. Nat. Hist., Ser. 8: 7:586-588, 1911.

Theodor, O.: On Sandflies (*Phlebotomus*) from Ceylon, Siam and Malaya, Indian J. M. Research, **26**:261-269 (July) 1938.

Thompson, V. M.: Thailand, the New Siam. New York, The Macmillan Co., 1941.

Weyer, F.: Die Malaria Überträger. Leipzig, G. Thieme, 1939.

Zimmerman, C. C.: Siam, Rural Economic Survey. Bangkok, Bangkok Times Press, Ltd., 1931.

Zinsser, H., Castaneda, M. R., and Mooser, H.: Epidemiology of Typhus. Tr. Ass. Am. Physicians, **47**:129-142, 1932.

12

Australia

GEOGRAPHY AND CLIMATE

Australia is situated at the apex, so to speak, of the South Pacific and Indian oceans, and, including Tasmania, lies wholly within the southern hemisphere between about 113 and 154° of east longitude and 10 and 44° of south latitude. The area of the mainland is 2,948,366 square miles, and the coast line is 12,210 miles long.

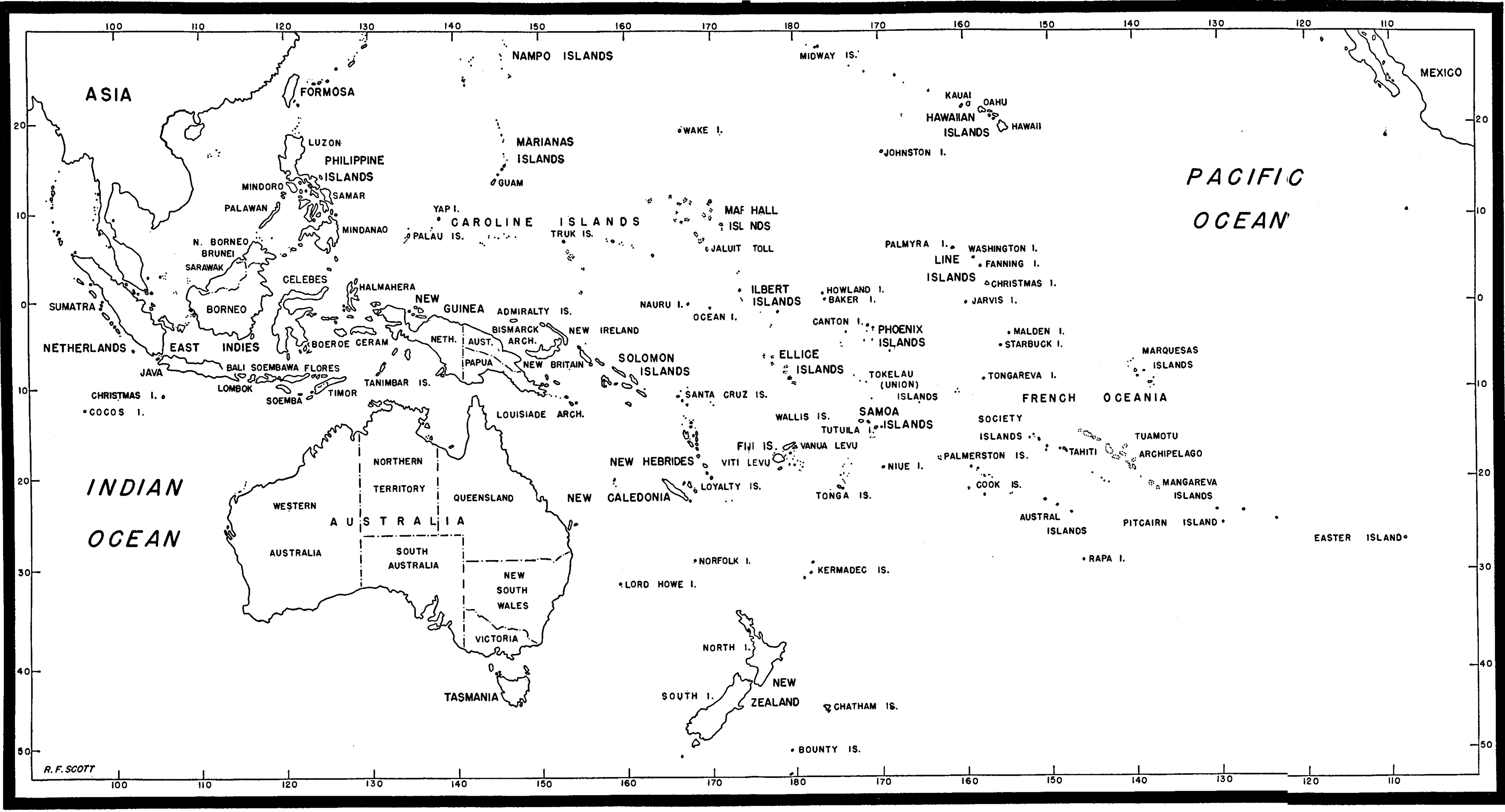
The northern or "tropical" part of Australia consists of the land lying north of the Tropic of Capricorn (23° 27′ of south latitude); the southern or "temperate" portion consists of the land lying south of that line. The 135th meridian of east longitude roughly divides Australia into two parts, so far as surface configuration is concerned. To the west of this meridian lies the great plateau; to the east, the lowlands; and beyond these, near the coast line, is an elongated belt of highlands known as the eastern highlands and South Australian highlands. The average elevation of the interior plateau is 1,500 feet, but mountainous elevations of as much as 5,438 feet occur in the north, northwest and central portions. Broad expanses of sandy plain, heath and scrub constitute this vast tableland.

The central lowlands extend south from the Gulf of Carpentaria to the eastern corner of South Australia and the Victorian highlands. Rolling and undulating in the north and east, these lowlands flatten into a boundless expanse of plain toward the south. They are covered with scattered timber, scrub and grass, and in some areas by limestone, gravel and moving dunes. A highland belt runs parallel to the eastern coast of Australia, forming three natural divisions: the northern uplands, the central and southeastern highland (including Tasmania), and the southern dividing range. The Great Barrier Reef stretches for 1,200 miles off the northeast coast, along the eastern border of the state of Queensland.

The flow of all the rivers and streams in Australia is subject to the seasonal extremes of heavy rains and dry periods. In the central lowlands and inner section of Northern Territory the beds of streams generally are dry, excepting after heavy rains, when the streams become moving floods. Drying up, they leave broad channels with water holes or shallow, sandy beds beneath which water probably can be found.

There is evidence for the conclusion that in the remote past the Australian aborigines stemmed from two strains of immigrants, members of one strain being akin to elements surviving in the south of India, in Ceylon and the Malay Peninsula. The Australian "black fellow" actually is not black, but is chocolate brown, and is of less than average height. Today, the "aboriginal" population, approximately 60,000, is confined mainly to the northern and northwestern sections of Australia. Among the aborigines in the northwest are found some fine types, adaptable, intelligent, and capable of civilization.

Of the remaining population, approximately 7,000,000 (97 per cent) were born either in Australia and New Zealand or in the British Isles. There is a small percentage of Asiatics, Chinese and half-caste persons. There are only 2.23 persons per square mile in Australia. The southeastern section of Australia contains 70 per cent of the population and produces 75 per cent of the



THE PACIFIC AREA

total wealth; to this area may be added the southeastern part of Queensland and the northeastern part of New South Wales, which are also areas in which the concentration of population is relatively heavy.

Since about half of Australia lies within the tropics, the climate naturally is warm, but for the most part conditions are equable. The continent is large enough for considerable extremes of temperatures to be experienced; in the interior a temperature of 80° F. (26.6° C.) is reached. The narrow coastal strip of the so-called tropical area is humid, but the great western plains are dry and usually arid. Heat persists for the longest periods and is most intense inland in the north and northwest, where temperatures of 100° F. (37.7° C.) may prevail for from 50 to 60 days. However, in great parts of these areas the humidity is relatively low, so that the heat is well tolerated. Ground frosts occur everywhere in winter, excepting along the northern and western margins of the continent.

The torrid, humid portion of Australia, in which the climate is consistent with the popular conception of a truly "tropical" climate characterized by heavy rainfall and high humidity, actually comprises only a very small proportion of the continent, including part of the tip of Arnhemland and the major part of the Cape York Peninsula, and extending along a narrow coastal strip of the state of Queensland as far as the vicinity of Rockhampton. Wyndham, in the northwestern part of Western Australia, is one of the hottest places in the world. The rest of the northern part of Australia is moderately warm and moist, but during half of the year the climate is said to be moderate. Monsoons play an important part in the cooling of the climate, and occur seasonally from October to April.

Australia lies within the zones of the southeastern trade and prevailing westerly winds. The heaviest precipitation occurs along the Pacific slopes northward from the northern section of New South Wales. The opposite situation exists on the northwestern coast of Western Australia, where prevailing winds, blowing from the interior of the continent instead of from the ocean, result in the lightest coastal rains in Australia. The westerly winds are responsible for the generally light-to-moderate rains of the southwestern portion of Western Australia, the agricultural areas of South Australia, and parts of Tasmania. In the north the rainfall is monsoonal from November to April, averaging 60 inches (1.5 meters) or less. In the southern area the winter rainfall, from May to October, averages 40 inches (about 1 meter) or less. Most of Tasmania has an abundant all-year rainfall, especially on the western coast, where the annual precipitation is from 110 to 120 inches (2.8 to 3.05 meters). In the winter, snow and hail fall in Tasmania and in the southeastern highlands of Australia. Along the lower eastern coast of the continent precipitation averages 60 inches (1.5 meters), whereas toward the center of the country it decreases to 40 inches (about 1 meter) or less. The greatest precipitation occurs along the northeastern coast of Queensland, where the average annual rainfall is about 145 inches (about 3.7 meters). The driest region is around Lake Eyre, which is the only part of the continent situated below sea level. Rainfall there is less than 5 inches (0.13 meter) annually. Rainfall is most uniform along the southwestern and southeastern margins of the continent, but elsewhere there are distinct wet and dry seasons. Cyclones are not uncommon along the northwestern coast from November to April; hurricanes and torrential tropical storms occur in the northeast (January to April), and so-called southerly bursters in the southeast.

PUBLIC HEALTH

Health Services

Organization. The Department of Health of the Commonwealth of Australia, is supervised by a Director-General of

Health who is responsible to the appointed Minister of Health. The Department of Health, however, confines its work largely to the organizations listed below, whereas the active protective, investigative and educational aspects of public health work are carried on by the departments of health of the individual states.

The Commonwealth Department of Health is divided into nine main organizations.

1. The Central Administration. This organization, located in Canberra, is responsible for co-ordination of the work of the individual state health departments with that of the federal government. It also administers the federal (national) organization.

2. The Quarantine Service. This service, founded in 1909, is said to be one of the most efficient organizations of its type in the world. In 1939 there were 45 quarantine stations, of which 14 were listed as major ports. At these quarantine stations are facilities for quarantining and, if necessary, hospitalizing seamen and immigrants, as well as adequate means with which to combat rodents and to carry out all other measures of quarantine. An estimate of the efficiency of the quarantine system can be gained from a report of the Director-General in 1939, in which it was stated that only one patient suffering from smallpox had been allowed to enter the country since 1921; that the last instance of plague in a human being had occurred in 1923; that the last plague-infected rat had been found in 1922; that cholera had never passed the quarantine barrier; that epidemic louse-borne typhus fever had not occurred during the 100 years previous to the time of the report; and that yellow fever had never reached the Australian coast.

3. The Commonwealth Serum Laboratories. These laboratories were established during the World War of 1914-1918 for the purpose of manufacturing a wide range of biologic products, so that Australia, in this particular respect, would be self-sufficient and independent of other countries. Research in bacteriology and immunology and the manufacturing of new serums and prophylactic agents are its prime functions. In 1939 the staff of the laboratories consisted of 235 physicians and trained laboratory technicians.

In the great majority of instances, the organisms used in the preparation of the various serums have been isolated in Australia. Exceptions to this rule are the organisms of plague and cholera, which are not obtainable in Australia; those of typhoid fever, which have been obtained from an English strain; and those of diphtheria, which are of the American strain, Park, No. 8. The wide range of vaccines prepared includes those for cholera, plague, dysentery, influenza, whooping cough and typhoid fever. In addition, streptococcic and staphylococcic vaccines, as well as special vaccines made to prescription, are prepared. Tetanus and gas gangrene antitoxins and tetanus toxoid are made. Serums are prepared for use in the treatment of anthrax, dysentery, cerebrospinal meningitis, gas gangrene and pneumonia. Antivenins for the treatment of the bites of various Australian snakes are made. Tuberculins for the diagnosis of both the human and bovine types of tuberculosis are prepared, as are also all the various allergens used in the diagnosis of hay fever and other allergic states. The laboratories also produce insulin, pituitary extracts and thyroid preparations. The media department supplies hospitals and other institutions throughout Australia with a wide variety of bacteriologic media. In addition to preparing biologic products, the laboratories are the national center for the maintenance of standard pharmaceuticals.

The Director-General has said that these products are made in such quantity that they are or have been regularly distributed throughout the southern Pacific, East Indies and parts of India, as well as in England and South Africa, upon request.

4. Commonwealth Health Laboratories. In 1941 there were 12 commonwealth health laboratories. One is located in each of the following cities: Darwin, Cairns, Townsville, Rockhampton, Toowoomba, Lismore, Bendigo, Port Pirie, Kalgoorlie and Broome, and at Hobart and Launceston in Tasmania. In these laboratories clinical investigative work is carried on in collaboration with local private medical practitioners and public health personnel.

5. School of Public Health and Tropical Medicine. The commonwealth government and the University of Sydney maintain this school in collaboration. The school not only graduates public health officers, but also carries out much original investigative work in tropical diseases. It was founded in 1930.

6. Division of Veterinary Hygiene. In addition to research in diseases of animals, this division has recently undertaken the supervision of veterinary inspection of meats in public abattoirs and, to a limited extent, the inspection of milk.

7. Division of Plant Quarantine. This division is situated at Canberra; local administration is carried on by chief quarantine officers (plants) and quarantine officers appointed under co-operative arrangements with the state departments of agriculture. In 1939 there were 19 ports of entry (that is, the only ports at which importation of plants was permitted) and 61 plant quarantine officers. The work of this division is important because it is concerned with the inspection and regulation not only of plants and foodstuffs, but also insects, pests and diseases of plants which are extraneous to Australia.

8. Australian Institute of Anatomy. This was founded at Melbourne in 1924 as the National Museum of Australian Zoology; in 1930 a building was erected for it at Canberra, and the name was changed to the Australian Institute of Anatomy. In 1931 it became an integral part of the Commonwealth Department of Health. Although the work of this institute is concerned largely with comparative anatomy, some work in child welfare, problems of the growing child, and biologic research has been done.

9. Commonwealth X-Ray and Radium Laboratory. In 1929 the Commonwealth of Australia purchased a large amount of radium for treatment and research and for loan to centers for the treatment of cancer in Australia. Later, roentgen-ray facilities were acquired, and the Commonwealth X-Ray and Radium Laboratory was established at the University of Melbourne. In 1939 this laboratory had a building of 16 rooms and apparatus which would deliver a current of 500,000 volts to an x-ray tube.

The care of the public health in the Australian states is for the most part vested in local authorities, who administer public health acts under the supervision of a central authority in each state. Within municipalities, the municipal council and within shires, the shire council, is the local authority. The membership or constitution of the central authority is not uniform throughout the commonwealth. In every state there is also a minister of public health, who occupies a seat in the state cabinet and is responsible to the parliament of the state for his department. In some states control is exercised by a central board (or commission) of health consisting partly of physicians and partly of laymen; in others it is vested in a medical health officer (a commissioner) appointed and paid by the government. The heads of the different state departments of health also act in advisory capacities to the Commonwealth Department of Health through a National Health and Medical Research Council.

Relative Effectiveness. The duties and authority of the health officers and health boards in the different states of Australia in many instances are not comparable with the duties and authority of corresponding officials of the commonwealth government. Serious discrepancies exist between the municipal governments and state governments. These differences in administrative organization, authority and duties of various units of the public health organization restrict to a limited degree the unification of public health purposes and policy. In addition to these discrepancies, the scope and effectiveness of the public health system are limited by the fact that frequently the health boards either fail or are unable to exert their influence forcibly in many matters that are solely or primarily of public health concern. Some of these limitations are referred to in the paragraphs that follow.

Water Supplies

Water is plentiful along most of the coast line of Australia. It is taken from rivers, collections of surface water and deep wells (some of which are as deep as 2,300 feet or about 700 meters); however, the hinterland is dry and arid, especially in the west. There are several large artesian beds in Australia, the largest extending over the entire eastern half of the country; several smaller ones are located in the western part of Australia. The larger cities, notably Sydney, Melbourne, Brisbane and Perth, have modern plants for the treatment of water and adequate supervision of their water supplies. In many cities filtration is employed, but in most places where it is used it is inadequate. Chlorination has not been readily accepted; for the most part the inhabitants of small towns and rural districts are dependent upon untreated water that is obtained from watersheds presumed to be uncontaminated. The unreliability of this practice is exemplified by the frequency of the occurrence of epidemics of diarrhea after heavy rains.

In Northern Territory and in the state of Western Australia much of the water has a very high mineral content. In many places it is sufficiently high to be responsible for much chemical diarrhea.

In the center of the country, and especially in the desert regions, water is obtained from shallow wells, springs or water holes. Migrant aborigines frequent these watering places year after year, and as the result of their insanitary habits the water and soil usually are badly contaminated.

Sewage Disposal

Some of the larger towns of the southeast and most of the big cities have facilities for the treatment of sewage, usually sedimentation tanks. Other than a few septic tanks there are no plants for the disposal of sewage in the smaller towns, the pan system of collection of night soil being commonly used, with eventual disposal of refuse in either the sea or trenches. Pit latrines are used in some rural areas, but in many areas their use is opposed, particularly in the eastern part of Australia, on the grounds that they are impracticable because of the impervious nature of the subsoil or because of the fear of contaminating the ground water. In these areas the pail system is used almost exclusively.

Insects and Animals

Vectors of Disease. Mosquitoes. *Anopheles punctulatus moluccensis* is the dominant vector of malaria in Australia. It is found in the northern part of the state of Queensland and in Northern Territory. Its breeding grounds are varied, but are usually well exposed to light. Larvae have been found in clear, swampy pools, in the cleared patches of mangrove swamps at the junction of fresh water with salt water, on the margins of running streams, and in muddy pools and hoof prints. Occasionally, this mosquito breeds in artificial containers near houses. Adult mosquitoes bite freely throughout the night and readily enter houses. A special type of *A. punctulatus* has been reported to be a vector of malaria on the mainland of Australia only in the vicinity of Borroloola in Northern Territory. Its breeding habits are similar to those of *A. punctulatus moluccensis*. *Anopheles bancroftii* is widespread in the coastal section of the state of Queensland, from Brisbane northward and throughout Northern Territory. The relationship of this mosquito to malaria is somewhat obscure, and its distribution in Northern Territory does not coincide with that of malaria. On the whole, it is unlikely that this mosquito is of importance as a vector of malaria excepting in a relatively few localities in which it is particularly abundant and vicious. *Anopheles annulipes annulipes* is the most widespread and best-known anopheline mosquito on the mainland of Australia. It ranges from Tasmania to Darwin and from Sydney to Perth. It is found at sea level and at elevations up to 5,000 feet, extending inland at least as far as the belt in which rainfall is 15 inches (0.38 meter). In the north this mosquito is particularly abundant. It bites chiefly at dusk and during the night. It also bites in shady places during the day. Its breeding habits are varied, but it prefers clear, sunlit pools and aquatic vegetation, especially in the backwaters at the edges of running streams, pools of rain water and at the margins of muddy water holes; sometimes it is found breeding also in brackish water. This mosquito is capable of serving as a vector of malaria under experimental conditions, although its role as a natural vector of malaria is not definitely established. There is evidence that it serves in this capacity in New South Wales. *Anopheles bancroftii* breeds in fresh, shallow water which is generally clear, although on occasion it breeds in muddy pools, and especially in swamps that are heavily overgrown with vegetation. In shaded regions it bites during the day as well as at night, but it is especially active about dusk. In the swamps along the Mary River in Northern Territory this mosquito bites most viciously, and is the worst pest. *Anopheles atratipes* is too uncommon and its distribution too scattered to have any practical relationship to malaria. It is found in the vicinity of Sydney in the southern part of Queensland and as far north as Cairns. *Anopheles amictus* is widely distributed in the coastal part of Queensland from Brisbane to Cairns, along the Gulf of Carpentaria, and as far west as Darwin. The only place in which this mosquito has a known relationship to malaria is in the vicinity of Cairns.

Aedes aegypti is widely distributed throughout the settled parts of Queensland, Northern Territory and in Western Australia as far down the coast as Geraldton. It is also widely distributed throughout New South Wales. Within recent years, the distribution of this mosquito has expanded to as far south as the coastal part of the state of Victoria. In Australia this mosquito is the vector of dengue fever. Although yellow fever does not occur in Australia, this mosquito is capable of serving as the vector of this disease if the disease should be introduced from areas in Africa in which it is endemic. *Aedes albopictus* is rare in Australia and is of no particular importance as a vector of dengue fever there. *Aedes vigilax* is the pre-eminent pestiferous species of Aedes along the coast from New South Wales to the Cape of York. It is also of importance as a vector of filariasis. It breeds in vast numbers wherever there are mangrove swamps, and bites at any hour of the day or night. It has a range of flight of many miles.

Culex fatigans is the principal vector of filariasis in Australia. It is the common household mosquito which bites at night and which is widely distributed throughout this entire region. It is especially noteworthy that this mosquito breeds in polluted water; not infrequently communities breed their own plagues of these mosquitoes, so to speak, by ineffective disposal of sullage water. *Culex annulirostris* also is a vector of filariasis. It is found in the bush of New South Wales and New Guinea. *Culex sitiens* is a mosquito which breeds in salt marshes and is a vector of filariasis. In the vicinity of its breeding places *Culex sitiens* occasionally occurs in such numbers and bites so viciously that life at night is almost intolerable.

Lice. The body louse (*Pediculus corporis*), the head louse (*Pediculus capitis*) and the pubic louse (*Phthirus pubis*) are widely distributed throughout this region. Although louse-borne diseases have not been reported from Australia, the body louse is of potential medical importance because of its ability to serve as the vector of epidemic typhus fever, relapsing fever and trench fever.

FLIES. Flies constitute a serious problem in sanitation in Australia. Houseflies (*Musca domestica*), stable flies of the genus Stomoxys and blow flies of the family Calliphoridae are widely distributed throughout the country and in some localities are encountered in abundance. The most prevalent fly, however, is the bush fly, *Musca vetutissima*. In some localities in the interior the prevalence of this fly is almost unbelievable. In contradistinction to the breeding characteristics of most flies, the breeding habits of the bush fly have not been discovered, and therefore no effective method of control has been developed. Whereas most of the flies mentioned herein are primarily pestilential, the housefly is of special importance as a mechanical carrier of the organisms of diseases of filth, and particularly the enteric diseases.

TICKS. The ticks of medical importance that occur in Australia are *Haemaphysalis humerosa* and *Ixodes holocyclus*. The former is the vector of Q fever, and the latter is responsible for the development of tick paralysis. Both ticks are distributed along the coast line of the eastern part of Australia, and are common ectoparasites of bandicoots.

FLEAS. The rat flea, *Xenopsylla cheopis*, and the cat flea, *Ctenocephalus felis*, are the common fleas and both are widely distributed throughout the country. The rat flea is of medical importance, inasmuch as it is the vector of endemic typhus fever and is of potential importance as the vector of plague.

MITES. A local type of *Trombicula hirsti* is suspected of being the vector of scrub or mite typhus fever in the tropical and subtropical parts of Australia, and especially in the area in northern Queensland in which sugar cane is raised. This larval mite is widely distributed throughout this area, and in addition to its role as a possible vector of mite typhus fever it is important because its bite produces severe dermatitis. In the states of New South Wales and South Australia the bite of the mite, *Leeuwenhoekia australiensis*, produces a type of dermatitis similar to that caused by *Trombicula hirsti*. These mites are common ectoparasites of a wide variety of rodents, marsupials and terrestrial birds, and are most frequently found in scrub, rank grass and among the fronds and flowers of certain palm trees.

MAMMALS. Several species of rats that are found in Australia are of medical importance, not only because of their ectoparasites (fleas, lice, mites and ticks) but because they are capable of serving as vectors of plague and of leptospirosis. The most important species are *Rattus rattus*, *R. norvegicus* and *R. culmorum*. Bandicoots, wallabies and field mice are of importance as the principal hosts for the mites that have just been mentioned.

AVIAN VECTORS. The mites that have been mentioned also are carried by certain birds, such as the bush turkey, cassowary, ground pigeon, bush fowl, swamp hen and the rail. Psittacosis is prevalent among all the more common species of Australian parrots and cockatoos, and in every state of the commonwealth. The disease is encountered among wild birds, as well as among birds bred in aviaries. Six species of true parrots (of the family Psittacidae) have been found to be infected in the wild state, and four other species have been shown to be infected in captivity. Among the cockatoos (of the family Kakatoidae), the little cockateel (*Leptolophus hollandicus*), the smallest of the cockatoo family, frequently is infected. Health authorities have not found it expedient to take measures to control the trade in wild birds or to control the sale and distribution of birds from commercial aviaries.

Snakes and Other Dangerous Animals. Aside from sea snakes of the family Hydrophidae, which live in the waters of the northern coast, Australia has but one family of poisonous snakes, the Elapidae, of which 14 genera and 80 species are known. A number of these snakes are not considered to be dangerous to man because their size is small, their fangs are short and their disposition is timid; but the larger snakes are outstanding for their abundance, aggressiveness and the high toxicity of their venom. There is a great range in the toxicity of the venom of the dangerous species. Although the action of the poison is largely neurotoxic, the toxin of some species possesses a hemolytic effect. Most of the snakes in Australia do not rear very far from the ground when they attack. Among the most important land snakes are the black snake (*Pseudechis porphyriaceus*), the copperhead snake (*Denisonia superba*), the brown snake (*Demansia textilis*), the tiger snake (*Notechis scutatus*) and the death adder (*Acanthophis antarcticus*). Twenty-seven species of sea snakes belonging to 12 different genera have been found in the waters off the northern shores of Australia. There is great individual variation in the toxicity of the venom of the different species. Under ordinary circumstances, the sea snakes do not bite unless they are forcibly restrained; it is said that they never attack bathers in the water. The sea snakes usually are found in shallow waters near the coast, especially near the mouths of rivers, but are never found inland. In most parts these snakes seldom exceed a length of 4 feet (1.22 meters), but specimens of two species have been found which were about 9 feet (2.7 meters) long.

Pests. Mosquitoes. The mosquitoes previously mentioned in this chapter are of importance principally because they are vectors of disease. Many of them, however, also are notorious pests. In addition, several other species act as pests.

Aedes alternans is the largest biting species in Australia, and although its bite is not so severe as that of *Aedes vigilax*, it is a pest of considerable importance in the southern part of the state of Queensland and in the northern part of the state of New South Wales. *Aedes vittiger* bites viciously. It is found in the open sclerophyllous forest in the northern part of New South Wales and the southern part of Queensland. It prefers animal blood to human blood and frequently is an extremely annoying pest as far as livestock is concerned. *Aedes camptorhynchus* is a pest out-of-doors on the southern coast, from Perth to Melbourne. *Aedes theobaldi* is sometimes a pest in the inland districts of the states of Queensland and New South Wales. *Aedes notoscriptus* is a pestilential mosquito that breeds in holes in trees and rock pools. This mosquito has become semidomesticated and even enters houses. It is especially annoying in heavily timbered country. *Aedes alboannulatus* breeds in rock pools; this species is at times rather numerous in the gullies and open forests of New South Wales and the southern part of Queensland. *Aedes concolor* bites viciously at dusk along the beaches and foreshores of New South Wales. It breeds in salt water in rock pools that have been filled by the spring tides. *Aedes similis* and *A. funereus ornatus* are small mosquitoes which can inflict sharp bites. They are most numerous in sheltered, moist localities in the northern part of Queensland. *Tripteroides atripes occidentalis* breeds in holes in trees and is a pest in the drier inland parts of Australia. In the northern part of Queensland and in Northern Territory *Mansonia uniformis* may be a serious pest to those living in the bush. It bites viciously by night rather than by day, and sometimes enters human habitations. The larvae live in association with the roots of the free-floating aquatic herb, *Pistia stratiotes*, from which they obtain their oxygen.

Ants. Throughout the northern half of Australia is distributed a very destructive white ant. It destroys all unprotected wooden objects, so that buildings constructed of wood must have underpinnings treated with creosote and termite shields, or some other means of protection.

SPIDERS. The bite of the red-back spider (found in the arid regions of Australia) is capable of producing a severe type of toxemia.

MOTHS. The larva of the cup moth, commonly found in the gum trees of the Sydney district, produces dermatitis when it comes into contact with unprotected human skin.

RABBITS. Rabbits breed prolifically throughout Australia, and because of their numbers and the damage they do to crops constitute an economic problem. Tularemia, a disease of rabbits which is transmissible to man, has not been reported from Australia.

Measures of Control. Measures for the control of insects and animals that affect man adversely have been undertaken only recently in Australia. All the major ports have active quarantine forces that carry on a constant campaign against rats. Control of malaria is limited to some of the regions in which the disease is endemic; in these places swamps have been drained and other efforts have been made to eradicate the places in which the mosquitoes breed; however, because of the fact that the northern part of Australia is the most malarious region and at the same time is so sparsely populated, little actually has been done to combat the disease. Measures for the control of the mites that carry scrub typhus fever have been limited to the large sugar plantations, where the fields are burned over before the crop is planted and after it is harvested, in an attempt to destroy the rodents that live along the edges of the cane fields.

FOOD AND DAIRY PRODUCTS

The southern part of Australia is self-sufficient, so far as food is concerned. This region ranks as one of the world's leading exporters of certain food commodities, being second only to Argentina in the exportation of beef and second to New Zealand in the exportation of mutton. It is the third largest exporter of wheat, the fifth largest exporter of dairy products and eggs, and is one of the leading exporters of the following products: oats, corn, barley, rice, beans, peas, sugar, and both fresh and dried fruits, such as grapes, apples, bananas, melons, citrus fruits, raisins and currants. On the other hand, it is necessary to import into this region potatoes (from New Zealand, where there is a considerable surplus), onions, beets, turnips and other root vegetables.

There are many dairy farms in the vicinity of the larger towns in southern Australia. The inspection of milk, farms, herds and plants is carried out by the various state departments of agriculture, rather than by the health departments. Although the state departments of agriculture are charged with this responsibility, they are without the authority to enforce compliance with milk ordinances where defects exist. This authority is vested in a so-called milk board composed largely of farmers, and is seldom invoked. The pasteurization of milk is uncommon. Bottled milk usually is distributed in narrow-necked bottles that are difficult to clean, or is dispensed from horse-drawn tank carts which, for obvious reasons, are difficult to sterilize. Cattle are not subject to the strict veterinary examinations that are required in the United States, and bovine tuberculosis and Bang's disease (infectious abortion) are common. The inadequacies and inherent dangers of the existing regulations are thoroughly appreciated by all public health authorities and physicians in Australia, but until the importance of pure milk in relation to the public health is recognized by government officials in general, it will be impossible to have a safe milk supply.

A service concerned with the inspection of meat is maintained by the government, and the meat produced in Australia in general is safe. However, because of the prevalence of tuberculosis, Bang's disease, hydatid disease and other parasitic infections, many animal carcasses are condemned. The health authorities recognize the absolute necessity for constant vigilance in this respect.

Facilities for refrigeration are lacking in many of the small towns and rural areas of Australia. The prevalence of flies in some localities and the lack of screening and other measures for the control of flies are factors in the spread of enteric diseases. This is particularly true in the northern part of Queensland.

Deficiency diseases are not common in Australia, although in the arid and sparsely populated part of the country it is sometimes difficult to obtain the constituents of a well-balanced diet.

Miscellaneous Problems of Sanitation

The problems of sanitation in Australia are varied and are greatly influenced by factors such as climate, topographic features, faunal distribution, distribution and composition of the population, and the occupational pursuits, customs, living conditions, and health of the people. As a result, practically every problem of public health that is encountered anywhere else in the world also is found in some part of Australia. In general, however, the major problems have to do with water supplies, disposal of sewage, control of insects, and the protection of food supplies.

During recent years interest has been awakened in the public health aspects of these problems. As previously mentioned, sewage disposal plants have only recently been placed in operation in some of the principal centers, and many towns and cities are without facilities with which to insure a constant supply of safe water. Other problems of sanitation and public health, such as control of insects, control of milk supplies and related veterinary problems, are not vigorously or effectively pursued. In general, sanitation in Australia is comparable to that found in some of the rural areas of the southern and southwestern sections of the United States.

MEDICAL FACILITIES

Hospitals

Number of Beds. In 1935 there were 526 public (government) hospitals in Australia, with 31,727 beds. At the end of 1937 there were approximately 1,575 private hospitals, but no information is available as to the total number of beds. As a rule, the hospitals are small and have no resident physicians, the patients being attended by their own physicians. There are 35 public hospitals for the insane, with 24,880 beds.

Equipment. The hospitals in the larger cities, and especially those connected with the medical schools in Sydney, Melbourne and Brisbane, compare favorably with teaching hospitals in the United States in equipment, facilities and personnel. Few hospitals in Australia are designed especially for the treatment of a particular disease or for the provision of special services. Private hospitals, as a rule, accept patients who have all kinds of diseases or conditions, whereas large public hospitals have specialized departments, including annexes for the treatment of patients with infectious diseases.

Although information is lacking concerning the equipment of most of the smaller hospitals, a number of them are known to have x-ray plants. Radium is lent to hospitals and clinics by the Commonwealth X-Ray and Radium Laboratory at the University of Melbourne. This laboratory, which also has a well-equipped roentgen-ray plant, produces radon, and in 1938 supplied 48,803 millicuries of radon to hospitals and clinics.

Supplies. There are several small manufacturers of medical equipment in Australia, but it is estimated that fully 95 per cent of all medical and surgical equipment must be imported. Drugs, chemicals and other medical supplies are imported.

Medical Personnel

Physicians. In 1940 approximately 4,000 physicians were practicing in Australia, or about one physician per 1,750 of population (in the United States there was one physician per 1,000 of population). For the most part, physicians in Australia are located in the larger towns; only a few practice in rural districts. This circumstance is due partially to the sparsity of population in the country districts. The deficiency in rural medical care is said to be well compensated for by "flying physicians"; that is, physicians who make rounds by airplane. Sometimes these physicians travel 150 miles or more to see a patient. A license to practice medicine is granted only to a graduate of an Australian medical school or of a university abroad which has similar standards, situated in a country which recognizes Australian medical degrees.

Nurses. In 1937 there were approximately 20,000 nurses in Australia and of this number 12,600 were working in public hospitals.

Medical Institutions

There are four medical colleges in Australia: the University of Sydney Medical School, the University of Adelaide Faculty of Medicine, the University of Melbourne Faculty of Medicine and the University of Queensland Faculty of Medicine. The School of Public Health and Tropical Medicine, established at the University of Sydney in 1930, has been previously mentioned herein. The director of this school is Professor of Preventive Medicine in the University of Sydney.

There are five dental colleges in Australia, but degrees are conferred by only two of them: the University of Sydney and the University of Melbourne.

Laboratories were described earlier in this chapter. The Australian Institute of Anatomy at Canberra was erected in 1930 and became a part of the Commonwealth Department of Health in 1931. Its work is concerned largely with comparative anatomy. The Commonwealth X-Ray and Radium Laboratory is situated at Melbourne.

Two other organizations may be mentioned: the National Health and Medical Research Council and the cancer conferences which are held annually under the sponsorship of the Commonwealth Department of Health. The National Health and Medical Research Council was established in 1936; it advises the national and state governments in matters of health, promotes medical research in Australia and investigates new technics of treatment or programs of disease control.

DISEASES

General Considerations. Death rates in Australia, which for practical purposes are a reflection of the death rates in the more densely populated and temperate regions of Australia, are comparable to those of the United States, indicating that general health conditions are about the same in the two countries. The important diseases subject to quarantine laws—cholera, plague, smallpox, epidemic typhus fever and yellow fever—are not found.

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. The reported incidence of typhoid fever, paratyphoid fevers, amebic dysentery and bacillary dysentery is not very high; however, the diseases do occur sporadically and even small epidemics of typhoid fever are recorded each year. Typhoid fever is found throughout Australia, whereas the incidence of bacillary dysentery is highest in the state of South Australia. As has been mentioned previously, facilities for the disposal of sewage and the treatment of water frequently are lacking, so that there is constant danger of contamination of water supplies with the causative organisms of one or more of these diseases. This point is illustrated by the fact that outbreaks of diarrhea which follow heavy rains are regarded in some cities as only a normal sequence of events. Almost invariably these epidemics have occurred as results of the drinking of water that was highly polluted with organic matter. The prevalence of flies and the absence of adequate screening are factors contributing to the spread of enteric diseases and not infrequently epidemics are traceable to the large number of flies. Diarrhea of chemical origin, due to the use of water with a high mineral content, is of frequent occurrence in a large part of Northern Territory and the state of Queensland.

Cholera. Cholera never has been successfully introduced into Australia; however, in these days of rapid transportation by sea and air, the danger of its introduction from areas in the Far East in which it is endemic and epidemic, cannot be disregarded.

Helminthiasis. HYDATID DISEASE. The statement has been made that hydatid disease is more extensive in Australia than in any other country in the world. This disease develops in dogs as the result of their eating mutton or offal contaminated with *Echinococcus granulosus.* In turn, man becomes infected with the hydatid cysts by the ingestion of water or vegetables polluted by infected feces of dogs. Man also can become infected by the fondling of infected dogs, by which action eggs gain access to the human mouth. In the western district of the state of Victoria and the south and southwestern districts of New South Wales, hydatid ova have been found in 30 to 40 per cent of the dogs examined, but hydatid disease among human beings is uncommon. This disease could be completely stamped out by the exercise of proper control of dogs and by careful destruction of offal.

INFECTION WITH TAPEWORMS. Although the rate actually is not very high, infections with the beef tapeworm (*Taenia saginata*) are much more common than are infections with the pork tapeworm (*Taenia solium*). Infection with the dwarf tapeworm (*Hymenolepis nana*) in Australia is relatively asymptomatic, and ordinarily the discovery of infection by this minute tapeworm is an incidental laboratory finding. Infection with these worms has been reported from all parts of Australia excepting Northern Territory, but it is most common in the state of Queensland and especially in the southern part where in some localities as much as 14 per cent of the population harbors this parasite. The mode of infection is believed to be the ingestion of ova in foods contaminated with infected human or rat feces. A few instances of infection with the broad fish tapeworm (*Diphyllobothrium latum*) among human beings have been reported in Queensland and New South Wales, but these cases were believed to have been imported. It is of interest, however, to note that a previously unsuspected focus of infection has been discovered recently in the vicinity of Picton Lakes and Kempsey in New South Wales, where a few dogs were found to be infected by adult worms.

HOOKWORM DISEASE (ANCYLOSTOMIASIS). This disease is found most commonly along the coast of Queensland, the upper part of New South Wales, in Northern Territory and in Western Australia. In some districts (Bathurst Island, for example), almost 100 per cent of the children are infected. The incidence is much higher among the aborigines than among white persons, because, as previously pointed out, aborigines are indiscriminate in the matter of the disposal of human wastes. The soil about the desert water holes frequented by these aborigines is heavily contaminated.

Prior to the inauguration of campaigns against infection with hookworm, about 90 per cent of the aborigines and 20 per cent of white persons in the state of Queensland were infected. In general, these campaigns have materially reduced the incidence of infection with hookworm in many localities, but there are many foci in which the incidence remains high.

Other Helminthous Infections. Among the other types of infection with worms that are encountered in Australia are those caused by the common roundworm (*Ascaris lumbricoides*), the pinworm (*Enterobius vermicularis*), and the whipworm (*Trichuris trichiura*). In Australia the incidence of infection with these worms is about the same as it is in other regions of the world and is not of sufficient importance to warrant special discussion. Paragonimiasis and clonorchiasis do not exist in Australia.

Diseases Spread Chiefly through Respiratory Tract

Acute Communicable Diseases. Diphtheria constitutes one of the greatest problems with which the health department has to contend. In Australia the annual death rate of diphtheria varies between 3 and 4 per 100,000 of population, and is roughly 3 to 4 times higher than the rate for this disease in the United States. Even in the progressive state of South Australia, where the health department is active in the promotion of immunization among the people and where vital statistics are well reported, more cases were reported in 1943 than were reported in the same year in New York City, the population of which is 13 times as great. On the basis of the many articles on this subject in medical and public health publications in Australia, it is apparent that the high incidence of diphtheria and a great number of the deaths are due entirely to the fact that many Australians refuse to recognize the value of immunization and the use of antitoxin. Very recently, however, intense campaigns have been conducted against this disease by the more progressive health departments, and as a result more people have come to recognize the seriousness of the public health aspects of diphtheria and are undergoing immunization. The other common communicable diseases occur with about the same frequency and are of about the same importance as in other temperate climates. A list of these diseases includes the following: influenza, pneumonia, whooping cough, measles, scarlet fever, acute rheumatic fever, cerebrospinal meningitis, encephalitis lethargica, anterior poliomyelitis and tuberculosis.

Psittacosis. As previously mentioned, psittacosis has been found in each important bird of the family Psittacidae in Australia. In spite of the prevalence of this disease among birds, it is uncommon among human beings.

Diseases Spread Chiefly by Contact

Venereal Diseases. Australia has made much progress in the control of venereal diseases. Information concerning the nature and seriousness of these diseases is presented to the public in a manner much more open than that employed in the United States. Because of the sparsity of the population in the rural districts, prostitution, as such, is most likely to be found only in the larger villages, towns and in the cities. The aborigines are promiscuous, however, and a high rate of venereal disease is to be expected among the native women. Syphilis and gonorrhea are the common venereal diseases, whereas chancroid and lymphogranuloma venereum occur infrequently.

Yaws. This disease is sparsely distributed among the aborigines along the coast of the northern part of Australia.

Leprosy. Leprosy is endemic among the aborigines in parts of Queensland, particularly in the vicinity of Cairns and Rockingham, but the disease appears in scattered spots as far south as Brisbane. Leprosy is common along the northern coast from the northwestern part of Western Australia to the Cape York Peninsula.

Leptospirosis. In 1934 leptospirosis was proved to occur in Australia. Since that time four pathogenically and serologically distinct types of Leptospira have been isolated. They are *Leptospira australis A*, *L. australis B*, *L. icterohaemorrhagiae* and *L. pomona*. Up until 1939 only about 150 cases of the disease had been reported, but health authorities in Australia considered it probable that the incidence is very much higher than this figure would indicate. This is particularly true of leptospirosis caused by *L. pomona,* which is a mild disease of short duration and which frequently has been confused with influenza, dengue fever, or Q fever. *L. australis A* and *L. australis B* are known to occur only in the sugar-growing coastal belt of Queensland, between 16 and 19° of south latitude. These organisms usually cause a severe infection; in general the clinical picture and course are similar to that of infection with *L. icterohaemorrhagiae,* or classic Weil's disease. The organisms are carried principally in the native rat (*Rattus culmorum*), although the black rat (*Rattus rattus*) also is a carrier. The organisms also have been detected in bandicoots (native marsupials). In the regions of northern Queensland in which the disease is endemic, approximately 10 per cent of the native rats (*Rattus culmorum*) have been found to be carriers of *Leptospira australis A* and *L. australis B*. This disease is primarily a disease of canecutters and dairy farmers, and although the actual mode of infection remains unsettled, it is believed that affected persons become infected as the result of the contamination of minute abrasions inflicted by cane "trash" (dried leaves and stalks) which have been soiled by the urine of infected rats.

Infections caused by *Leptospira icterohaemorrhagiae* also exist in the northern part of Queensland. This particular organism is not an important infecting agent, and only a very few cases of classic Weil's disease have been reported. Isolated instances of Weil's disease have occurred among workers in the sewers of Brisbane, and the disease has attacked a worker at the fish market in Melbourne. *Leptospira icterohaemorrhagiae* has been found only in the imported brown rat (*Rattus norvegicus*). Six per cent of the brown rats in Brisbane have been found to be carriers of this species of Leptospira.

Leptospirosis caused by *L. pomona* is the most common type of leptospirosis in Australia. The disease is known to be endemic in the coastal region of Queensland and in the northern section of New South Wales between 25 and 30° of south latitude. As mentioned above, *L. pomona* causes an illness that is much milder than that caused by other species of Leptospira and that in the past has been mistaken for influenza, dengue fever or Q fever. The onset of the disease is sudden, accompanied by headache and muscular pains. The fever lasts from three to 12 days, the average duration being about seven days. Prostration is always a feature, and conjunctival congestion is usual. Jaundice does not occur, and in a small percentage of cases a rash has been observed on about the fourth day of the illness. Convalescence is uneventful, and in no cases has the illness ended fatally. The native hosts of *L. pomona* have not been definitely established, but there is evidence which suggests strongly that pigs and possibly calves act as carriers of causative organisms. Results of micro-agglutinin tests of the serum of pigs killed at the Brisbane abattoirs disclosed evidence of infection in 41.5 per cent of the animals examined. On direct examination of the kidneys of freshly killed pigs *Leptospira pomona* was demonstrated in 4 per cent of the specimens. This form of leptospirosis is primarily a disease of dairy farmers; it is probable that infection occurs as a result of the victim's coming in contact with water that is contaminated by infected pig urine. This contention is in part substantiated by the fact that leptospirosis caused by *Leptospira pomona* is most commonly observed during the wet season, from December to April.

Diseases of the Eyes. An "epidemic ophthalmia" of obscure etiology is widespread throughout the tablelands of New South Wales. Various forms of this disease are common among the aborigines of tropical Australia; during the months of October and November and again in February and March, the spring and autumn, the disease assumes epidemic proportions. The bush fly has been incriminated as the chief agent responsible for the spread of this disease.

TRACHOMA. Trachoma (sandy blight) is limited in its distribution to the western plains of New South Wales, especially in the basin of the Darling River, where sand and dust, heat and flies accompany the regular summer weather. The disease is said to be especially prevalent at Mungindi, Louth, White Cliffs, Torrowangee, and Milparinka. "Epidemic ophthalmia" is unrelated to trachoma. Although the former disease may spread into areas in which trachoma is present the two diseases have, for the most part, different geographic distribution.

Skin Infections. In southern Australia the diseases of the skin are of the types that usually are encountered in temperate climates. However, in tropical Australia mycotic (fungous) infections are of common occurrence, especially ringworm of the hands, feet and nails; dhobie itch; and pityriasis. Scabies is extremely common among the aborigines. Creeping eruption (caused by parasitic larvae) is fairly common in the state of Queensland, where the larva of the dog and cat hookworm is the common causative agent. In the arid tropical and subtropical regions of the central desert in Australia Barcoo rot is common among the teamsters, sheepshearers and other outdoor workers, particularly those whose occupations bring them into close contact with horses and cattle. The etiology of this disease of the skin is not known. The lesions, however, are infectious from person to person and from area to area by contiguity or by scratching; apparently inoculation can occur only when the skin is broken. Flies are believed to serve as mechanical carriers of this disease and to be partly responsible for its spread. In the tropical and subtropical parts of Australia prickly heat is not uncommon and frequently is a very annoying affliction. The almost unbearable itching that is associated with prickly heat excites patients to scratch; secondary infections of the lesions caused by such scratching are not uncommon.

Schistosomiasis. After the World War of 1914-1918, a number of Australian soldiers who had acquired bilharziasis (infection with *Schistosoma haematobium*) in Egypt returned to Australia. It was learned later that certain Australian snails were capable of acting as the intermediary hosts of this fluke, and for a time it was feared that the disease might become established in the western part of Australia. At present it is believed that the disease has been stamped out, but the fact that a natural host exists in Australia creates a situation that requires vigilance on the part of public health officials.

DISEASES SPREAD BY ARTHROPODS

Malaria. Malaria is considered to be endemic in tropical Australia. Cilento in 1940 said that malaria was only slightly endemic, with sporadic spread and occasional rare epidemicity, in the Fitzroy and Ord valleys of Western Australia. In the coastal reaches, he wrote, the disease proceeded to the north, and from Wave Hill, near the border of Western Australia and the Northern Territory, north of a line running diagonally to the mouth of the Roper River. From that point the disease was distributed along the coastal fringes of the Gulf of Carpentaria south and east to enter the Queensland area, from which it continued along the shores of the Gulf to the Staaten River. Near that river, he pointed out, malaria seemed to be particularly prevalent. It was widespread in Badu, Boigu and Saibai of the Torres Islands, was not found on Thursday Island, and was found to a minor degree in the remaining islands of the Torres Straits. It occurred along the eastern coast of the Cape York Peninsula to the Lockhart River Mission; inland it was present beyond the town of

Laura. Malaria was found in the Parramatta and Malaytown areas of Cairns, and in the vicinity of the Yarrabah Mission Station on Trinity Bay. Cases were reported rarely from places as far to the south as Mourilyan Harbor.

Indigenous malaria south of the Cape York Peninsula in Queensland is a sporadic disease of comparatively rare occurrence. The statement frequently is made that malaria does not occur in latitudes farther south than about 23°, but locally acquired infections have been reported in the state of New South Wales. Each year a few cases of malaria are reported from the states of South Australia and Victoria, but these cases are believed to represent imported infections.

Anopheles punctulatus punctulatus and *A. punctulatus moluccensis* are generally thought to be the principal vectors of malaria in Australia, although *A. annulipes* and *A. bancroftii* possibly are of importance in a few localities.

Filariasis. *Wuchereria bancrofti* infections occur along the east coast of Australia to as far south as 30°. In some areas from 3 to 5 per cent of the population suffer from this disease, but for the most part the incidence of the disease is decreasing. In the past the principal centers in which filariasis is endemic have been the Cairns district, Townsville, Ingham, Bowen, Proserpine, Ayr, Rockhampton, Mackay, Brisbane, Ipswich and other smaller intermediate towns on the coast of Queensland and inland to the coastal ranges. The chief vector of filariasis is the domestic mosquito, *Culex fatigans* (*quinquefasciatus*), which bites at night. Other mosquitoes that have been identified as vectors of filariasis include *C. annulirostris* and *C. sitiens.*

Dengue Fever. Dengue fever is endemic throughout the Austral-Pacific region. In Australia this disease is endemic in Queensland, Northern Territory, the northern part of Western Australia, and in the northern rivers of New South Wales to as far south as the town of Bourke. Dengue fever also is endemic in Thursday Island off the Cape York Peninsula, in Townsville in Queensland, and in Papua and other parts of New Guinea. At intervals of about 10 years dengue fever assumes epidemic proportions and spreads from centers in which it is endemic to the rest of eastern and northern Australia. Dengue fever is primarily an urban disease; during the extensive epidemics almost the whole civilian population of a place may be attacked within a few weeks. At times the number involved is so great that the economic life of whole communities is completely disrupted. The most recent epidemics occurred in the northern part of Australia between March and November of 1942; in some localities as much as 75 to 80 per cent of the population suffered from the disease. The factors which govern the distribution of dengue fever in Australia are the distribution of the mosquito host and the number of nonimmune persons present. *Aedes aegypti* is the vector, and its distribution greatly exceeds the distribution of the disease. On the western coast, *Aedes aegypti* has been found as far south as Geraldton in the state of Western Australia and since 1926 has extended as far south on the east as Sydney, Liverpool, Bathurst, Junee and Narrandera in the state of New South Wales. *Aedes albopictus* is the vector of dengue fever in the Philippine Islands and other Pacific islands. Although this mosquito is found in the northern part of Australia, it is rare and of no practical importance as a local vector of dengue fever.

Yellow Fever. Yellow fever remains confined to the African and South American continents and never has invaded Australia, Asia or the Pacific islands. A potential danger exists in respect to Australia, however, in that the principal mosquito vector of urban yellow fever, the *Aedes aegypti* mosquito, is widely distributed. If infected mosquitoes or human beings should be introduced into Australia, the disease might become rapidly and widely distributed throughout the nonimmune population of this entire region.

Typhus Group of Fevers. In Australia the term "epidemic typhus fever" is used to include not only the classical louse-borne form, but also its closely related forms, such as Brill's disease, tabardillo and endemic typhus fever (murine typhus fever). Under "endemic typhus fever" are included the tick-borne and mite-borne rickettsial diseases such as Rocky Mountain spotted fever, tsutsugamushi disease, Sumatran mite typhus fever, tropical typhus fever, and scrub typhus fever. This terminology is widely used and understood in Australia.

EPIDEMIC OR LOUSE-BORNE TYPHUS FEVER. This classical form of typhus fever, caused by *Rickettsia prowazeki,* has not appeared in Australia since the early days of colonial settlement.

ENDEMIC OR FLEA-BORNE TYPHUS FEVER. In Australia this form of typhus fever, caused by *Rickettsia mooseri,* is called "Brill's disease." It is endemic in many cities in Queensland, in the city of Adelaide in South Australia, and in the city of Perth in Western Australia. This disease is primarily urban in distribution and is especially common in seaports, particularly those of the state of Queensland. The rat flea, *Xenopsylla cheopis,* is the vector of the disease and is widely distributed throughout the country. The fatality rate associated with this disease is less than 2 per cent in Australia.

SCRUB OR MITE TYPHUS FEVER. This form of typhus fever appears to be closely related to, if indeed it is not identical with, Sumatran mite fever, Malayan scrub typhus fever, tropical typhus fever and tsutsugamushi disease, because the serum of patients who have the disease agglutinates *Proteus vulgaris,* type OXK. In Australia scrub or mite typhus fever occurs in the northern part of Queensland and at scattered points along the eastern coast to as far south as the city of Sydney in New South Wales. The etiologic agent is, or is closely related to, *Rickettsia orientalis.* This disease is transmitted to human beings by the bite of infected larval mites of the genus Trombicula. In Japan *Trombicula akamushi* transmits the disease; *T. deliensis* is the vector in Sumatra and Malaya; and in New Guinea it is a type of *T. hirsti.* In the northern part of Australia the vector has not been definitely established, but mites similar to those which spread the disease are common and it is suspected that a local variety of *T. hirsti* is the vector. The reservoir of the infection has not been definitely determined, but it is strongly suspected that field rodents or bandicoots or other marsupials are normal hosts for the mite vectors of scrub typhus fever. This form of typhus fever is largely an occupational disease, and occurs most frequently among people who work in the rank grass and thick scrub of the cane fields, in the timber, along roads and in opening up and clearing new ground. In areas in which the disease is endemic the incidence has been lowered by clearing the scrub and keeping down the rank grass as well as by the wearing of miteproof clothing and the use of mite repellents.

The incubation period of scrub typhus fever is from 4 to 21 days. In general, the clinical course and features of the disease are similar to those of murine typhus fever. The death rate varies considerably in different localities; in the northern part of Queensland it is only 6 per cent, whereas in Japan it is as high as 60 per cent.

Q Fever. In 1935 an obscure and previously undescribed illness was discovered among farm workers who were employed in abattoirs at Brisbane and Gympie in the state of Queensland. The disease occasionally occurred farther inland. Results of subsequent studies suggest that the distribution of Q fever is much wider than it originally appeared. Investigation disclosed that this disease, which was provisionally named "Q fever," is a rickettsial disease which is distinctly different from other rickettsial diseases in that the serum of patients who have Q fever does not provoke agglutination of any known strain of *Proteus vulgaris*. Nor can agglutination be caused by the use of serum from patients who have other types of rickettsial infection. The causative organism was named *Rickettsia burneti*. Results of subsequent investigations have revealed that a tick, *Haemaphysalis humerosa*, is the vector of the disease and that a species of bandicoot, *Isoodon torosus*, is the natural reservoir. The clinical features of the disease are not particularly characteristic, and the important points in the arrival at the clinical diagnosis are a history of the patient's being an abattoir or farm worker, an acute onset with the temperature increasing rapidly to 102 to 104° F. (38.8 to 40° C.) and remaining high, severe headache, photophobia, a comparatively slow pulse and the absence of other diagnostic signs. There are, as a rule, no rash, no splenomegaly, no diarrhea and no respiratory signs. Ordinarily, the illness lasts from 6 to 10 days and convalescence is complete within from 14 to 41 days from the onset of the illness. Occasionally, the illness and convalescence are more protracted than this. The specific diagnosis is based on the results of inoculation of immune and nonimmune guinea-pigs with blood and urine from the patient, as well as by the results of Burnet's agglutination test in which a pure culture of *Rickettsia burneti* is employed. The prognosis for young people is very good, but among older people the disease tends to be more severe. The fatality rate is between 1 and 2 per cent.

Plague. Plague occurred in Australia during the great pandemics of the past. The last epidemic in Australia occurred in 1921 and 1922 along the seaboard of the states of Queensland and New South Wales. The disease is of importance in this particular region because of the fact that it is endemic or potentially so in China, India, Java, New Caledonia and other Pacific islands. Under circumstances which are favorable to the flea and rat which spread plague, the disease spreads with the greatest ease, especially wherever there are filth and overcrowding. In addition to rats, there are certain other animals in Australia that can become infected with plague. These are wallabies, wallaroos and certain other species of kangaroo. They could serve as a reservoir of the disease.

Relapsing Fever. This disease has been reported from every continent excepting Australia. Both the louse (*Pediculus corporis*) and the tick (*Ornithodorus talaje*) vectors of relapsing fever, are found in Australia and are capable of transmitting the disease if it should be introduced.

Leishmaniasis. Neither cutaneous nor visceral leishmaniasis is present and so far as is known, species of Phlebotomus capable of carrying this disease are not present. Cutaneous leishmaniasis (Oriental sore) is not present in the northern part of Queensland, although its presence there has been suggested.

SUMMARY

The Department of Health of the Commonwealth of Australia co-ordinates the work of the individual state departments of health, the latter being responsible for prevention and measures of control. The southern portion of Australia is one of the greatest food-producing areas of the world. The northern portion is dependent upon the south for most foods. Local hospital facilities usually are good; but even in urban communities they do not exceed the needs of the local population. The greater part of medical supplies, drugs and chemicals must be imported. Water is plentiful along most of the coast line, being taken from rivers, deep wells and collections of surface water; the hinterland and the central part of the southern coast are dry and arid, with only occasional springs and wells. In the north water usually is untreated, and the purity of the supply depends upon either the maintenance of uninhabited and uncontaminated watersheds, or the use of water from deep wells. The same is true in all the

southern sections except for the larger cities, which have facilities for filtration or chlorination. Methods of disposal of sewage are primitive (consisting of either the use of pit privies or the collection of night soil) excepting in the larger cities and towns, in which local (sedimentation) plants for the disposal of sewage are found.

Death rates in Australia are comparable to those in the United States. The important diseases subject to quarantine laws, such as cholera, plague, epidemic typhus fever, and yellow fever, are not found. A list of the diseases that are of special importance includes the following: malaria, dengue fever, mite typhus fever, Q fever, Brill's disease, typhoid fever, paratyphoid fevers, bacillary dysentery, amebic dysentery, venereal diseases, fungous infections of the skin and the acute communicable diseases, especially diphtheria. Leptospirosis, filariasis and various infections with worms (particularly ancylostomiasis and echinococcosis) are of occasional importance. In addition to the diseases mentioned, yaws, leprosy, trachoma and an "epidemic ophthalmia" of obscure etiology are of importance to the aborigines.

BIBLIOGRAPHY

Australia. Bureau of Census and Statistics: Demography, 1939. Canberra, Govt. Print., [1941] (Bull. No. 57).

——. ——: Official Year-Book, No. 32, 1939. Canberra, 1939.

——. ——: (Tasmania Branch) Statistics of Tasmania. Pt. 3. Vital and Meteorological, 1940. Tasmania, Govt. Print. [1941].

——. Department of Health: Health Organization in Australian Ports. Canberra, Govt. Print. [1928?] (Service Publication No. 39).

——. Parliament: Report on the Administration of the Northern Territory for the Year 1939-40. Canberra, Govt. Print., 1941.

——. ——: Report of the Board of Inquiry Appointed to Inquire into the Land and Land Industries of the Northern Territory of Australia. Dated 10th October, 1937. Canberra, Govt. Print., 1937.

Burnet, F. M.: Psittacosis in Australia. Proc. Pacific Sc. Congr. 1939, 6th Congr., **5**:349-352, 1942.

Cilento, R. W.: Filariasis with Especial Reference to Australia and Its Dependencies. Melbourne, Govt. Print. [1924]. (Australia, Department of Health Service Publication (Tropical Division) No. 4.)

——: Malaria, with Special Reference to Australia and Its Dependencies. Melbourne, Govt. Print. [1924]. (Australia, Department of Health Service Publication (Tropical Division) No. 3.)

——: Tropical Diseases in Australasia. Brisbane, W. R. Smith & Paterson, Ltd., 1940.

——: The White Man in the Tropics, with Especial Reference to Australia and Its Dependencies. Melbourne, Govt. Print., 1925. (Australia, Department of Health Service Publication (Tropical Division) No. 7.)

Cilento, R. W., McIntosh, R. D., and Charlton, N. B.: The Diagnosis of Bowel Diseases in Northern Australia. Melbourne, Govt. Print. [1924]. (Australia, Department of Health Service Publication (Tropical Division) No. 5.)

City of Melbourne: Report of Health Committee for the Year Ended 31st December, 1939. Melbourne, 1940.

Cook, C.: The Epidemiology of Leprosy in Australia. Canberra, Govt. Print., 1927. (Australia. Department of Health Service Publication No. 38.)

Cooling, L. E.: The Larval Stages and Biology of the Commoner Species of Australian Mosquitoes, with the Biology of *Aedes pecuniosus* Edwards. Melbourne, Govt. Print. [1924]. (Australia, Department of Health Service Publication (Tropical Division) No. 8.)

——: Seven Common Species of Mosquitoes Described for Purposes of Identification. Melbourne, Govt. Print. [1924]. (Australia, Department of Health Service Publication (Tropical Division) No. 1.)

——: A Synonymic List of the More Important Species of the Culicidae of the Australian Region. Melbourne, Govt. Print. [1924]. (Australia, Department of Health Service Publication (Tropical Division) No. 2.)

Cumpston, J. H. L.: The History of Diphtheria, Scarlet Fever, Measles, and Whooping Cough in Australia. Canberra, Govt. Print., 1927. (Australia, Department of Health Service Publication No. 37.)

——, and McCallum, F.: The History of the Intestinal Infections (and Typhus Fever) in

Australia, 1788-1923. Melbourne, 1927. (Australia, Department of Health Service Publication No. 36.)

Derrick, E. H., and Burnet, F. M.: Q Fever. Proc. Pacific Sc. Congr. 1942, 6. Congr., 5:745-752.

Fielding, J. W.: Australasian Ticks. Melbourne, Govt. Print. [1926]. (Australia, Department of Health Service Publication (Tropical Division) No. 9.)

Gordon, H. M.: Occurrence of Broad Fish Tapeworm of Man and Carnivores in Dogs in Australia. M. J. Australia, **1** (2):47-48 (Jan. 13) 1940.

Gunther, C. E. M.: Endemic Typhus in New Guinea; Its Occurrence and Probable Vector. Proc. Pacific Sc. Congr. 1939, 6. Congr., **5**:715-724, 1942.

Health, Canberra: Vols. 15, 16, 17, 18, 19. 1937-1941.

Johnson, D. W.: Leptospirosis in Australia. Proc. Pacific Sc. Congr. 1939, 6. Congr., **5**:331-336, 1942.

McCallum, F.: International Hygiene; a Review from the Australian Viewpoint of International Activities in the Field of Public Health. Glebe, N. S. Wales, Australasian Medical Publishing Co., 1935. (Australia, Department of Health Service Publication No. 40.)

Murray, R. Elliott: Plumbism and Chronic Nephritis in Young People in Queensland, together with a Method for the Estimation of Lead in Biological Materials. Glebe, N. S. Wales, Australasian Medical Publishing Co., 1939. (Australia, Department of Health Service Publication (School of Public Health and Tropical Medicine) No. 2.)

New South Wales. Government: Statistical Register for 1938-1939. Sydney, N. S. Wales, Govt. Print., 1941.

New South Wales. Parliament: Report of the Director-General of Public Health, New South Wales, for 1939. Sydney, N. S. Wales, Govt. Print., 1940.

Queensland: Annual Report on the Health and Medical Services of the State of Queensland for the Year 1938-39. Brisbane, Govt. Print., 1939.

——: Statistics for the Year 1937-38. Brisbane, Govt. Print., 1938.

——: Government Statistician. Yearbook, 1940 (No. 4). Brisbane, Govt. Print., 1940.

Statesman's Year-Book. London. The Macmillan Co., Ltd., 1943.

Sundstroem, E. S.: A Summary of Some Studies in Tropical Acclimatisation. Melbourne, Govt. Print., 1924. (Australia, Department of Health Service Publication (Tropical Division) No. 6.)

Sutton, H.: Geographic Incidence of Disease in Australia. Australian Geographer, **2** (2):3-10, 1933.

Tasmania. Department of Public Health: Annual Reports for 1931-1939. Hobart, Govt. Print., 1932-1940.

Taylor, F. H.: A Check List of the Culicidae of the Australian Region. Glebe, N. S. Wales, Australasian Medical Publishing Co., 1934. (Australia, Department of Health Service Publication (School of Public Health and Tropical Medicine) No. 1.)

Victoria, Australia. Department of Public Health. Health Bulletin, Nos. 37-56, 1934-1938; Nos. 57-60, 1939; Nos. 61-64, 1940.

Victorian Year-Book, 1938-39. 59th Issue. Melbourne, Govt. Print., 1940.

Western Australia: Statistical Register of Western Australia for 1938-39 and Previous Years. Perth, Govt. Print., 1939-1941.

——: Public Health Department. Report of the Public Health Department for the Years 1937 and 1938. Perth, Govt. Print., 1939.

13

Cook Islands and Niue Island

GEOGRAPHY AND CLIMATE

The Cook Islands and Niue Island were made part of the Dominion of New Zealand by annexation. They are situated in the southern part of the Pacific Ocean between 8 and 23° of south longitude and 156 and 170° of west longitude. It is usual to divide the Cook Islands into two groups: a southern chain of eight volcanic islands which includes the principal island, Rarotonga; and the northern chain of seven typical coral atolls which are from 300 to 900 miles north of Rarotonga. Niue Island is situated almost on the meridian of 170° of west longitude about 600 miles west of the Cook Islands and 300 miles east of the Tonga Islands. It is believed that the Cook Islands and Niue Island have an area of about 200 square miles, in which some 17,000 persons live. Niue Island alone, with an area of about 100 square miles, has a population of 4,000. Rarotonga, largest of the Cook Islands, has an area of 22 square miles and a population of about 5,000. Most of the islanders are Polynesians.

Physically, the Cook Islands and Niue Island are of both coralline and volcanic origin. The island of Rarotonga in particular has great peaks ranging from 2,000 to 2,300 feet in elevation, with sloping aspects and fertile valleys in the central part of the island. The island of Mangaia is characterized by a circuitous coral cliff which rises to a height of 100 feet and is topped by low hills which slope to form a swampy basin in the center of the island. The physical structure of Atiu Island is somewhat like that of Mangaia, excepting that it has an elevation of about 300 feet. The coralline atolls to the north are not featured by elevated configurations, and few are inhabited. Niue Island has the general form of two terraces: the upper is about 200 feet high and the lower is perhaps 90 feet high. The central forested region of Niue Island is almost inaccessible.

The hydrographic features of the Cook Islands and Niue Island are not notable. Rarotonga has numerous streams, as have Mangaia, Atiu and Rakahanga; but Niue Island is so destitute of natural supplies of fresh water that rain water must be collected in catchment basins.

In the northern part of the Cook Islands equatorial climate prevails. On Rarotonga during the summer season (November through March) the average diurnal temperature is 84° F. (28.8° C.), and that at night is about 74° F. (23.3° C.). The cool season on Rarotonga is from April through October; at this time the temperature is about 8° F. (4.4° C.) less than during the summer season. On Niue Island the maximal temperature is 94° F. (34.4° C.) and the minimal temperature is 60° F. (15.6° C.), with an average temperature of about 77° F. (25° C.). It is said that the climate of Mangaia Island is the most healthful. Rainfall throughout the Cook Islands and Niue Island is not excessive, but the relative humidity often is great. It has been as high as 92 per cent during the rainy season of from December through February. On Rarotonga the average annual rainfall is 78 inches (2 meters). On Niue Island it is 82 inches (2.1 meters). The southern portion of the Cook Islands is situated in what is known as a "hurricane belt," and Niue Island is located on the edge of this belt.

PUBLIC HEALTH

Health Services

Organization. Under the provision of the Cook Islands Act of 1915, it is the duty of the administration to provide gratuitously all natives with such medical and surgical aid and assistance as is practicable. The headquarters of the medical and public health services are located at Rarotonga, and these services are administered by the Chief Medical Officer, who is assisted by a small European staff and native medical practitioners. The principal functions of the medical and public health services are to: (1) provide medical and surgical services, (2) maintain hospitals and aid stations, (3) carry out preventive measures such as vaccination against smallpox and typhoid fever, isolation of leprous and tuberculous patients, campaigns to promote soil sanitation and initiation of mosquito-control measures for the suppression of filariasis, (4) assist in the provision of training for native nurses and native medical practitioners, (5) reduce infant mortality by means of the promotion of child welfare, (6) enforce quarantine regulations—individual, port and island—and to control epidemic diseases, (7) govern the sanitary inspection of houses, public buildings and villages, (8) make dental service available on Rarotonga and the outer group of islands, (9) extend water supplies, (10) initiate legislation for the protection of public health and (11) compile vital statistics.

The majority of the medical personnel, both white and native, have been stationed at the administrative headquarters at Rarotonga, but during recent years a white nurse has been stationed at Aitutaki; native nurses have been stationed at Atiu and Mauke. Native medical practitioners have been stationed at Atiu and Mangaia. The medical personnel stationed at the above points serve the local inhabitants. Those points and other outer islands, however, are visited by the medical officer or the assistant medical officer as often as circumstances will permit.

The district nursing sister, as well as members of the Au Vaine (women's) Committee, assists the medical staff by making regular house-to-house visits on Rarotonga and other islands. Their activities are concerned mainly with cleanliness of homes, the inspection of sanitation and sanitary facilities, water supplies and other activities designed to improve hygienic conditions. They also assist the natives in improvement of their food and plant supplies. On Rarotonga the district nurse assists in these activities and also visits regularly and systematically all schools. In the course of her surveys she both treats and makes recommendations for the treatment of undernourished and diseased children. In the outer islands the white and native nurses and native medical practitioners make surveys of the health and sanitary conditions of both the infant and adult native population. In the outer islands, where resident medical service is not available, the resident agents render medical assistance and supervise sanitation and hygiene. At the administrative headquarters of all the islands of the outer group wireless services are available, and can be employed in the obtaining of medical aid or advice.

Relative Effectiveness. The administration of health and sanitary services in the Cook Islands is complicated by the fact that the numerically inadequate medical staff is required to serve a population of approximately 17,000 which is distributed over a land-and-sea area of some 850,000 square miles. Because of the distances involved, communication by sea is difficult, and during the season of hurricanes (January to March) it is impossible. The medical and public health services are most effectively administered at Rarotonga, but since native medical practitioners and native nurses have been stationed in some of the outer islands considerable improvement in the health and sanitary conditions has occurred throughout the group. This is particularly so in the more densely populated islands of the southern group. The most notable improvements have been made in the matters of soil sanitation, extension of water supplies, reduction of infant mortality and the treatment of yaws.

The organization, scope and effectiveness of the medical and public health services on Niue Island are essentially the same as in the Cook Islands. The major exception to this similarity exists in the administrative authority, which now rests in a resident commissioner who is directly responsible to the New Zealand Minister of External Affairs (responsible for the Mandate of Western Samoa); formerly the resident commissioner was responsible to the Ministry of the Cook Islands.

Water Supplies

With the exception of Rarotonga, where streams are abundant, the islands of the Cook group, as well as Niue Island, are notably lacking in water resources. For the most part, the population is dependent upon rainfall and the erection and maintenance of concrete water tanks for the water supply. Although the concrete water tanks are numerous, they are of small capacity (average, 3,000 to 5,000 gallons). In some localities, however, shallow wells are used, and in a few places there are springs. In the flat coral islands in the northern group droughts are not infrequent, and acute shortages of water develop. On these islands, as well as on other islands, the natives drink the milk from young coconuts.

The catchment basins for water on Rarotonga contain sufficient amounts of fresh water to supply the needs of the island. Water is delivered from the catchment areas through 31½ miles of 6-inch iron water mains to practically all the inhabited areas on the island. The pressure maintained in this system is not known, and other than that the water is reported to have come from safe sources, no information is available concerning the measures employed to assure the safety of the water supplied for human consumption. So far as is known, there are no facilities for the treatment of water on Rarotonga, the other islands of the Cook group or Niue. The sole dependency for the maintenance of a safe water supply is upon keeping sources of the water uncontaminated. To accomplish this, considerable attention is paid to the development and maintenance of water supplies and supply systems, including the erection of new concrete water tanks, the cleaning and re-cementing of old tanks at frequent intervals, the walling and covering of wells, and the repair and installation of new pumps. In spite of these measures, many natives draw water from contaminated water holes, as well as from other unprotected sources, and localized epidemics of enteric diseases are not uncommon. With the possible exception of Rarotonga, where the water supply is believed to be adequate, persons in the Cook Islands and the vicinity must consider both the quantity and the purity of the water as being unacceptable.

Sewage Disposal

No systems in which sewage is waterborne exist in these islands. With the exception of some of the administrative buildings which are equipped with septic tanks, the small white population uses pit latrines; for the native population disposal of sewage is effected by the use of pit latrines and pollution of soil. Formerly, the latter means was almost universally employed, but in 1932 a three-year campaign for soil sanitation was commenced with the co-operation and financial assistance of the Rockefeller Foundation. The purpose of this campaign was to provide flyproof privy accommodations for every public and private building, as well as for market places and other points of public assembly in all the islands of the lower group. Since that year this program has been extended, and at present there is a large number of fairly adequate latrines on most of the islands, including Niue. It is estimated that in the past 10 years about 2,500 latrines have been constructed. The standard type of latrine is of the pit type. It is about 12 feet deep and 3 feet wide, and is covered by a ferroconcrete slab which is surmounted by a ferroconcrete pedestal and provided with a flyproof metal lid. Satisfactory ventilation is maintained by the use of a vertical vent pipe. In the islands subject to the greatest European influence these accommodations have been well accepted by the natives, and in consequence thereof there has been a decrease in the incidence of infection with hookworm and other intestinal parasites or diseases. In spite of this improvement pollution of soil is still practiced, and the incidence of infection with hookworm remains high as compared to that of similar infection in the southern part of the United States.

Insects and Animals

Vectors of Disease. Mosquitoes. There are no anopheline mosquitoes in the Cook Islands or on Niue Island, and malaria does not occur. Three species of Aedes mosquitoes are found in the Cook Island group. They are *Aedes aegypti, A. vexans* and *A. pseudoscutellaris. Aedes aegypti* is distributed throughout all the islands. This mosquito would be of the greatest importance if dengue fever or yellow fever were introduced into this area. *A. vexans* is almost exclusively a pestilential mosquito, but *A. pseudoscutellaris* is known as a vector of filariasis in these islands. It is not a domestic mosquito like *A. aegypti.* It breeds in small collections of fresh water which contain decaying vegetable matter, such as coconut husks and shells, in crevices and holes gnawed by rats, in coco pods, in artificial reservoirs hewn out of coconut trees and in bottles, tins and other receptacles lying about in sheltered spots in the brush. It is extremely intolerant of wind and sun, and is found in the shady, thick brush about native villages. It is a mosquito which bites strictly during the daytime.

Culex fatigans is distributed throughout the islands and is the principal vector of filariasis, particularly in the lower group of islands. It is a domestic species that breeds in water tubs or in dirty or contaminated water such as is found in gutters and septic tanks.

Flies. Flies are common and are serious nuisances on many of the inhabited islands, but information concerning their specific identity is lacking. Presumably, most of them are of the domestic variety and therefore are of importance from the standpoint of being capable of serving as mechanical carriers of the organisms of enteric diseases. The biting gnats (Simuliidae) and midges (Ceratopogonidae) are not known to occur in the Cook Islands or on Niue Island.

Lice. No information is available to indicate the presence or absence of lice on Niue Island or the Cook Islands. In spite of the fact that conditions are not particularly conducive to infestation with lice, it is believed that infestation with head lice (*Pediculus capitis*), body lice (*Pediculus corporis*) and pubic lice (*Phthirus pubis*) is common. No louse-borne diseases have been reported from these islands, but the body louse is a vector of epidemic typhus fever and relapsing fever, and could spread these diseases if they were to be introduced.

Ticks. There are no reports indicating the presence of ticks.

Fleas. The flea of human beings (*Pulex irritans*) and the Oriental rat flea (*Xenopsylla cheopis*) are widely distributed throughout these islands. No flea-borne diseases are known to occur, but the rat flea is capable of serving as the vector of endemic typhus fever and plague.

Rodents. The only rodents that are known to occur on these islands are the domestic rat, *Rattus rattus,* and the native Polynesian rat, *R. exulans.* Both of these rats serve as hosts for the Oriental rat flea. In addition to being destructive, these rats and their ectoparasites are of potential medical importance to man.

Centipedes. Two large centipedes are encountered in this area (*Scolopendra morsi-*

tans and *S. subspinipes*). Although these centipedes are not of great medical importance, their poisonous claws are able to pierce the skin of a victim and cause severe pain, with some swelling at the site of the bite.

Snakes and Other Dangerous Animals. No poisonous snakes or other dangerous animals are reported. Little definite information is available concerning the marine fauna. It is known, however, that sharks occur and that they occasionally attack man. Other dangerous marine fauna include small poisonous reef fish, rays and barracuda.

Pests. With the exception of mosquitoes that are vectors of filariasis, and domestic flies which are capable of serving as mechanical vectors of disease, the insects mentioned previously in this chapter are primarily pestilential.

Food and Dairy Products

Native vegetables and fruits are very plentiful; fruits are produced in a quantity sufficient to permit sizable exports. The Cook Islands Agricultural Department is actively engaged in the promotion of agricultural enterprises and considerable progress has been made in this respect. Fish are available, but with the execption of limited quantities of pork and fowl, most meats must be imported. The dietary habits of the native inhabitants are poor, and deficiency states, particularly those arising from the lack of fresh green vegetables, are commonly observed. Fresh milk is scarce, and no facilities for pasteurization are known to exist. There is a refrigeration plant at Rarotonga, but facilities for the storage and refrigeration of perishable foods are inadequate.

Miscellaneous Problems of Sanitation

Various measures for the control of mosquitoes are employed and consist primarily of the stocking of breeding places with larvivorous fish (Gambusia). To a limited degree, draining and filling are undertaken. Indirectly, the control of *Aedes aegypti* is accomplished by inspection of native habitations and insistence upon suitable standards of sanitation and cleanliness. So far as is known, screening is not common. Vermin such as fleas and flies are controlled to a limited extent by the periodic disinfection of native habitations. Poisoning is the only measure of rat control employed. The regulations applying to the use of flyproof latrines, disposal of refuse, and animal trespass are believed to have reduced materially the menace of flies.

The outstanding problems of sanitation concern disposal of sewage and the extension of water supplies. Considerable progress has been made in respect to both these problems, but gross deficiencies still exist. Other problems in sanitation are created by frequent and destructive hurricanes. The problem of water supply is rendered difficult because of earthquakes which make the erection of large concrete reservoirs impracticable.

MEDICAL FACILITIES

Hospitals

Number of Beds. The only general hospital in the Cook group is at Avarua on Rarotonga. It has accommodations for approximately 40 inpatients. The hospital is up-to-date. On Atiu there is a small cottage hospital with four beds; on Penrhyn there is a small segregation hospital with 12 small houses built of native materials, for leprous patients. These buildings serve as a temporary retention center for leprous patients who are later transferred to the Central Leper Asylum at Makogai, Fiji. On Mangaia the London Missionary Society has built a two-room house behind the dispensary for use as a cottage hospital. On Niue there is a hospital of 20 beds which in 1939 was reported to be well equipped.

Equipment. The general hospital at Avarua has an operating theater, a modern portable x-ray unit, an outpatient clinic, a dispensary, dressing room, consulting room, laboratory and dental clinic. In 1940 an extension was added to the outpatient department to provide additional space for the laboratory and dental clinic and for a storeroom. In 1941 a morgue was added. A small home for nurses is attached to the hospital. On Mangaia the hospital of the London Missionary Society has some equipment, but no x-ray unit. Information is lacking concerning hospitals other than these two.

Medical Personnel

Physicians. All medical personnel in the Cook Islands and on Niue Island are attached to their respective medical and public health services. As is the case elsewhere in the Pacific islands, in the Cook Islands the great medical problem is that of providing medical service on the innumerable islands which are widely separated and which in many cases have very small populations. Gradually, this need is being met by the provision of native medical practitioners.

In the Cook Islands there are two Occidental physicians: the Chief Medical Officer and the Assistant Medical Officer. At Niue there is an Occidental physician who serves in the capacity of Chief Medical Officer. In 1939 there were four native medical practitioners attached to the Cook Islands Administration, and three students were in training at the Central Medical School at Suva, Fiji Islands. In 1941 native medical practitioners were stationed at Mangaia, Atiu, Penrhyn and Rarotonga. Like the medical officers, they visit various islands and administer medical and surgical assistance. There are no native medical practitioners on Niue Island.

Nurses. In 1940 there were three white nurses in the Cook Islands. One of these was stationed at each of the following points: the hospital at Rarotonga, Aitutaki and Mangaia. In addition several native nurses were employed. There was one Occidental nurse and five native nurses on Niue Island.

Dentists. Periodically, a white dental officer is stationed at Rarotonga, and he visits the various islands of the Cook group. In his absence dental care is administered by a female native assistant and a male student. Dental services on Niue Island have been rendered by a dentist from the Western Samoan Administration.

Medical Institutions

Laboratories are operated in conjunction with both administration hospitals. Although it is believed that these laboratories are capable of performing the ordinary clinical, chemical, bacteriologic and pathologic examinations, definite information concerning their facilities is lacking. There is in these islands the Au Vaine Committee, which is a women's committee that assists in the performance of public health and dental services.

Native medical practitioners attend the Central Medical School at Suva in the Fiji Islands for four years, and receive a thorough basic medical training. As the result of this training they are adequately equipped to carry out operative surgery and to practice public health and preventive medicine. The medium of instruction is English, and the native practitioners speak this language fluently.

Native nurses receive their training at the general hospital at Avarua on Rarotonga. In 1940 two natives were taking training at the dental clinic at Apia in Samoa.

DISEASES

General Considerations. Medical conditions in the Cook Islands and on Niue Island are similar to those of other southern Pacific islands which lie east of longitude 170° west. As in the other island groups, these conditions are to a certain degree governed by the geographic factors of great distance and poor communications, the insect fauna and by sociologic and sociomedical factors which have been interjected by white man's civilization. Foremost among the sociomedical factors are the respiratory diseases, such as common colds, influenza, pneumonia, measles, chickenpox, whooping cough and tuberculosis. The enteric diseases, and especially the diarrheas and typhoid fever, formerly took a heavy toll of native lives. The occurrence of these diseases among the nonimmune natives has been associated with high mortality and morbidity rates, and in many instances their destructive effect has been limited only by the geographic factor of distance. In these days of rapid transportation by air and sea, the possibility of the introduction of diseases foreign to these people from other Pacific islands, as well as from other continents, constitutes a serious threat to the health of the people.

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. Typhoid fever and paratyphoid fevers are endemic on Niue Island and in the Cook Islands, especially in Rarotonga and to a lesser extent on the other more densely populated islands of the southern group. In practically all instances, outbreaks of these diseases have been traced to contaminated wells or water holes, or to flies. During recent years improved sanitation, flyproofing of latrines and vaccination against typhoid and paratyphoid fevers have materially reduced the incidence of these diseases. Formerly, bacillary dysentery was common, but during recent years it has been said to be rare. Dysenteries of an unspecified type are, however, reported. As is the case elsewhere throughout this region of the Pacific, in the Cook Islands many of these diarrheas probably are caused by the less severe Flexner type of bacillary dysentery. Infantile and summer diarrheas are common. There are no reports of the occurrence of amebic dysentery.

Cholera. Cholera has not been reported. The possibility of the introduction of this disease is slight, particularly in view of the fact that the majority of the population depend upon collections of rain water for their water supply. In the absence of facilities for the treatment of water and for the adequate disposal of all human excrement, this disease would probably spread widely if it were introduced.

Intestinal Parasitism. Intestinal parasitism, and particularly ascariasis, is common in both the Cook Islands and Niue. Infection with worms is a significant cause of morbidity among the natives, and is of particular importance, inasmuch as the high incidence of the disease is indicative of the degree and extent of pollution of the soil. In 1926 it was said that 90 per cent of the population was infected with hookworm. In 1936 results of a survey of all school children indicated that the incidence of helminthiasis was not more than 57 per cent. The nature of the parasite causing the infection of these children was as follows: (1) Ascaris, 55 per cent, (2) Trichuris, 20 per cent, (3) hookworm, genus not specified, 13 per cent and (4) Enterobius, 3 per cent.

Diseases Spread Chiefly through Respiratory Tract

It is commonly stated that, as a group, the diseases of respiratory origin constitute the most serious menace to the natives. Of greatest importance are common colds, influenza, pneumonia and tuberculosis, all of which are endemic. Epidemics of chickenpox are of frequent occurrence, and occasionally measles and whooping cough occur in epidemic form with disastrous effects among the native population. Diphtheria, scarlet fever and poliomyelitis are said to be unknown in these islands. No reference is made to the occurrence of cerebrospinal meningitis. Smallpox has been effectively controlled by means of mass vaccination. The importance of these diseases among the nonimmune native population cannot be overemphasized.

DISEASES SPREAD CHIEFLY BY CONTACT

Venereal Diseases. It is stated that there is no syphilis among the native population of these islands; but occasional cases are reported among the non-native population and transient persons. Previous reports of the prevalence of syphilis are attributed to the confusion that existed in the differential diagnosis of yaws and syphilis. In view of the fact that there is enough similarity between the two diseases to make the differential diagnosis very difficult in certain cases, the possibility that syphilis does occur and has been overlooked cannot be disregarded. Gonorrhea, on the other hand, is recognized and is widely distributed throughout the islands. The incidence of this disease is high, especially on Rarotonga, Niue and other islands that are visited frequently in the course of interisland commerce. The other venereal diseases (soft chancre, lymphogranuloma venereum and granuloma inguinale) have not been reported in either the Cook Islands or Niue. Commercialized prostitution as such is rare, but indiscriminate sexual indulgence is common. As a result, factors are conducive to the spread of venereal diseases and constitute an exceedingly difficult problem in control. This problem is rendered more difficult because of the tendency of the natives to conceal their illness, as well as the lack of facilities and staff with which to exercise effective control. On Rarotonga and Niue, however, some degree of control is exercised by the use of police and by threats of punishment to bring both parties in for treatment.

Yaws. This once-prevalent disease has been well controlled on Rarotonga, Niue and other islands that have regular medical service. Elsewhere, however, yaws is common, and reports indicate that 50 to 75 per cent of the inhabitants have been infected. This disease, usually contracted in infancy, ordinarily is not a cause of morbidity among Occidentals stationed in areas in which it is endemic.

Leprosy. Except in the northern Cook Islands and especially on Penrhyn, leprosy is not common. Each year a few new patients are detected and are sent as soon as practicable to the segregation hospital on Penrhyn Island and thence to the Central Leper Hospital which is located at Makogai, Fiji.

Diseases of the Skin. Impetigo, scabies and fungous infections are very common among the natives. The fungous infections of the skin, including tinea imbricata, athlete's foot, tinea cruris and similar infections, occur with considerable frequency. Pyogenic infections of the skin, especially boils, carbuncles, abscesses and the secondary infections of wounds, are common. Tropical ulcers are not reported. Although no reference is made to infestation with lice, it is considered likely that head lice (*Pediculus capitis*), body lice (*Pediculus corporis*) and pubic lice (*Phthirus pubis*) are common.

Diseases of the Eyes. "Conjunctivitis" of an unspecified type is common and occurs in epidemic form. It is possible that this disease is related to the severe "epidemic conjunctivitis" of Samoa, which is highly disabling, and at times so intense as to destroy the eye; under certain circumstances the infection spreads to the nasopharynx. The possible relationship of the conjunctivitis that occurs on Niue to that which occurs in Samoa is made more likely, since Niue maintains contact and communication with the Western Samoan Administration. It is also possible that this disease may be the keratoconjunctivitis which is known to have occurred during recent years in other parts of the south and central Pacific.

Tetanus. Several cases of tetanus are reported each year.

Leptospirosis. Leptospirosis has not been reported among either rats or human beings on these islands.

Diseases Spread by Arthropods

Malaria. Malaria is unknown in these islands, and no anopheline mosquitoes are present. In these days of rapid transportation by air and sea the possibility of the introduction of malaria or the anopheline vectors of the disease constitutes a potential danger to the population of these islands, as well as to visitors.

Filariasis. Filariasis caused by *Wuchereria bancrofti* is generally prevalent among the islands. *Aedes pseudoscutellaris* and *Culex fatigans* are vectors of this disease. In the lower Cook Islands *Culex fatigans* is the principal vector. Results of recent studies indicate that 34 per cent of the population is infected. The disease is more common in the lower group than in the northern group or at Niue. On Rarotonga in 1936 results of a survey indicated the rate of infection to be 62 per cent. The filariasis is of the nonperiodic type, and hydroceles, abscesses and elephantiasis are seen frequently. Except for the breeding of larvivorous fish (Gambusia), and a limited amount of draining and filling, no measures of mosquito control are employed. At present, larvivorous fish are distributed throughout most of the islands, but particularly those of the lower group.

Dengue Fever. There are no reports of the occurrence of dengue fever in either the Cook Islands or Niue. The disease, however, is known to be endemic in the adjacent groups of islands; namely, the Society Islands and Samoa. The vector of this disease, *Aedes aegypti*, abounds throughout the islands. If the virus of the disease should be introduced, it would be of importance because of the suddenness with which it strikes and temporarily incapacitates large numbers of nonimmune persons.

Yellow Fever. The mosquito vector of yellow fever is the same as that of dengue fever; namely, *Aedes aegypti*. Yellow fever has never been reported in this area, but the presence of its vector would expose these islands to epidemics of the disease if infected mosquitoes and human beings were introduced. At present this danger is slight, but will be increased if regulations concerning the inspection and disinfection of aircraft arriving from endemic regions in South America are not strictly enforced.

Typhus Fever. Epidemic typhus fever, endemic typhus fever and tropical or mite-borne typhus fever have not been reported from these islands. The flea vector of endemic typhus fever is known to be present; although there are no reports of the presence of the louse vector of epidemic typhus fever or the mite vector of tropical typhus fever, it is believed that both these vectors may be encountered in this area.

Plague. There are no reports of the presence of plague in these islands. The disease does exist in the Hawaiian Islands, New Caledonia and on the continent of Asia. If plague should be introduced from these areas the large rat and flea population of the Cook Islands and Niue Island would constitute a formidable reservoir from which these diseases could spread.

Miscellaneous

Rheumatic Diseases. Rheumatic (infectious) arthritis and rheumatic fever are commonly observed among both the native and non-native population.

SUMMARY

Although numerically deficient in personnel and therefore functionally inadequate, the organization of the medical and public health service of both Niue Island and the Cook Islands is well suited to the needs of the population. There are no facilities for the treatment of water, and, except on Rarotonga, surface water is scarce. The greater part of the population is dependent upon collections of rain water. There are no sewerage systems, but all the more populated islands are adequately provided with entirely acceptable flyproof pit latrines. A significant portion of the native population still practices pollution of the soil, and contamination of water is not infrequent. Mosquitoes, flies, fleas and rats are the principal pests. There are no anopheline mosquitoes, and there is no malaria. Mosquitoes that are present are important as vectors of filariasis. The food supplies and dietary habits of the natives frequently are inadequate, and minor deficiency states are common. Hospital facilities are inadequate, and are not readily available to the majority of the population. Medical personnel is numerically inadequate to serve the needs of the native inhabitants in this area. There are a few well-trained English-speaking native medical practitioners in the Cook Islands, and they are valuable additions to the medical staff because they are well acquainted with native customs.

The diseases of greatest importance to Occidentals in this area are typhoid and paratyphoid fevers; diarrheal diseases; gonorrhea; respiratory diseases and particularly common colds, influenza, pneumonia and chickenpox; dermatologic conditions, including impetigo, scabies, boils, secondary infections of wounds and fungous infections; filariasis; rheumatic arthritis; and rheumatic fever. It is possible that the conjunctivitis found in the Cook Islands is related to the highly disabling type of conjunctivitis found in Samoa. Yaws is fairly common. The incidence of infection with hookworm is high.

BIBLIOGRAPHY

Beaglehole, E., and Beaglehole, P.: Ethnology of Pukapuka. Honolulu, The Museum, 1938. (Bernice P. Bishop Museum Bull. 150.)

Buxton, P. A.: Researches in Polynesia and Melanesia. Pts. V-VII. (Relating to Human Diseases and Welfare.) London, The London School of Hygiene and Tropical Medicine, 1928. (Memoir Ser. No. 2.)

——, and Hopkins, G. H. E.: Researches in Polynesia and Melanesia. Pts. I-IV. (Relating Principally to Medical Entomology.) London, The London School of Hygiene and Tropical Medicine, 1927.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, The Museum, 1934. (Bernice P. Bishop Museum. Special Publication 23.)

——: Health Survey of the Cook Islands, with Special Reference to Hookworm Disease. Cook and Other Islands, Annual Report. Wellington, N. Z., Govt. Print., 1926.

Lambert, S. M.: Yaws Incidence in South Pacific. J. Trop. Med. **34**:117-122 (May 1) 1931.

Larsen, A. E.: Some Medical Observations in the Pacific Islands and Dutch East Indies. California and West. Med., **40**:413-417 (June) 1934.

New Zealand. Cook and Other Islands (Annual Report). Wellington, N. Z., Govt. Print., 1926-1933.

——. Census and Statistics Department. Official Year-Book. Wellington, N. Z., Govt. Print., 1942.

——. General Assembly: Report of the Cook Islands Administration (Annual Report). Wellington, N. Z., Govt. Print., 1934-1941.

U. S. Bureau of Foreign and Domestic Commerce (Dept. of Commerce): World Trade in Dental and Surgical Goods. Washington, D. C., U. S. Govt. Print. Off., 1939.

14

Easter Island

GEOGRAPHY AND CLIMATE

Easter Island, owned by the Republic of Chile, is situated at approximately 27° of south latitude and 109° of west longitude. It is 2,000 miles west of Chile and some 3,000 miles southeast of Tahiti. The triangular island has an area of about 45 square miles, in which about 450 natives live, chiefly at the settlement of Hanga Roa. The language, physical characteristics and traditions of these people would appear to link them to the Polynesians, although Melanesian traits and features have been observed. When the island was discovered in 1722 the inhabitants numbered 3,000 or more.

The island is of volcanic origin. The craters of extinct volcanoes are to be seen in all parts of the region, and in some places the volcanic structure rises to an elevation of fully 1,700 feet. Cliffs which occasionally are 1,000 feet high line parts of the coast, but in the eastern and western sections the coast ascends in grassy slopes and rolling hills.

Easter Island is barren of surface streams, but rain water collects in some of the craters and sometimes penetrates the porous soil to flow in subterranean channels. Near the coast line this water may emerge in streamlets.

The climate is subtropical. Some have called it almost perfect. In midsummer the temperature ranges between 78 and 80° F. (25.5 and 26.6° C.), but it is said that the island is agreeably warm throughout the year. Rainfall is abundant from April through October; in the summer precipitation is confined to passing showers. Southeastern trade winds prevail at the beginning and end of the summer season.

PUBLIC HEALTH

Health Services

No public health system or service exists on Easter Island, and there are no government, religious or private agencies that assist in this capacity.

Water Supplies

Rain water is the principal source of fresh water. It is obtained from the roofs of dwellings and is collected in all types of containers. There are no rivers, but near the sea and only slightly above sea level there are streamlets of fresh water which become brackish at high tide. In a few places there are shallow, uncovered wells. There is one permanent spring near Hanga Roa; other springs are small and intermittent. Five pools of varying capacity are located at scattered points along the western and northern coasts. Inexhaustible but rather inaccessible supplies of fresh water exist in the crater lakes of the volcanoes at the three corners of Easter Island. The governor's quarters and a private ranch company have fairly large and permanent supplies of rain water impounded in reservoirs. There are no facilities for the treatment or distribution of water.

Sewage Disposal

The disposal of sewage is primitive. Excrement of human beings is indiscriminately deposited about the homes of the natives; garden plots are the areas most commonly used. Neither the latrine nor the pail system of sewage disposal is used by the native population.

Insects and Animals

Vectors of Disease. Mosquitoes. Mosquitoes (species unidentified) are common in the region of the crater lakes at the western end of the island. They are not known to be vectors of any diseases.

Lice. Infestation with head lice (*Pediculus capitis*) and body lice (*Pediculus corporis*) is prevalent among the natives. The lice are not known to be vectors of disease on this island, but the body louse is capable of transmitting epidemic typhus fever and relapsing fever, should these diseases be introduced.

Flies. Houseflies (species not known) are encountered in countless numbers and, in the complete absence of any measures of control, indiscriminately swarm over food, persons and excrement. Under present conditions they are serious pests. They are also capable of serving as mechanical vectors of enteric diseases, and especially typhoid fever, paratyphoid fevers, bacillary dysentery and amebic dysentery.

Fleas. Rats on the island are heavily infested with fleas; because of the domestic habits of the rats, fleas abound in the native dwellings. These fleas are said to parasitize human beings to an inordinate degree, particularly in the vicinity of native habitations. The fleas are not known to harbor the causative organisms of diseases that are transmissible to human beings. However, if endemic typhus fever or plague should be introduced, fleas would assume great medical importance and would constitute an extremely difficult problem in control.

Mites. The itch mite, *Sarcoptes scabiei,* is ubiquitous.

Ticks. Information is lacking concerning these pests.

Cockroaches. Great numbers of cockroaches are present on Easter Island. They are harmless pests, but by means of contact with contaminated material may spread diseases of filth.

Rodents. Enormous numbers of ship and domestic rats (presumably *Rattus norvegicus* and *R. rattus*) are encountered in all parts of the island, and great colonies of these pests are found living in and about native dwellings.

Measures of Control. No measures for control of insects or rats are employed.

Snakes and Other Dangerous Animals. These do not exist on the island.

Food and Dairy Products

The diet of the natives is quantitatively but not qualitatively adequate. It consists largely of carbohydrates, especially sweet potatoes, taro, beans and bananas. Eggs and fowl frequently are included and occasionally the diet is supplemented by beef and mutton. Fish is not commonly eaten. Salt is not used in cooking or on food but this requirement is partially met by the drinking of brackish water. Milk and dairy products have no part in the native diet.

Many sheep, cattle and hogs are available as a result of the enterprises of a private ranch company, but other standard items of the American diet, such as flour, cereals, citrous fruits, green vegetables, salt and sugar, must be imported. There are no facilities for the inspection of meat or pasteurization of milk. Information is lacking concerning the presence or prevalence of diseases of animals that are of importance to man. Facilities for refrigeration do not exist.

Miscellaneous Problems of Sanitation

The entire native population of Easter Island is concentrated in and about the village of Hanga Roa and all native property is confined to an area of 7.72 square miles surrounding the village. The rest of the island, which is leased by the ranch company, is separated from the holdings of the natives by patrolled and fenced boundary lines. There are 50 houses in the village; these houses accommodate the entire population. The existing conditions create difficult problems in environmental sanitation. These conditions and problems, however, are confined exclusively to this area and are effectively isolated from the rest of the island. Because of the lack of soap the matter of personal cleanliness is neglected. The natives, however, are always eager to obtain soap and when it is available reasonable standards of cleanliness are maintained. Soap ranks high as an item of barter and commerce.

MEDICAL FACILITIES

Hospitals

There are no hospitals, or medical or surgical equipment or supplies on the island. There is a small leper colony located near Ahu-Te-Peu, three miles north of Hanga Roa. No medical care or service is rendered to members of this colony.

Medical Personnel

There are no physicians, nurses, dentists, pharmacists or trained native assistants on Easter Island. The entire population is without medical care or assistance.

DISEASES

General Considerations. In the absence of medical personnel, the collection of information and statistics concerning the causes of morbidity and mortality has been impossible. Only mortality statistics have been recorded. The average annual mortality rate (1919 to 1931) was approximately 22 per 1,000 of population. The only medical survey of Easter Island was made in 1934. The general health of the natives at that time was reported to be surprisingly good, and there was almost complete absence of epidemic diseases.

Intestinal Diseases. Typhoid fever, paratyphoid fever, bacillary dysentery and amebic dysentery are not known to be endemic on Easter Island. In 1931, however, there was an epidemic of an intestinal disease which probably was typhoid fever. No subsequent outbreaks of this or of other intestinal diseases occurred between 1931 and 1935; more recent information is lacking. The primitive sanitary habits of the natives and the amazing prevalence of flies and cockroaches would be conducive to the spread of enteric diseases if these diseases should be introduced among the natives.

Intestinal Parasitism. Information is lacking concerning intestinal parasitism. However, considering the prevalence of intestinal parasitism throughout Polynesia, as well as the opportunities for infection on Easter Island, it is considered probable that it exists.

Respiratory Diseases. None of the common respiratory diseases, such as measles, mumps, scarlet fever, whooping cough, diphtheria, common colds, influenza, pneumococcic pneumonia, virus pneumonia or tuberculosis, are endemic on Easter Island. Smallpox last appeared in 1886. In 1934 all the people were vaccinated. With each visit of a ship to the island, an epidemic of "la grippe" develops among the natives. The fact that respiratory diseases have not been endemic among the natives of Easter Island has occasioned considerable concern lest introduction of these diseases among this nonimmune population result in their decimation.

Venereal Diseases. Gonorrhea is the most prevalent disease on Easter Island; practically the entire adult population is infected. Gonorrhea is reported to be a remarkably benign infection among the natives, and it is said that complications are rare. Syphilis, soft chancre and lymphogranuloma venereum are reported to be unknown.

Leprosy. Approximately 5 per cent of the population is known to have leprosy. Most of the lepers are confined to the leper colony, but the few who have escaped detection mingle freely with the nonleprous natives. This disease is of considerable importance to the islanders.

Dermatologic Diseases. Undifferentiated eczematoid diseases of the skin are of common occurrence and cause considerable annoyance. Yaws has not been reported. No information is available concerning the presence or prevalence of mycotic, pyogenic or ulcerative diseases of the skin.

Insect-Transmitted Diseases. No insect-borne diseases such as malaria, yellow fever, dengue fever or sandfly fever are known to be endemic on Easter Island.

Psychoneurosis. No specific information is available concerning the development of psychoneuroses among the small white population of Easter Island, but reference is made to the exceedingly difficult and sometimes desperate situations that are created because of the almost complete isolation of the island, the lack of recreational facilities and the monotony of life on the island.

SUMMARY

There is no public health system or service on Easter Island, and no professional services are available. Water is obtained largely from collections of rain from roofs. There are large but rather inaccessible supplies of fresh water in the crater lakes of the volcanoes. There are no facilities for the treatment or distribution of water. Methods of disposal of sewage are primitive, and indiscriminate pollution of the soil extensive. With the exception of meat, the food supply is quantitatively but not qualitatively adequate. There are no facilities for the storage of perishable foods. The island abounds with flies, fleas, lice and rats. Native habitations are heavily infested with these vermin. The communal habits of the natives, their lack of acquired immunity, and their inability to appreciate the rudimentary principles of sanitation are conducive to the spread of disease.

Easter Islanders are reported to enjoy good health, and to be free from serious epidemic and endemic diseases. The diseases of greatest importance in this area are venereal disease and diseases of the skin. Common contagious diseases, infectious respiratory diseases and specific enteric diseases, such as cholera, typhoid fever, paratyphoid fevers, bacillary dysentery, and amebic dysentery, are not indigenous to the island. Should these diseases be introduced, however, they undoubtedly will be associated with extremely high morbidity and fatality rates among the native population. Diseases common to the tropics, such as malaria, dengue fever, sandfly fever, yaws, filariasis, ancylostomiasis, trachoma, the various typhus fevers, cholera, plague and infection with flukes, have not been reported.

BIBLIOGRAPHY

Chauvet, Stephen: L'île de Pâques et ses mystères. Paris, Editions "Tel," 1935.

Drapkin, I.: Contribution to the Demographic Study of Easter Island. Honolulu, Hawaii, The Museum, 1935. (Bernice P. Bishop Museum, Occasional Papers, Vol. 11, No. 12.)

——: L'état sanitaire de l'île de Pâques. Bull. Office internat. d'hyg. pub. 1936, **28**:723-728.

Gt. Brit. Foreign Office: Cocos and Easter Islands. London, H. M. Stationery Off., 1920.

Knoche, Walter: Die Osterinsel, eine Zusammenfassung der chilenischen Osterinselexpedition des Jahres 1911. Concepción, Wiss. Archiv von Chile, 1925.

Pacific Islands Year Book, 1939, 3d ed., Pacific Publications, Ltd. Sydney, Australia, 1939.

15

Fiji Islands

GEOGRAPHY AND CLIMATE

The Fiji Islands, owned by Great Britain since 1874, constitute a crown colony with a large measure of self-government. The colony consists of about 250 islands, 80 of which are uninhabited and scarcely higher than sea level. The islands lie between 15 and 22° of south latitude, and 177° of west longitude and 175° of east longitude. The 180th meridian in fact crosses the tip of one of the larger islands of the group, Vanua Levu, and intersects a smaller one, Taviuni. The entire group forms an important link in the chain of trade and commerce between Australia and Canada, since it is about 1,100 miles north of Auckland in New Zealand and about 1,700 northeast of Sydney in Australia. To the east of the Fiji Islands is the British protectorate of Tonga; to the southwest are the French islands of New Caledonia.

The Fiji Islands have a total area of about 7,083 square miles, or somewhat less than that of the state of New Jersey (8,224). The chief islands, in point of size and also economically, are Viti Levu (4,053 square miles), Vanua Levu (2,128 square miles), Taviuni (166 square miles) and Kandavu (165 square miles). The remaining islands range from 5 to 90 square miles in size, and include the unexploited island of Rotuma some 220 miles northwest of the crown colony.

The population of the Fiji Islands is divided into two broad groups: the native Fijians, preponderantly Melanesian in derivation; and the Indians who were imported from India to work in the sugar mills and rice mills. In 1941 the estimated population was 227,000; there were approximately 107,000 Fijians, 102,000 Indians, 5,000 persons from Europe or of European extraction, 5,000 persons of European and native descent, 3,000 Rotumans, some 2,000 Chinese and 3,000 other persons. The capital, Suva on Viti Levu, has a population of about 15,000.

Physically, with the exception of a few coral atolls, the Fiji Islands are of volcanic origin, characterized by mountains which in a few instances are more than 4,000 feet high. Fertile river valleys are interspersed; like the mountains, they are cloaked with a luxuriant tropical vegetation. From summit to water line the islands are amenable to cultivation, a feature which has been notably exploited by the sugar and coconut industries.

Hydrographically, the islands are exceptional. Forty well-defined rivers drain into the ocean, the largest stream being the Rewa River on Viti Levu, which traverses most of the width of the island. Thermal springs, the temperature of the water of which ranges between 100 and 210° F. (37.7 and 98.8° C.), occur on several islands, particularly Vanua Levu. Excellent sheltered bays and harbors are provided by the coral reefs which encircle most of the islands.

The climate of the Fiji Islands is tropical, and has been said to be the most healthful in the world. The tempering effect of the prevailing southeastern trade winds is apparent. The maximal temperature is 98° F. (36.6° C.); the minimal is rarely less than 60° F. (15.6° C.); the average temperature is 78° F. (25.5° C.). The maximal figure of 98° F. (36.6° C.) was recorded during the period of from December to April, with a relative humidity of 83.8 per cent. In some instances humidity actually may reach the complete saturation point.

The islands are featured by a so-called dry belt in the north and northwestern sectors, and a wet belt in the densely forested southwestern sectors. Rainfall varies in quantity; in some regions it is 60 inches (1.5 meters) a year, and in others it is as much as 130 inches (3.3 meters) annually. During the rainy season, which extends from November to March, inclusive, a rainfall of 5 inches (0.13 meter) a day is not uncommon, and it may occasionally exceed 10 inches (0.25 meter) a day. Annual figures in respect to the climate of three towns, Lambasa, Levuka and Suva, are seen in Table 25.

TABLE 25

Salient Climatic Data, Annual Figures, Certain Regions in Fiji Islands

Place	Temperature, °F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq. %	Elev., feet
Lambasa	94	56	78	83	..	......	..
Levuka	95	61	78	94	..	......	..
Suva	98	55	77	117 *	79	SE, 27	20

* At Suva, as a rule, rain falls on nearly every day in the month. Torrential rains are possible; the heaviest rainfall for 24 hours thus far recorded in Suva occurred in August, and the figure was 26 inches (about 0.7 meter). But at Suva the rainfall for the entire month has been as low as less than 1 inch (less than 2.5 cm.) and as high as 37 inches (roughly, 1 meter) or more.

PUBLIC HEALTH

Health Services

Organization. In Fiji there is a system of state medicine, but there are also a few private practitioners of medicine in certain centers. The health and sanitary services are administered through the Medical Department at Suva by the Director of Medical Services. In 1938, the staff of the department, in addition to the Director, included the Assistant Director of Medical Services, 13 European medical officers, 63 native Fijian medical practitioners, seven Indian medical practitioners, 63 Fijian obstetric nurses, a pathologist in charge of the pathology and research division, a medical officer in charge of the sanitary division, a medical superintendent for the Central Leper Hospital, the principal of the Central Medical School and a medical officer in charge of the Colonial Memorial Hospital. The Central Health Board, of which the Director of Medical Services is chairman *ex officio,* advises the government on all matters concerning health and holds executive powers in areas in which there are no local authorities. The local authorities which are headed by the chairman of the district commissions, with the medical officers as *ex officiis* members, are responsible for the administration of public health in the areas assigned to them, and have power to make their own regulations. The public health ordinance is not applicable to the Fijians, who have their own villages or compounds apart from urban centers. Public health measures which affect them are administered under a special chapter in the code of native regulations. The Fijian health services are co-ordinated with the others through the government medical officers, who are responsible health officials in both cases. The government medical officers in country districts are medical officers of health *ex officiis* (hygiene and sanitation). The sanitary staff consists of a chief sanitary inspector, three assistant sanitary inspectors, four sanitary overseers and 13 sanitary assistants. The Fijian infant-welfare organization was conducted as a branch of the native administration until 1938, when it was transferred to the Medical Department. Close co-operation with the native administration is maintained in the essential phases of the work. The control of communicable diseases is administered by the Medical Department, and is effected chiefly by isolation of patients and by immunization.

The medical officer of health is an official member of the Suva Town Board and chairman of the health committee. He also acts as adviser to the Central Board of Health. The functions of this board comprise the following: the reporting of communicable diseases; health work and administration in ports, including quarantine, control of vermin, disinfection of imported articles and examination of imported foods; sanitary inspection of public and private buildings; inspection of milk, water, meat and other foods; special inspections of laundries and barber shops; compilation of vital statistics; dissemination of health and sanitary propaganda; and the training of personnel for sanitary work.

Relative Effectiveness. In general, sanitary conditions in Fiji are better than those in other South Pacific islands. The Medical Department has an active and well-organized division of hygiene and sanitation. The major sanitary problems are concerned with disposal of sewage, protection of water supplies, quarantine measures, housing conditions and measures for the control of insects. Formerly, disease resulting from pollution of soil constituted the major problem. For many years special campaigns have been conducted with the result that soil sanitation and improved water supplies have led to general improvement in public health. In spite of the advancement in this respect, dysenteries, enteric fevers and infection with hookworm are relatively prevalent, and constant vigilance is necessary to assure the permanency of the results thus far attained and to prevent these endemic diseases from assuming epidemic proportions. These problems are greatest in the rural areas and in the zones in which rainfall is greatest. Sanitation of the port, town and environs of Suva for the most part is good, but the problem has become increasingly difficult because of an increase in population resulting in overcrowding of all housing facilities, much of which has taken place in inferior homes with defective sanitary accommodations. These conditions are said to have been at their worst in the area known as "Toorak." Pollution of soil and contamination of water are most frequent in rural areas, especially those that are subject to flood, and where drinking water is obtained from shallow wells.

The sanitary organization of the communally living native inhabitants is carried out principally under the direction of the native medical practitioners, assisted by the native officials and rural police, and has legal assistance under the public health regulations. The government's efforts consist of propaganda, teaching, employment of the elementary principles of public health, and the wholesale construction of systems for disposal of sewage that meet the specific requirements and habits of the two great racial groups; namely, the communally living Fijians and the individualistic immigrant population, especially the Indians.

Water Supplies

With a plentiful annual rainfall and with the numerous streams and rivers, there is an abundant supply of water in Fiji. The water supply of Fijians and Occidentals is generally good, but that of the Indian tenant farmer often is drawn from shallow, open-topped surface wells that are exposed to frequent pollution by surface washings from the highly infected surrounding soil. This is particularly true during the rainy season and in areas in which floods are likely to occur. Water obtained from rivers and streams that traverse the agricultural areas are subject to heavy bacteriologic contamination. In the rural districts, tanks for the collection of rain water are used commonly and are being made generally available to the Indian tenant farmers. Water is also obtained from lined and covered wells.

The water supply for Suva is derived principally from the Rewa River; water is pumped into reservoirs and is then piped to the port, town and environs of Suva. Details concerning treatment of the water are lacking, but it is known that the supply from one of the reservoirs is chlorinated and that frequent examinations indicate that it meets satisfactorily standards with respect to bacteriologic content. In 1938 the results of analyses of the other reservoirs were unsatisfactory, since they frequently showed large numbers of *Escherichia coli.* Results of bacteriologic examination of the Suva sea baths indicated that the baths were not subject to gross contamination. All the hospitals, including those in the rural areas, are reported to be supplied with domestic water (candle) filters. These filters, however, are unreliable unless they are meticulously and frequently cleaned.

Sewage Disposal

During recent years, soil sanitation has received special attention, which has been directed toward provision of the whole population with an adequate number of properly constructed latrines. At present, some satisfactory method for disposal of sewage has been installed in almost every house on the island of Viti Levu, and the system is slowly being extended to other islands. Suva alone has a disposal system in which sewage is water-borne. A comparatively small but increasing number of septic tanks is being installed for the better-class homes. The pan system persists only where there is an unavoidable delay in the providing of a substitute, and the bulk of the population depends on either the pit latrine or the bored-hole latrine. The bored-hole latrine is suitable for individual households and is in general use among the Indian peasantry. For communal use a pit latrine has been found essential, and with few exceptions, this type is found in the Fijian villages. Cement slabs or covers are essential in both instances, and are locally obtainable. The types of latrine in use by the different racial groups, Fijians and Indians, were designed to meet the conditions of the ground, as well as the habits of the people. The ordinary bored-hole type fulfills all the requirements of the East Indians. The communal habits of the Fijian and the use of coconut husks, grass, sticks and reeds for toilet purposes necessitate the use of the large and deep pit type.

In spite of the general availability of proper facilities for disposal of sewage, pollution of the soil is of fairly common occurrence. This is true in spite of the fact that the campaign for soil sanitation has legal assistance under public health regulations, which require that every rural home be provided with a latrine fitted with a concrete slab.

In all the main centers there is a service for the disposal of garbage. In the Fijian villages and Indian settlements the burial of refuse is taught and well practiced.

Insects and Animals

Vectors of Disease. Mosquitoes. Although no anopheles are present, mosquitoes abound throughout the islands. Those that are of medical importance include: *Aedes aegypti, A. albopictus, A. scutellaris, A. kochi, A. vexans* and *A. vigilax;* and *Culex fatigans, C. annulirostris* and *C. sitiens. Aedes aegypti* and *A. albopictus* are vectors of dengue, while *A. scutellaris* and *Culex fatigans* are the principal vectors of filariasis. The other Aedes and Culex mosquitoes are potential carriers of filariasis and are of minor medical importance. However, *Aedes vigilax, A. vexans* and *Culex annulirostris* are severe pests in the swamps and in areas subject to floods.

Lice. The crab louse, *Phthirus pubis,* the head louse, *Pediculus capitis,* and the body louse, *Pediculus corporis,* are common. They are pestilential, but are not known to transmit any specific diseases in Fiji. The body louse is a potential vector of epidemic typhus fever.

Flies. The common housefly, *Musca domestica,* is encountered in great abundance in some areas. Stable flies, *Stomoxys calcitrans,* are common on all the islands. Both flies are capable of transmitting the various enteric diseases by mechanical means. A large tabanid fly sometimes enters houses and attacks human beings; its bite is painful.

Fleas. The rat flea, *Xenopsylla cheopis,* is widely distributed throughout the islands; it is a potential vector of plague and endemic typhus fever.

Snakes and Other Dangerous Animals. There are no poisonous snakes in Fiji. Snakes belonging to the family Boidae are found, but information concerning their size or potential danger to man is not available. Members of the suborder Lacertilia (lizards) are well represented, and include true crocodiles.

Mongooses, wild pigs, rats, bats, voles, flying foxes and mice are widely distributed throughout the islands. In themselves they are not injurious to man, but they do harbor insects, particularly lice and fleas, that are potential vectors of disease.

Bird life in Fiji is abundant, and one common bird, the myna, has been found to serve as a host for threadworms, roundworms, fleas and several species of lice.

Pests. A large, yellow stinging wasp, *Polistes hebraeus,* is common everywhere and, because of its prevalence, is particularly troublesome. A small cockroach, called "Maori bug" by the Fijians, squirts a fluid that has a very offensive odor and is extremely irritating when it comes in contact with the mucous membranes, particularly those of the eye. A small wood-boring anobiid beetle, locally called the "deathwatch beetle," is common and is troublesome because of its destructive habits. Ants, small spiders, scorpions, centipedes, millipedes, fish moths, grasshoppers, locusts, beetles and dragonflies are everywhere and are abundant in both number and species. Except as noted above, they are not poisonous or injurious, but are important as pests.

Dangerous Marine Life

In the waters and on the coral reefs about the islands, certain marine life is dangerous to man. The giant trapping clam (*Tridacna gigas*) has sharp, scalloped edges and a vise-like grip and, if stepped on, inflicts serious injury. Occasionally, men have been drowned by being held captive by such clams until the tide rose over them. A little fish with poisonous spines on its head, called the "scorpion fish," *Scorpaenopsis laotali,* occurs in small caves in coral reefs; if this fish is touched, its sting causes severe pain, which is occasionally so intense that the victim collapses. Several species of shark are present in the waters of Fiji, and some of them, particularly the devil shark, *Carcharias melanopterus,* are said to be dangerous to man.

Food and Dairy Products

In Fiji, there is a sanitary overseer who is responsible for the inspection of dairies where milk and ghee (semifluid butter) are produced. He is acquainted with the sanitary conditions of these establishments, including the results of bacteriologic analyses, and is authorized to prosecute for offenses against regulations. The dairy cattle in rural Suva are tuberculin-tested by the veterinary department; in 1937 regulations were passed that require all premises in which milk and cream are produced, collected, stored or distributed, to be registered. Pasteurized milk is available, but all supplies of it do not meet the government standard. In spite of the fact that pasteurization is not universally practiced, bacteriologic counts, in general, have compared favorably with figures in countries with well-regulated dairies. Regular inspection of bakehouses, restaurants, food shops, mineral-water factories, vehicles for the transportation of meats, bread, vegetables, ice cream and so on is made by the sanitary division. Meat is inspected under the supervision of a fully qualified meat inspector, and daily visits are made to slaughterhouses that supply meat to Suva; however, inspection of meat is not carried out in rural areas. Carcasses are condemned most commonly because of generalized tuberculosis. There is almost complete absence of tapeworm larvae in cattle and pigs.

In Fiji there is an abundance of native foods—sweet potatoes, yams, taro, beans, pumpkins, maize, bananas, pineapple, coconuts and sugar—and the common clinical manifestations of dietary deficiency diseases, both vitamin and mineral, are almost unknown. Among the Fijians and Indians, however, there is some evidence which suggests that the diet is deficient in calcium, vitamins A and D, animal protein and fresh vegetables. Milk is known to be deficient in mineral ash. Some cutaneous reactions to infections are observed that suggest dietary deficiency. Yearly, several instances of epidemic dropsy are reported among Indians; this type of dropsy is attributed to the use of mustard oil, contaminated by *Argemone mexicana,* in the curry employed by the Indians.

Facilities for refrigeration are known to exist, but detailed information concerning them is not available.

MEDICAL FACILITIES

Hospitals

All hospitals and dispensaries are owned by the government and are administered under the direction of the Medical Department. In Fiji, the administration has adopted the policy of replacing all private and plantation hospitals by government or provincial hospitals and dispensaries. This program was started in 1936, and is probably now complete. In 1938 there were four well-equipped general hospitals under the control of the Medical Department of Fiji: the Colonial War Memorial Hospital, the Lautoka Hospital, the Levuka Hospital and the Lambasa Hospital. There were also certain special institutions operated by the Medical Department: the Central Leper Hospital, on Makogai; the Central Insane Asylum, at Suva; and the Central Medical School, at Suva. Sixteen hospitals were also maintained and staffed as auxiliary hospitals, serving their purpose only in times of epidemics. The government also maintains a chain of dispensaries, most of which are staffed by native medical practitioners; a few are headed by Indian practitioners of medicine, but with few exceptions they are supervised by government medical officers. Outpatient branches are connected with all hospitals; there were said to be 31 additional dispensaries scattered throughout the whole colony.

Medical Personnel

Physicians. The medical services in Fiji are almost exclusively administered by government physicians employed by the Medical Department. There are a few private practitioners in the large centers. In 1938 in the outlying districts there were 63 Fijian practitioners who had received a thorough basic medical training in the Central Medical School and were adequately equipped to treat and handle the common disease problems, as well as to perform some surgical procedures.

Nurses. Nursing services are provided by the government. The personnel consists of graduate white and native nurses, and training is provided for white and native students. The nursing system is affiliated with the New Zealand Government Health Department, and is subject to its inspection. The training schools are operated in connection with the Colonial War Memorial Hospital. The nursing services in Fiji are divided between the hospitals and the public health service. In recent years, the number of nurses in hospital service was said to have been as follows: trained Occidental nurses, 38; probation Occidental nurses, 13; trained native nurses, 38; and probation native nurses, 35. Nurses in public health services were as follows: trained

Occidental nurses, five; and trained native nurses, 67.

Others. There were not more than five dentists in the colony, and all were located in the principal centers on the islands of Viti Levu and Vanua Levu.

Medical Institutions

The Central Medical School at Suva is directed by a principal who is a medically qualified official and whose full time is devoted to administrative and teaching duties at the school. The school provides medical training for specially qualified Fijians and natives of other islands outside the Fiji group who, on completion of four years of study, are given the degree of medical practitioner and return to their districts or communities, where they practice for the government. English is the medium of instruction. The training is thorough. It emphasizes operative surgery and fits most graduates to contend with ordinary surgical emergencies; it stresses public health and preventive medicine, thus rendering the graduates competent to deal with ordinary epidemics, to carry out the mass treatment of ancylostomiasis, yaws and ringworm and to conduct preventive measures, such as the improvement of soil sanitation and infant welfare.

The pathology and research laboratories are operated in conjunction with the Central Medical School and the Colonial War Memorial Hospital; they are small but well equipped. Services of the pathology and research division of the medical school include bacteriologic, pathological and biochemical examinations, medicolegal analyses, research, hematologic and serologic examinations and the preparation of antityphoid, antiparatyphoid, staphylococcic and autogenous vaccines.

DISEASES

General Considerations. As in the other islands of the South Pacific, information concerning disease conditions is based largely on reports of admissions to hospitals and the results of campaigns directed against specific diseases. This information does not necessarily reflect the real incidence of the various diseases or the disease problems. General conditions of health in Fiji are better than those in the other South Pacific islands, and with the exception of malaria, which does not exist in Fiji, the diseases and the problems of health are approximately the same. Formerly, the population suffered severely from yaws and the diseases resulting from pollution of soil (intestinal parasitism, especially infection with hookworm, and the enteric diseases). Vigorous campaigns have been conducted against these conditions, with the result that ancylostomiasis and yaws are now under control. At present, the need of reduction in the incidence of pulmonary tuberculosis and the dysenteries and of the infant and child mortality rates is the most urgent health problem. The other diseases that are common among the native inhabitants are typhoid and paratyphoid fevers, measles, chickenpox, whooping cough, influenza, pneumonia and common colds, infectious forms of conjunctivitis, various septic and parasitic diseases of the skin, filariasis and leprosy.

The drinking of kava is conducive to the spread of respiratory and other diseases because this native custom requires that all participants in the ceremony partake of the beverage from a communal cup. In some remote communities kava is still prepared by the ancient method of masticating the kava roots, spitting the material into a mixing bowl and preparing the beverage therefrom. This practice has been discouraged by the government, and has been replaced by more sanitary methods of preparation, but the custom at its best is not a sanitary one.

Diseases Spread Chiefly through Intestinal Tract

Bacillary Dysentery. Bacillary dysentery is reported to be foremost among the health problems in Fiji. It is endemic, but yearly assumes epidemic proportions in various districts. In most cases the disease is of the Flexner type, but Shiga, Sonne and Schmitz types also are encountered. Because of the frequency of pollution of the soil, particularly by the Indian population, water supplies are contaminated by washings of surface soil, especially during the rainy seasons.

Amebic Dysentery. This disease was formerly of common occurrence, but for some unexplained reason its incidence has decreased sharply during recent years.

Typhoid Fever and Paratyphoid Fevers. These diseases are endemic and occasionally assume epidemic proportions, especially among the Fijians. The incidence of typhoid and paratyphoid fevers has been greatly reduced as the result of rather widespread immunization and improved sanitary conditions.

Intestinal Parasitism. At one time, infection with hookworm, especially that caused by *Necator americanus,* was extremely prevalent among the native population, surveys indicating that 93 per cent had these parasites. The rate of infection was highest in the wet zones and where rainfall was the heaviest. Other intestinal parasites, whipworms (*Trichuris trichiura*), pinworms (*Enterobius vermicularis*), roundworms (*Ascaris lumbricoides*), hookworms (*Ancylostoma duodenale*), dwarf tapeworms (*Hymenolepis nana*), beef tapeworms (*Taenia saginata*) and sheep roundworms (Trichostrongylus), are encountered, but only the first two occur to a significant degree. The other parasites occur largely among the East Indians and are of comparatively infrequent occurrence. At present the incidence of infection with hookworm is lower than it was formerly, varying between 0.5 and 60 per cent; but because of the still-common practice of indiscriminate pollution of the soil, particularly in the agricultural regions, it remains a major public health problem.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis is one of the most formidable health problems in Fiji, particularly among Fijians. It is responsible for from 12 to 18 per cent of all deaths in hospitals and for from 25 to 37 per cent of all deaths in hospitals caused by infectious diseases. The deaths among Fijians from this cause are greater than those among Indians from all causes. Recent reports indicate that in early adult life well over 90 per cent of the Fijians are infected. No special provisions are made for the isolation, hospitalization or treatment of tuberculous patients. Patients who have the disease in an active stage are numerous, and because of the communal habits of the Fijians, including indiscriminate spitting and drinking from communal cups, as previously mentioned, tuberculosis continues to spread.

Influenza and Pneumonia. These diseases are endemic but periodically assume epidemic proportions, particularly among the non-European population. Each year 15 to 20 per cent of the patients with infectious disease admitted to the hospitals are found to have influenza. Deaths attributable to influenza alone account for 30 to 35 per cent of all those caused by infectious disease. Mycotic and fusospirochetal diseases of the lungs are not uncommon.

Other Respiratory Infections. Measles, whooping cough, mumps, German measles, chickenpox, diphtheria, scarlet fever, rheumatic fever and cerebrospinal meningitis are other diseases that are endemic in Fiji. Periodically, measles, whooping cough and chickenpox assume major epidemic proportions, particularly among the Fijians. Measles is not so severe as formerly, when, during epidemics, it was accompanied by a fatality rate of 25 per cent; the same is true of whooping cough. Chickenpox and diphtheria occur in mild forms and infrequently become malignant. Diphtheria is of particular importance to Occidentals, because of the presence of a large number of carriers of the disease among the native inhabitants.

Diseases Spread Chiefly by Contact

Venereal Diseases. Gonorrhea is endemic in Fiji, and recently there has been an increase in its incidence. It has been stated that the increase was due not to importation of the disease, but to the spread of local disease. Until recently, syphilis was almost nonexistent in Fiji, although at one time the Indian population was heavily infected. Although definite information is not available, it is believed that the incidence of syphilis also has recently increased. Information concerning the presence or absence of the other venereal diseases, soft chancre, lymphogranuloma venereum and granuloma inguinale, is conflicting, but competent observers doubt that they are present.

Commercialized prostitution is not sanctioned, but exists. Promiscuity is common and casual sexual contacts are easily arranged, especially among the Indians.

Yaws. Formerly, the entire native adult population was infected with yaws; intensive campaigns have greatly reduced the incidence of the disease, and it is now well under control.

Leprosy. There is a comparatively large number of lepers in Fiji, but facilities for the isolation and treatment of patients found to have the disease are excellent.

Diseases of the Skin. Pyogenic and mycotic (fungous) infections of the skin are commonly found among the Fijians, Indians and Europeans. The pyogenic infections include boils, secondarily infected abrasions and abscesses of soft tissues. The common mycotic infections include the various tineas, which are said to be prevalent among Occidentals, particularly one type that involves all the covered portions of the body and causes intense itching; this infection is said to persist because clothes, when washed, are not boiled. Parasitic diseases of the skin also are extremely frequent, especially scabies and infestations with lice. None of the various species of lice is a vector of disease in Fiji, but the body louse is dangerous because it is the potential vector of epidemic typhus fever and of relapsing fever, and could spread these diseases if they were introduced into the islands.

Diseases of the Eyes. Various forms of infectious conjunctivitis, including trachoma, are prevalent.

Diseases Spread by Arthropods

Filariasis. Although once a very prevalent disease, filariasis (due to *Wuchereria bancrofti*) is now well controlled. The incidence of this disease, however, probably is considerably higher than recently published reports indicate (1.5 per cent of all admissions to hospitals). Manson-Bahr in 1941 wrote that his statistics on the Fiji Islands showed that of 1,320 people of Fijian blood, 30.4 per cent of the males and 23.9 per cent of the females were found to have the disease. Mosquitoes capable of transmitting the disease, such as *Aedes scutellaris* and *Culex fatigans,* abound throughout the colony.

Dengue Fever. Dengue fever is endemic in Fiji, and *Aedes aegypti* and *A. albopictus,* both of which are capable of transmitting this disease to man, abound throughout the colony. Although the incidence of this disease has been low, previous experience in the South Pacific and elsewhere indicates that the disease may assume great significance among nonimmune persons because of the suddenness with which it strikes and because of the large numbers that it temporarily incapacitates.

Miscellaneous

Occasional cases of tetanus and undulant fever are reported. Cholera, plague, malaria, yellow fever, smallpox, relapsing fever, typhus and typhus-like fevers are said not to exist in Fiji.

SUMMARY

The health problems in Fiji are similar to those in other tropical islands of the Pacific. The matter of their administration is complicated by the fact that the two great population groups—Fijians and East Indians—are antipathetic morally, socially, and immunologically. The present well-organized and efficient health and medical services, both curative and preventive, are designed to meet the practical needs of these groups. The Fijians are provided with a medical organization that extends into their homes and includes native medical practitioners, with provincial hospitals and dispensaries situated at convenient points. The rest of the community is grouped more or less around the large government hospitals.

Sanitary conditions in Fiji are better than those in the other Pacific islands, but in spite of this, the major public health problems are concerned with soil sanitation, disposal of sewage, protection of water supplies and control of insects. The sanitary staff is well organized, and sanitary conditions in the port, town and environs of Suva are, in general, good. The wholesale construction of bored-hole latrines and pit privies has resulted in an appreciable reduction in the incidence of the dysenteries, typhoid and paratyphoid fevers and infection with hookworm. These diseases, however, are still prevalent. Pollution of soil and contamination of water are most frequent in the rural districts, particularly in areas in which the drinking water is obtained from shallow subsoil wells. There is an abundant supply of water in Fiji.

Mosquitoes abound throughout the islands, but there are no malaria-carrying (anopheline) mosquitoes; those present, however, are transmitters of dengue (breakbone) fever and filariasis. Pestiferous insects include body lice, head lice, pubic lice, fleas, flies, cockroaches, ants, scorpions, centipedes, wood-boring beetles and wasps. There are no dangerous animals or snakes, but certain marine life in the shallow waters of the coral reefs is hazardous to man.

All the hospitals in Fiji are owned or controlled by the government. In 1938 there were four well-equipped general hospitals, 16 provincial hospitals, and a chain of 31 dispensaries throughout the islands. The medical services in Fiji are almost exclusively rendered by government physicians. Valuable medical service is rendered to the native population by the native Fijian medical practitioners.

As previously mentioned, the major health problems largely concern the control of diseases that are the result of pollution of the soil; namely, bacillary dysentery, amebic dysentery, typhoid fever, paratyphoid fevers and infection with hookworm. Diseases of the skin are frequent, particularly ringworm, dhobie itch, scabies, and louse infestation. Gonorrhea is the only prevalent venereal disease. Pneumonia and influenza are particularly dangerous to the native inhabitants and, during epidemics, are associated with abnormally high mortality rates. Tuberculosis is prevalent among the Fijians and Indians.

BIBLIOGRAPHY

Atlas of Zoögeography. Bartholomew's Physical Atlas. Vol. 5. Under the Patronage of The Royal Geographical Society. Published at the Edinburgh Geographical Institute by John Bartholomew & Co., 1911.

Bahr, P. H.: Filariasis and Elephantiasis in Fiji, Being a Report to the London School of Tropical Medicine. London, 1912.

The Colony of Fiji, 1874-1924. Suva, Fiji, J. J. McHugh, Acting Government Printer, 1925.

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

Encyclopaedia Britannica, 14th ed. London, Chicago, Encyclopaedia Britannica, Inc., 1939.

Epidemiological Record of the Austral-Pacific Zone for the Year 1939. Health, Canberra, 1940, **18**:25-31.

Fiji Blue Book, 1934. Published by Authority Government Printer, Suva, 1935.

Gt. Brit. Colonial Office: Fiji. Report for 1925. Colonial Reports—Annual No. 1299. London, H. M. Stationery Off., 1926.

Gt. Brit. Colonial Office: Information as to the Conditions and Cost of Living in the Colonial Empire, 3d ed. London, H. M. Stationery Off., 1937.

Herms, W. B.: Medical Entomology, 3d ed. New York, The Macmillan Co., 1939.

Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, Hawaii, The Museum, 1934. (Bernice P. Bishop Museum. Special Publ. 23.)

——: East Indian and Fijian in Fiji: Their Changing Numerical Relations. Honolulu, Hawaii, The Museum, 1938. (Bernice P. Bishop Museum. Special Publ. 32.)

——: Medical Conditions in the South Pacific. M. J. Australia, 1928, **2**:362-378.

——: A Resurvey of Hookworm Disease in Fiji in 1935 Ten Years after Mass Treatment. J. Trop. Med., 1936, **39**:19-21.

——: Yaws Incidence in the South Pacific. J. Trop. Med., 1931, **34**:117-122.

League of Nations, Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. IV. Memorandum Concerning the Colony of Fiji. Submitted by the Health Authorities of the Colony. Geneva, 1937.

Manson, P.: Manson's Tropical Diseases. Edited by P. H. Manson-Bahr, 11th ed. Baltimore, Williams & Wilkins Co., 1941.

Nutting, C. C.: Fiji-New Zealand Expedition. Iowa City, The University, 1924. (University of Iowa Studies in Natural History, Vol. 10, No. 5.)

Spencer, D. M.: Disease, Religion and Society in the Fiji Islands. New York, J. J. Augustin, 1941.

Statesman's Year-Book. London, The Macmillan Co., Ltd., 1943.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942. 2 vols.

U. S. Bureau of Foreign and Domestic Commerce (Dept. Commerce): World Electrical Markets. Washington, 1939.

——: World Trade in Dental and Surgical Goods. Washington, U. S. Govt. Print. Off., 1939.

World Almanac. New York, New York World-Telegram, 1942.

16

French Oceania

GEOGRAPHY AND CLIMATE

For the purposes of this particular survey, French Oceania is considered to consist of the Society Islands, the Marquesas Islands, the Tuamotu Islands, and the Tubuai or Austral Islands.

The islands individually are almost uniformly small. Nevertheless, the area in which French Oceania as a whole is enclosed is enormous.

Society Islands. The Society Islands are situated between 15 and 18° of south latitude and 148 and 155° of west longitude. The area of the group is only about 700 square miles, but the islands are the most important, politically and economically, in all French Oceania. They are of volcanic origin, with somewhat rugged interiors of varying elevations. On the island of Tahiti, for instance, some peaks are more than 7,000 feet high. The soil in the Society Islands is unusually fertile and watercourses are numerous. The island of Tahiti has the finest harbor, Papeete, in French Oceania, as well as an excellent macadamized highway about 85 miles long. Moorea and Raiatea likewise have macadamized roads; these three islands, however, are the only ones in French Oceania where such roads are in existence.

The inhabitants of the Society Islands for the most part are Polynesians. On Tahiti there has been an increase in population since the first World War, due chiefly to the migration of natives to Papeete, the one so-called urban center of French Oceania. The population of the Society Islands is about 22,000. It can be assumed that by far the greater part of the population is Tahitian. Many Chinese have settled in the Society Islands, but Europeans and Americans are thought to be very few.

The climate of the Society Islands is far from uniform throughout the islands. In general, it ranges between 80 and 94° F. (26.6 and 34.4° C.), but a temperature of 94° F. is rare. Nights are cool. The temperature during the hot months is about 80° F. (26.6° C.). Rainfall will vary not only from island to island, but also within different parts of the same island. The southeastern sections of the islands are those which the trade winds affect first; hence, they receive much greater precipitation than the other sections. The salient climatic data concerning Papeete on Tahiti are seen in Table 26.

Marquesas Islands. The Marquesas Islands are situated between 7 and 12° of south latitude and 138 and 141° of west longitude. The area of the group is from 400 to 480 square miles, four fifths of which is nonarable land. Like the Society Islands, the Marquesas are of volcanic origin, but the land is not so fertile as that of the Society group. It is, however, capable of supporting a larger population than that now existent on it.

The population of the Marquesas is thought to be about 2,400. The Marquesans are Polynesians, like the Tahitians, but have been said to be more "self-indulgent" than the Tahitians. It should be recalled, however, that the resources of the Marquesas probably are not so extensive or so impressive as those of the Society Islands, a fact which may have dampened the incentive of the Marquesans. For more than 100 years the population of the Marquesas

TABLE 26

Salient Climatic Data, Annual Figures, Certain Regions in French Oceania

Place	Temperature, °F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq. %	Elev., feet
Papeete, Society Islands	93	61	79	56 *	80	NE, ?	20
Atuana, Marquesas Islands	..	..	..	74	84	E, ?	25
Hatiheu, Marquesas Islands	..	..	..	110	80	E, ?	30
Makatea, Tuamotu Islands	95	60	80	62	79	E, 41	154
Mangareva, Tuamotu Islands	97	56	76	87	84	......	13

* This figure is not significant, since at Papeari, only a very short distance from Papeete, precipitation has been as much as 106 inches (about 2.7 meters) a year. At Papeari precipitation in August has varied from ½ inch (1.27 cm.) to more than 23 inches (0.6 meter).

had been declining, but recently there has been a definite increase in population, and this increase has endured for some years. The native tongue is Maori, differing appreciably from the language of other Polynesian groups.

The temperature in the Marquesas Islands is somewhat comparable to that of the Society Islands. It ranges between 70 and 90° F. (21.1 and 32.2° C.), and the group is subject to severe and prolonged droughts. On the other hand, rainfall is usually heaviest on the windward portions of the islands. Hurricanes are not common in these particular islands, but storms are frequent. Tidal waves have occurred. Climatic data concerning Hatiheu and Atuana, based on three years of observation, are seen in Table 26.

Tuamotu Islands. The Tuamotu Islands are situated between 14 and 25° of south latitude and 125 and 149° of west longitude. The total area of the group is only about 310 square miles, and the islands themselves consist largely of coral atolls of varying size and importance. It has been said that the economic value of the Tuamotu Islands lies in their production of coconuts, shells and pearls. Most of the islands are heavily wooded. They are featured by lagoons, but not every lagoon is accessible.

The population of the Tuamotu Islands in 1936 was thought to be 4,300. Almost all the people are Polynesians, but the island of Makatea has some Chinese, Annamese and Japanese minorities, and the Chinese, who control the commerce, seem to be rather well distributed. The language of the inhabitants has remained more closely similar to that of the Maoris than is true in other parts of French Oceania, because the Tuamotu group is relatively free of extraneous contacts.

The islands are hot and dry. The variations in temperature, excepting for the islands of Makatea and Mangareva, have not been recorded for a period sufficient to permit generalization, but data concerning the aforementioned two islands, based on less than 10 years of observation, appear in Table 26. Squalls are likely to occur from January to March, and seven severe hurricanes have occurred within a period of 30 years. The prevailing winds are southeastern, but they are not steady. In the eastern part of the group east to east-northeast winds are prevalent; in the western islands the winds are from east to east-southeast. Other climatic data for Makatea and Mangareva in the Tuamotu Islands are seen in Table 26.

Tubuai or Austral Islands. The Tubuai or Austral Islands are situated between 22 and 30° of south latitude and 145 and 155° of west longitude. It is thought that the total area of the islands is 115 square miles, but some of them have not been surveyed. Most of them are well wooded, but the soil in none is exceptionally fertile. Some of the islands are in fact atolls, but others are lofty, attaining to elevations of as much as 1,300 and 1,400 feet in various places.

The population of the Tubuai Islands is not known. In 1936 it was believed to be 3,000, almost all of whom are of a primitive Polynesian derivation. Natives on the island of Rurutu are said to be industrious and independent; those on Rimatara and Rapa are considered amiable and somewhat indolent. The language everywhere but on Rapa is Tahitian; on Rapa the dialect is very different from that used on the other islands. In 1936 there were about 30 Chinese in the Tubuai Islands and not more than 12 Occidentals.

The islands are recognized as cool and temperate, and the seasons are well marked. Cool weather persists from May to September, and the warm season is from about October through April. On the island of Rapa the temperature seldom is more than 76° F. (24.4° C.) or less than 58° F. (14.4° C.). The islands lie at the southern limits of the southeastern trade winds, which in the northern islands are active from November to March. In the winter, and particularly on the island of Rapa, the west wind prevails with intensity. The Tubuai Islands themselves lie within the so-called hurricane belt.

PUBLIC HEALTH

Health Services

Organization. Detailed information is lacking concerning the organization of and the service rendered by the Service of Medical Assistance of French Oceania. It is known, however, that the service is administered by a physician who resides in Papeete, Tahiti. This regularly appointed official is selected by and serves on the Governor's Council. At the moment of writing the governor is subordinate to the High Commissioner of New Caledonia and French Oceania. So far as is known, no regularly established corps of public health officials is charged with the responsibility and execution of the duties and services ordinarily ascribed to and rendered by a well-organized health department. For the most part, the prescribed measures are limited to the island of Tahiti, and more specifically the town of Papeete and its environs. In the outlying islands, the administration and enforcement of the few measures that are generally applicable to them are undertaken by the administrators of these island groups. In the Marquesas the administrators have been French medical officers, but in the other islands all matters pertaining to health and sanitation have been in the hands of laymen. The principal functions of the Service of Medical Assistance are as follows: the support and maintenance of hospitals, medical-aid stations and leper colonies; the supervision of medical care and treatment; the training of medical orderlies, nurses, midwives and teachers to serve as auxiliary aids to the service in the various islands; the vaccination of the population against smallpox, typhoid fever and paratyphoid fevers; the projection of measures for the control of tuberculosis, syphilis and leprosy; the promotion of the nutritional betterment of school children; the supervision of quarantine regulations; and the collection of vital statistics.

Information is lacking concerning the role of the Service of Medical Assistance in the inspection of food and dairy products, sanitary engineering, surveillance of public water supplies, control of vermin, epidemiology, promotion of health education, and law enforcement.

Relative Effectiveness. When it is considered that such public health measures as are practiced are limited almost exclusively to the island of Tahiti and, more specifically, to the town of Papeete, health and sanitary conditions are reasonably good, in spite of the poorly integrated public health service. Elsewhere throughout the islands, the administration and enforcement of public health measures are almost completely neglected. Even on the islands in which public health measures are administered by medical personnel, sanitary regulations are not strictly enforced. Prophylactic measures, such as vaccination and campaigns directed toward control of prevalent diseases, are carried out sporadically and infrequently. Except on Tahiti, medical services are grossly inadequate. On the other islands, such medical assistance and services as are available are customarily rendered by nonmedical or poorly trained medical personnel, such as missionaries, native nurses, orderlies, teachers and *gendarmes,* who serve in the capacity of auxiliary aides to the service. The inhabitants of some of the islands receive no medical attention other than that rendered by a physician aboard a guard ship whose calls are infrequent. The distances involved, the difficulty of travel, and the problem of dealing with a primitive people whose lives are governed by deeply ingrained habits and customs create a difficult problem in the administration and enforcement of measures designed for their welfare. In addition, the Service of Medical Assistance is limited by funds and personnel.

Water Supplies

On Tahiti and other mountainous islands of French Oceania there are numerous streams that furnish an abundant supply of fresh water. On the low-lying atolls, water is scarce, being obtained from shallow wells or pits, temporary streams or collections of rain water. The water from the open wells and streams, which is often brackish, is subject to contamination as the result of surface drainage and of the practice of dipping any available container into the wells to secure water. At Papeete, on Tahiti, water is piped from a reservoir to the city; although it is known that there are mains leading to the wharves, information is lacking concerning the distribution of the supply at other places in the city. Except for the natural sedimentation that takes place in the reservoirs or catchment basins, the water is delivered untreated. On the islands where fresh water is scarce, the natives regularly use the milk of fresh coconuts for drinking purposes.

Sewage Disposal

No sewerage systems exist in French Oceania, and except in the densely populated areas, disposal of sewage is achieved by primitive means. Indiscriminate pollution of soil is practiced to a limited degree, and most of the native inhabitants use the beaches as depositories for their excrement. This method of disposal is well suited to the natives' habits and customs, and the ebb and flow of the tides keep the beaches clean. On Tahiti, Moorea and Borabora, latrines that are not flyproof are commonly used. In Papeete, Tahiti, a few flush toilets are in use, but the disposal of the effluent from these units is secured by outfalls or septic tanks, since no sewerage system exists. Garbage, trash and other refuse ordinarily are fed to hogs, dumped into the ocean or burned. In Papeete, regular collections are made, but in other localities the disposal of garbage and other refuse is a matter of individual concern. In many native villages all inedible refuse (coconut husks, shells and leaves) is burned.

Insects and Animals

Vectors of Disease. Mosquitoes. No anopheline mosquitoes have been reported in French Oceania. *Aedes aegypti* is widely distributed throughout the islands. This mosquito is capable of transmitting yellow fever and dengue fever. *Aedes pseudoscutellaris* also occurs, and is a vector of filariasis and dengue fever. *Culex atriceps* and *C. fatigans* are extremely prevalent on some islands; the latter is a vector of filariasis. No information is available concerning the role of *C. atriceps* as a vector of disease.

Apparently no measures are taken for the control of mosquitoes.

LICE. Infestations with the head louse, *Pediculus capitis,* pubic louse, *Phthirus pubis,* and the body louse, *Pediculus corporis,* are common among the native inhabitants. Although the vector of relapsing fever and epidemic typhus fever, *Pediculus corporis,* is present, there is no information to indicate that it serves in this capacity in French Oceania.

FLIES. Houseflies are extremely common, and several species belonging to the family Muscidae are represented, notably *Musca domestica, M. convexifrons, M. sorbens* and *M. vicina.* These flies are capable by mechanical means of spreading enteric diseases, especially typhoid fever, paratyphoid fevers, bacillary dysentery and amebic dysentery. No measures for the control of flies are employed, and the natives' habits of disposal of human excrement and other wastes and refuse, as previously described, are conducive to the spread of diseases by flies.

Flesh flies belonging to the family Sarcophagidae are rather widely distributed throughout the islands. They are of importance because of their habits of feeding on dead animals, garbage, excrement and other wastes. For these reasons they become dangerous as mechanical vectors of enteric diseases.

TICKS. No reference is made in available literature to the presence of ticks in French Oceania. Recently, however, a tick-borne disease—Texas cattle fever—was reported as having occurred in Tahiti.

FLEAS. The flea of human beings, *Pulex irritans,* the flea of cats, *Ctenocephalus felis,* and the Oriental rat flea, *Xenopsylla cheopis,* are widely distributed throughout the islands. The last-named flea is a common ectoparasite of rats, and serves as the principal vector of endemic typhus fever and plague in other parts of the world.

MITES. Tropical or mite-borne typhus fever does not occur in French Oceania, but mites which can carry the disease are probably present.

RODENTS. Domestic rats and Polynesian rats abound on many of the islands. They are not definitely known to harbor spirochetes of the genus Leptospira. No information is available to indicate that the government employs or enforces any measures for the control of rats.

OTHERS. Cockroaches are extremely common on some islands, and by coming in contact with contaminated material they are capable of spreading the diseases of filth. The principal species are *Periplaneta americana, P. australasiae* and *P. brunnea.*

Centipedes are very numerous, and 15 species have been identified. By mechanical means they are capable of spreading the diseases of filth and contamination. Furthermore, the bites of *Scolopendra morsitans* and *S. subspinipes* are venomous.

Snakes and Other Dangerous Animals. There are no poisonous snakes or dangerous terrestrial animals. Spiders belonging to the families Theridiidae and Lycosidae are reported from Tahiti. Some members of these families are venomous, but it is not known whether the species represented in the Society Islands are poisonous.

A small spiny fish, called the porcupine fish, is encountered along the coral reefs. If touched it stings, causing severe pain and sometimes temporary paralysis of the affected part. The exact identity of this fish is not known, but presumably it is similar or identical to the scorpion fish, *Scorpaenopsis laotali,* found in Fiji. Several species of eels are encountered along the coral reefs. Among these is an eel that reaches 20 feet in length and attacks man. It winds itself around the victim like a snake, and drowning has been reported to be a result of such an attack. There are giant trapping clams (*Tridacna gigas*) along the coral reefs; the edges of their shells are sharp, and their grip is viselike. If stepped on they inflict serious injury, and occasionally victims held captive by these clams have been drowned. Sharks that attack human beings are common in the waters of French Oceania; however, such attacks have never been reported as occurring inside the lagoons.

Pests. Beetles. Many species of beetles (Coleoptera) are found. Of medical importance are the "blister" or "coconut" beetles (Oedomeridae) belonging to the genus Sessinia. Beetles of this genus swarm about the open male flowers of the coconut and feed on the pollen. They are readily attracted by light. Contact with one of these beetles causes a sharp, momentary burning pain, followed within a few hours by the development of a blister.

Scorpions. Scorpions are common, and the stings of two species, *Hormurus australasiae* and *Isometrus maculatus,* are said to be moderately venomous.

Ants. Thirty-eight species of ants (Formicidae) have been identified in French Oceania. On some of the islands, especially the inhabited ones, they are extremely abundant. Where large colonies of ants exist, stores of food must be protected from these scavengers.

Biting Flies. Six species of black flies (Simuliidae) have been identified. They are a scourge in the Marquesas, especially on Nukuhiva and Eiao. The principal offender is *Simulium buissoni,* which also has a subspecies, *S. gallinum.* Other species are *S. mumfordi, S. adamsoni, S. tahitiense* and *S. cheesmanae. Simulium buissoni* is a vicious biter and attacks all exposed surfaces of the body. The bite is painful and produces almost unbearable itching, which is followed by the development of wheals. The distribution of and the readiness with which these black flies attack man are subject to great variation. They are much more troublesome on some islands than on others. Secondary infection of the bites of black flies is not infrequent.

Midges. Nine species of biting midges (Ceratopogonidae) have been reported, some of which attack human beings. Their bites cause considerable itching and are followed by the development of wheals. They are said to occur most commonly on low islands and along sandy beaches. Two species of nonbiting midges (Chironomidae) are found in the Society Islands. They are of no medical importance, but because of their prevalence in certain regions, these swarming pests are sources of great annoyance.

Troublesome flies of the genus Hippelates, commonly known as "eye gnats," "fish flies" or "frit flies," are prevalent. They swarm about and get into the eyes, nose and ears. They are suspected of being mechanical carriers of diseases of the eyes.

Termites. Among the 33 species in French Oceania are the "house termite," *Kalotermes piceatus,* and the tropical termite, *Coptotermes pacificus.* These and other species belonging to the Termitidae are responsible for an enormous amount of damage to wooden structures and are of great economic importance.

Poisonous Plants

No information is available concerning the poisonous plants in French Oceania, other than that the nuts of the *hutu* tree are said to be poisonous.

Food and Dairy Products

The foods that constitute the native dietary are plentiful, but only limited quantities of those that are ordinarily eaten by Europeans are obtainable. No information is available concerning the incidence of malnutrition and deficiency diseases among the native inhabitants, but in reports concerning their diets it is suggested that diets are deficient, particularly in respect to their content of protein and vitamins. Information is lacking concerning the inspection of meat before or after the slaughter of animals. A small dairy industry is carried on in Papeete, but the supply of dairy products is limited. It is not known whether or not facilities exist for the pasteurization of milk and other dairy products. In view of the laxity with which most measures of public health are regarded, it is likely that even if the inspection of meats, milk and dairy products is prescribed, the regulations are not carefully enforced.

There are limited facilities for the manufacture of ice in Papeete on Tahiti and in Uturoa, on Raiatea. The plant at Papeete has a capacity of three tons a day. Cold-storage rooms are said to be operated in conjunction with the plant at Papeete, but information is lacking concerning the capacity of these rooms.

MEDICAL FACILITIES

Hospitals

Number of Beds. The Colonial Memorial Hospital at Papeete is a general hospital of 60 beds. A small general hospital of 11 beds is located at Taravao on Tahiti; another of 30 beds is situated at Uturoa on Raiatea; another is located at Atuana on Hiva Oa in the Marquesas. Borabora in the Society Islands has a dispensary-infirmary. Huahine in the Society Islands has a dispensary. A small maternity hospital is located at Papeete on Tahiti. Leper colonies or hospitals are situated at Orofaro on Tahiti, at Atuana and Puamau on Hiva Oa in the Marquesas, at Taiohae on Nukuhiva in the Marquesas, and on Reao Island in the Tuamotu group.

Equipment. Medical and surgical equipment, even in Papeete, is inadequate. The Colonial Memorial Hospital at Papeete has surgical facilities, a bacteriologic laboratory and an obsolete (1922) x-ray unit, but facilities, equipment and services at this hospital do not compare favorably with those of American hospitals. A quarantine station situated at Motu-uta Islet in the harbor of Papeete is provided with what is called a "sulfur room." A Clayton apparatus for the fumigation of ships is maintained on a barge. Facilities for isolation and quarantine are inadequate, at both the quarantine stations and on the mainland.

Medical Personnel

Physicians. Prior to 1940, there were 10 physicians practicing in French Oceania. On the island of Tahiti there was one physician for every 2,500 inhabitants, whereas in the rest of the colony there was only one physician for every 12,000 inhabitants. Four of the physicians on the staff of the Colonial Memorial Hospital at Papeete and one each at Taravao on Tahiti, at Uturoa, on Raiatea, and at Atuana, on Hiva Oa, were in government (military) service. Three civilian physicians were engaged in general practice in Papeete. All these practitioners were graduates of recognized French medical schools; the requirements for licensure in French Oceania are the same as those in France.

Nurses. There were 18 male nurses, 10 female nurses, and a Red Cross unit. With few exceptions, the nurses received their training at the nursing schools of the Colonial Memorial Hospital and the maternity hospitals in Papeete.

Others. Seven midwives, a pharmacist, members of a Red Cross unit and of several missionary groups, an unstated number of partially trained teachers who serve as auxiliaries to the public health service, and medical orderlies, is reported. Like the nurses, the midwives and medical orderlies received their training at the Colonial Memorial Hospital and the maternity hospitals in Papeete. The teachers from the various islands had short periods of instruction in health and sanitary matters, and constitute a semi-official body which collaborates with the health officials by administering simple forms of treatment, applying dressings and selecting patients in need of professional care. Both trained and untrained members of the aforementioned missionary groups serve in a similar capacity. Three dentists were in practice at Papeete. They were graduates of French dental schools.

Medical Institutions

Clinical and bacteriologic laboratories are operated in connection with the Colonial Memorial Hospital in Papeete. Schools of nursing and midwifery are conducted at the Colonial Memorial Hospital, but the facilities for training and instruction are limited.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Dysentery. Typhoid fever, paratyphoid fevers, bacillary dysentery and amebic dysentery are endemic in French Oceania (Table 27). Each year several cases of each are reported. In some of the outlying islands, however, outbreaks of a mild form of bacillary dysentery are frequent. The insanitary habits of the native inhabitants and the prevalence of flies and other insects are conducive to the spread of enteric diseases. These diseases, however, are controlled to a limited degree by vaccination against typhoid fever and paratyphoid fevers and the practice on the part of many of the natives of drinking coconut milk instead of water.

TABLE 27

Diseases Reported in French Oceania *

Disease	Cases, no. 1936	1937
Pneumonia	48	82
Grippe	3,851	1,094
Typhoid fever	5	4
Chickenpox	67	19
Tetanus	3	3
Tuberculosis	268	296
Syphilis	938	728
Gonorrhea	774	430
Soft chancre	0	2
Leprosy	89	79
Amebic dysentery	0	1
Bacillary dysentery	0	3
Intestinal parasitism	81	73
Filariasis	70	289
Yaws	37	32
Tropical (phagedenic) ulcer	2	19
Totals	6,233	3,154

* Abstracted from *Annales de médecine et de pharmacie coloniales*, Vols. 36 and 37, 1938 and 1939.

Cholera. In the absence of facilities for the treatment of water and for the disposal of sewage, conditions are favorable for the introduction and spread of cholera. Although this possibility is slight, the disease might occur if carriers of *Vibrio comma* or patients with cholera in the incubation period are transported to these islands.

Intestinal Parasitism. Intestinal parasitism, particularly ascariasis, enterobiasis and trichuriasis, is frequent among the native inhabitants, but the incidence is unknown. The figures seen in Table 27 are by no means representative.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis is a problem of paramount importance to the native population of French Oceania (Table 27). The communal habits of the native inhabitants, poor diets, lack of natural immunity and lack of appreciation of the rudimentary principles of sanitation and contagion are conducive to the spread of the disease. In 1936 the morbidity rate for tuberculosis in French Oceania was 1,600 per 100,000 of population. At the Colonial Memorial Hospital in Papeete between 20 and 25 per cent of all deaths are caused by tuberculosis. This disease is particularly prevalent in the Marquesas, where 60 per cent of all deaths are attributed to tuberculosis. The incidence of positive reactions to the tuberculin test among Marquesan school children is between 30 and 35 per cent. The incidence of tuberculosis among the Occidental population of French Oceania also is high, being about 1,000 per 100,000 of population.

Smallpox. A large proportion of the native population is said to be vaccinated against smallpox. This disease is not endemic in French Oceania, but in the past it occasionally assumed the proportions of major epidemics, and was associated with high fatality rates. In 1939 an extensive outbreak occurred in Tahiti in the Society Islands.

Chickenpox. Chickenpox is endemic, and extensive localized epidemics of it are of frequent occurrence.

Common Colds. Common colds and similar infections of the upper part of the respiratory tract are endemic in the principal centers of the islands. In the remote islands and among the groups of native inhabitants who have little contact with white men, these diseases do not exist, excepting when they are introduced. Once introduced, they readily assume epidemic proportions.

Other Communicable Diseases. Meningococcic meningitis, measles, mumps, scarlet fever, diphtheria, poliomyelitis, influenza, pneumococcic pneumonia and viral types of pneumonia are not very common in this region. Elsewhere in Polynesia and Melanesia experience has shown that the introduction of these diseases has been associated with the development of epidemics that have decimated population groups. The disastrous effects that are likely to attend the introduction of these diseases among the nonimmune native population of French Oceania, and especially such diseases as measles, whooping cough, influenza and pneumonia, cannot be overemphasized.

Diseases Spread Chiefly by Contact

Venereal Diseases. Syphilis and gonorrhea are rife on many of the islands, and occasional cases of soft chancre are reported (Table 27). Lymphogranuloma venereum has not been reported in recent years. Venereal diseases are problems of the greatest magnitude in French Oceania. Throughout the islands prostitution and promiscuity are indulged in by a very large proportion of the native women, both attached and unattached. These practices are aided and abetted by native custom, and ordinarily are unassociated with any moral or social stigma. Among some groups provocative offers on the part of the women are assisted by the men; among other groups, a woman's social prestige is based largely on the number of her conquests.

Efforts to control venereal diseases have been made on Tahiti, especially in Papeete, by the biweekly examination of the regularly listed prostitutes. Those who are found to be diseased are hospitalized and treated until they are rendered noninfectious. Dispensaries are operated at Taravao and Papeete on Tahiti, at Taiohae and Atuana in the Marquesas, and at Uturoa on Raiatea, where patients with venereal disease are treated and an effort is made to determine and locate the contacts. Provisions also are made for the follow-up examination of patients receiving treatment. This plan of treatment and control has been in operation since 1923, and although the results have been favorable, administration of the plan is not carried out firmly. Nine hundred and thirty-eight cases of syphilis were reported in 1936, and 728 cases in 1937; the majority of the patients were on Tahiti. Of all the communicable disease reported from French Oceania each year, between a third and a half is venereal disease.

Yaws. Yaws is rare among the European population but is of common occurrence among the native inhabitants, particularly those on Tahiti and the Moorea group of islands (Table 27). In some groups as much as 10 per cent of the population suffers from this disease.

Leprosy. Leprosy is of common occurrence in all the island groups, but the incidence is highest in the Marquesas. Between 80 and 100 new cases are reported each year, and it is estimated that about 1 per cent of the native population suffers from this disease.

Diseases of the Skin. Tropical (phagedenic) ulcers, mycotic infections, parasitic infestations, particularly the various types of pediculosis and scabies, and secondary infections of wounds, abrasions and bites of insects, are prevalent (Table 27).

Tetanus. Tetanus is endemic, and a few cases of this disease are reported each year (Table 27).

Diseases Spread by Arthropods

Filariasis. Filariasis, although more prevalent in some islands than in others, is practically universal throughout French Oceania. It is said to be especially prevalent on the islands of Huahine, Raiatea and Borabora in the Society group, in the Tubuai group, and on Eiao Island in the Marquesas. In the more heavily infected areas as much as 20 per cent of the population is affected. Each year filariasis develops among a few Occidentals. The use of nets is recommended by those who have lived in the highly endemic areas in which measures for the control of mosquitoes are not practiced.

Dengue Fever. Dengue fever has been reported from French Oceania, and the vector of this disease, *Aedes aegypti,* abounds throughout the islands. If dengue fever does not actually exist in French Oceania at present, the presence of the disease in adjacent groups of islands makes its introduction a distinct possibility. If introduced, it will be of importance because of the suddenness with which it strikes and the large numbers of people whom it temporarily incapacitates.

Malaria. Malaria does not occur in French Oceania. The possibility of the introduction of malaria and the anopheline vectors of the disease constitutes a distinct danger.

Yellow Fever. The lack of application of measures for the control of mosquitoes and the prevalence of the vector, *Aedes aegypti,* make it possible that epidemics of yellow fever will occur if infected mosquitoes or human beings are introduced. At present this danger is slight, but it may assume importance if regulations concerning the quarantine inspection and disinfestation of aircraft arriving from regions in which the disease is endemic are not strictly enforced.

Typhus Fevers. The vectors of epidemic (louse-borne) and endemic typhus (flea-borne) and probably of tropical (mite-borne) typhus are present. If these rickettsial diseases should be introduced, they would constitute a serious hazard to health.

Plague. If plague should be introduced from the other French possessions in the Pacific Ocean or from the continent of Asia, the large rat and flea population of French Oceania would form a reservoir favorable to the spread of this disease throughout the islands.

Miscellaneous

Infectious Jaundice. Occasional deaths are reported as having been caused by "infectious jaundice," but specific information concerning the etiology of the disease is not available. It is believed, however, that the disease is of spirochetal origin (*Leptospira icterohaemorrhagiae*).

Malnutrition. Malnutrition and subclinical types of avitaminosis are frequent.

SUMMARY

The Service of Medical Assistance, which is responsible for the control of public health, is incompletely developed and loosely organized. Such public health services, medical care and hospital facilities as are available are limited almost exclusively to the administrative centers of the various groups of islands, especially Papeete on Tahiti. Supplies of water are available on all islands excepting the low-lying atolls, but there are no facilities with which to ensure their safety. There are no sewerage systems. The disposal of sewage is accomplished by primitive methods, excepting on a few islands on which latrines are used. There is a shortage of the staple items of the Occidental dietary. Native foods are plentiful but qualitatively inadequate. In the absence of measures of control, local meat, milk and dairy products must be considered to be unsafe. The islands abound with vermin, and particularly rats, mosquitoes, flies, black flies, lice, termites and ants. Native houses and villages are of the primitive type and are often infested with vermin. The communal habits of the native inhabitants, their lack of natural immunity and their inability to appreciate the rudimentary principles of sanitation are conducive to the spread of disease.

The diseases of greatest importance are "grippe," venereal diseases, intestinal parasitism, diseases of the skin, tuberculosis, filariasis and yaws. Of utmost importance to the nonimmune native population are the common communicable diseases, and particularly common colds. Although malaria, dengue fever, yellow fever, the various types of typhus fever, plague and cholera are not encountered in French Oceania at present, they could be introduced readily and must be considered as potential hazards to be guarded against by quarantine, immunization and the strict inspection and disinfestation of incoming aircraft and ships.

BIBLIOGRAPHY

Buck, P. H.: Ethnology of Mangareva. Honolulu, Hawaii, The Museum, 1938. (Bernice P. Bishop Museum. Bull. No. 157.)

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

French Establishments in Oceania: Journal Officiel. Papeete, Tahiti, 1942.

Gast: La tuberculose aux îles Marquises. Ann. méd. pharm. col., Par. **37**:993-1000, 1939.

Gessler, G.: Road My Body Goes. New York, Reynal and Hitchcock, 1937.

Herms, W. B.: Medical Entomology, 3d ed. New York, The Macmillan Co., 1939.

Interviews and Reports: Medical Intelligence Division, Preventive Medicine Service, Office of The Surgeon General, U. S. Army.

Keesing, F. M.: The South Seas in the Modern World. New York, The John Day Co., 1941.

League of Nations. Health Organisation: Public Health Services in the French Colonies, by S. Abbatucci. Liége, Imp. G. Thone, 1926.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

Marquesan Insects . . . Honolulu, Hawaii, The Museum, 1932, 1935. (Bernice P. Bishop Museum. Bulletin Nos. 98, 114.)

Pacific Islands Year Book, 1939. Sydney, Australia, Pacific Publications, 1939.

Parson, H.: You Could Do It Too. Cleveland, Ohio, Nationwide Press, 1939.

Rudy, J. F.: And the Poor Travel Too. Nashville, Baird-Ward Press, 1941.

Society Islands Insects . . . Honolulu, Hawaii. The Museum, 1935. (Bernice P. Bishop Museum. Bulletin No. 113.)

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases, 6th ed. By R. P. Strong. Philadelphia, The Blakiston Co., 1942, 2 vols.

U. S. Bureau of Foreign and Domestic Commerce (Dept. of Commerce): World Trade in Dental and Surgical Goods. Washington, U. S. Govt. Print. Off., 1939.

Vogel, E., and Rouzic, J.: Les maladies transmissibles observées dans les colonies françaises et territoires sous mandat pendant l'année 1936. Ann. méd. pharm. col., Par. **36**:633-725, 1938.

—— and Riou: Les maladies épidémiques, endémiques et sociales dans les colonies françaises pendant l'année 1937. Ann. méd. pharm. col., Par. **37**:257-551, 1939.

17

Gilbert, Ellice, Ocean and Nauru Islands

GEOGRAPHY AND CLIMATE

Gilbert Islands. The 16 Gilbert Islands are a part of the Gilbert and Ellice Islands Colony, which was proclaimed as a protectorate of Great Britain in 1892 and annexed as a colony in 1915. The Gilbert Islands are Little Makin, Makin or Butaritari, Marakei, Abaiang, Tarawa, Maiana, Kuria, Aranuka, Abemama, Nonouti, Tabiteuea, Beru, Nukunau, Onotoa, Tamana, and Arorae. They are located within the area indicated by 5° of north latitude, 3° of south latitude, and 172 and 178° of east longitude. The total area is 166 square miles; the population in 1938 was some 27,000 and included about 90 non-natives, and 40 Asiatics. The rest were Gilbertese, who are Micronesians.

Ellice Islands. The Ellice Islands are situated between 5 and 12° of south latitude and 176 and 180° of east longitude. They include the islands of Funafuti, Nukufetau, Vaitupu, Nui or Netherland, Niutao or Lynx or Speiden, Nanumaga or Hudson, Nanumea or Saint Augustine, Nukulaelae or Mitchell, and Niulakita. The area of the Ellice Islands is only 14 square miles; the population was, in 1937, approximately 4,000, of whom only two were nonnatives.

Ocean or Banaba Island. Ocean Island, capital of the Gilbert and Ellice Islands Colony, is situated at, approximately, 1° of south latitude and 170° of east longitude, between the Gilbert Islands and Nauru Island. The island has a circumference of only 6 miles; in 1938 the population was about 2,700, including 140 non-natives and 700 Asiatics. The island was formally annexed to the Gilbert and Ellice Islands Colony in 1916.

Nauru Island. Nauru Island is about 26 miles south of the equator at 167° of east longitude. It has a circumference of some 12 miles, and a total area of slightly more than 8 miles. In 1940 there were 1,700 natives on the island, 1,300 Chinese, 200 British, Australians or New Zealanders, and perhaps 100 others, or a total of 3,300. The island is administered under a mandate conferred upon Great Britain in 1920.

All the islands under consideration are coral atolls with the exception of Ocean Island. Nauru Island is particularly noted for its deposits of high-grade phosphate. Coral reefs surround many of the islands; and as is common among islands of coralline origin, the elevation generally is low. Fertile soil can be found in small areas on a few of the islands, but sandy or coralline terrain predominates.

In the northern islands the annual rainfall may amount to as much as 150 inches (3.8 meters); but through a belt described by 1° of north latitude and 3° of south latitude drought may occur every few years. On Ocean Island, for instance, from 1909 through 1919, the annual rainfall varied from 14 to 174 inches (0.4 to 4.4 meters).

PUBLIC HEALTH *

Health Services

Organization. Public health work in the islands prior to the war was under the

* Unless otherwise indicated governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

administrative direction of a Chief Medical Officer located at Tarawa in the Gilbert Islands. This officer in turn was responsible to the High Commissioner for the Western Pacific, with headquarters at Suva in the Fiji Islands. On Ocean Island a medical officer employed by the British Phosphate Commission acted as a government medical officer assisted by another medical officer, a matron, a sister in charge of infant welfare, a dispenser, a native medical practitioner, and three native medical dressers. In the Ellice Islands a medical officer was in charge. The Chief Medical Officer, with headquarters in Tarawa, although responsible for the health program of the entire colony, gave most of his time to the work in the Gilbert Islands. Altogether, 10 native medical practitioners and 51 locally trained native dressers were reported to be assisting in health work throughout the colony in the year 1938.

Public health work on Nauru Island was directed by a Chief Medical Officer, with a staff of two medical officers, two sisters, one Nauruan native medical practitioner, a laboratory assistant, several native medical dressers and several nurse girls. The British Phosphate Commission on Nauru Island had its own medical organization which cooperated fully with the Government Health Department.

Relative Effectiveness. The public health program as carried out in recent years was considered to be fairly adequate. Special emphasis had been placed on maternal and child hygiene and on the prevention of infectious diseases. The use of trained native medical practitioners and native dressers had enabled the program to reach most of the people. The rise in the general economic and educational standards aided in the work. The effectiveness of the public health program is shown by the gradual increase in native population which until recent years had been characterized by a slow decline.

Water Supplies

Water is limited on all the islands. Rain water caught in various kinds of containers and water from wells, which during the dry season often is brackish, furnish the principal supply. Because of the porous character of the soil, rain water soon disappears. On most of the islands, however, ground water is obtained about 2 feet (0.6 meter) below the surface. Rain water is collected from the trunks of leaning palm trees; at times furrows are cut diagonally down the trunk to carry the water into artificial cavities near the base. Tin cans and drums, wooden buckets and jars also serve as water containers. Water collected from the roofs of foreign homes, churches and other buildings is stored in concrete or iron cisterns. Some of the natives, however, are afraid to use water collected from church roofs. Water from taro swamps frequently is used for cooking. Sea water is used as a substitute for common salt. Usually, the water is added to the food after it has been cooked; this practice may aid the dissemination of enteric infections since the sea water used is commonly contaminated by fecal material deposited on the beaches. Milk from green coconuts is readily obtainable; that from older coconuts as a rule is mildly laxative. Most of the water collected in containers is unprotected; it soon becomes stagnant and filled with mosquito larvae. Many of the wells are unprotected and shallow and are thus subject to frequent contamination. Although in recent years the health departments have encouraged the building of protected wells, removed as far as possible from human habitations and the sea, most water on the islands still is contaminated. The use of such water has been a factor in the production of outbreaks of dysentery.

Sewage Disposal

Although pollution of the soil, except for areas near beaches, is not common in the Gilbert, Ocean and Nauru islands, it is common in the Ellice Islands, where promiscuous defecation is practiced. The natives of the former group have a superstitious fear that harm will befall them if their feces, urine, hair and nail parings fall into the hands of others, especially their enemies; thus, these materials are deposited in places where they cannot be obtained easily. Through the years the beaches below high-tide mark have been the favorite site for defecation; they are convenient because the sea ordinarily is not more than a few hundred yards from the villages. In the Gilbert Islands over-the-sea drop latrines, connected to the beaches by bridges, have been built at intervals along the shore opposite each village. Such latrines also have been built in the Ellice Islands but have not been used commonly. The fecal material beneath the latrines is washed out to sea twice daily by the receding tide, but between tides it remains exposed to flies and other scavengers. Government houses for Occidentals were in most cases fitted with pan or bucket latrines. Some of the non-native homes were equipped with bacteriolytic tank systems. On Ocean Island the villages were supplied with simple pit latrines. A system in which sewage was water-borne was used in settlements of the British Phosphate Commission; hospitals, too, were served by this system. Government staff homes, police quarters, and the prison were equipped with "kaustine" chemical systems or with pan latrines. On Nauru Island the disposal of sewage and refuse was carefully supervised; it is probable that facilities were similar to those found on Ocean Island.

The disposal of garbage, refuse and waste in the majority of the islands was not entirely satisfactory. In most villages men or women were hired to dispose of rubbish; on many of the islands this material was deposited on the beach below high-tide mark. On Ocean Island, Saturday was "village clean-up day" and the collected wastes were either burned in incinerators or buried in the lagoon. In many of the villages, however, the garbage and other wastes were scattered about indiscriminately, leaving the chickens, pigs, dogs and rats free to act as scavengers. Thus, on most of the islands the insanitary disposal of excreta and other waste materials led to the pollution of the beaches, aided in the multiplication of flies, rodents and other carriers of disease, and was a factor in the spread of helminthiasis, dysentery and other diseases.

Insects and Animals

Vectors of Disease. Mosquitoes. Mosquitoes are abundant on all the islands, but are less numerous on Ocean and Nauru islands, probably because those islands had better measures of control than the others. Although breeding throughout the year, mosquitoes are said to be more plentiful after rains.

Anopheline mosquitoes have not been reported from any of the islands. The possibility cannot be ignored, however, that increased communication between these islands and areas to the south and west in which anophelines breed may introduce the mosquitoes.

Two species of Aedes mosquitoes are recorded from the Gilbert and Ellice Islands: *Aedes aegypti* and *A. pseudoscutellaris.* The same types probably are found also on Ocean and Nauru islands. *A. pseudoscutellaris* breeds in collections of water in coconut husks and pods (the interiors of which frequently have been eaten by rats), holes in trees, cavities at the junction of leaf stems and tree trunks; *A. aegypti* breeds in various tanks, jars and tins. Although Aedes mosquitoes prefer to live in dark, windless places and are most numerous about dwellings, they are also abundant in areas even 2 or 3 miles from habitations. *Aedes albopictus* has been reported from the Marshall Islands but not from Ellice, Gilbert, Ocean or Nauru islands. *Aedes aegypti* and *A. albopictus* are potential vectors of both dengue fever and yellow fever, which, however, have not been reported from any of the Ellice, Gilbert, Ocean, and Nauru islands. *Aedes pseudoscutellaris* is the chief vector of the nonperiodic strain of *Wuchereria bancrofti,* which is the common type found in the Gilbert and Ellice Islands.

One species of Culex, *Culex fatigans,* has been reported from the Gilbert and Ellice Islands; it is probably found also on the other islands. It has been introduced comparatively recently into the islands. Its breeding habits are similar to those of Aedes mosquitoes. *Culex fatigans* is the vector of the periodic type of filariasis, caused by *Wuchereria bancrofti.* The periodic type of filariasis is the form commonly found on Nauru and Ocean islands.

Measures of Control. Mosquito nets, smudges and incense are used in some homes, but except for limited measures of control about the British Phosphate Commission's establishments on Ocean and Nauru islands and about foreign homes and hospitals, little work in the control of mosquitoes has been done.

LICE. Lice of human beings are said to be abundant in the Gilbert and Ellice Islands. The species found are probably the head louse, *Pediculus capitis* and the pubic louse, *Phthirus pubis,* both of which have been recorded from Jaluit in the Marshall Islands and from other islands. It is probable that they are also found on Ocean and Nauru islands. Lice are potential vectors of *Rickettsia prowazeki* and some species of the genus Borrelia, the agents of epidemic typhus fever and relapsing fever, respectively. These diseases, however, have not been reported from the Ellice, Gilbert, Ocean or Nauru islands.

FLIES. Flies, and especially houseflies, are abundant but records of the names of the species found are not available. The insanitary conditions on many of the islands furnish favorable breeding conditions.

TICKS. There are no data regarding ticks in these islands.

FLEAS. Fleas have not been reported.

MITES. The common itch mite, *Sarcoptes scabiei,* is present in the Ellice, Gilbert and Nauru islands and probably occurs also on Ocean Island. It is reported to have been introduced into the Gilbert and Ellice Islands from Rotuma about 1864.

RODENTS. Rats are reported to be numerous in the Gilbert and Ellice Islands, and undoubtedly are found on Ocean and Nauru islands as well. In the health report of the Gilbert Islands for 1914 are details of an active campaign waged against rodents which live in and about the homes, in burrows and in trees. It is probable that the Pacific rat, *Rattus exulans,* one of the so-called *concolor* group which has colonized the Pacific islands, is the most prevalent species. This is the rat which commonly opens coconuts and lives on the meats found therein. Rats introduced in recent years, and probably found on many of the islands, are the black rat, *Rattus rattus,* the roof rat, *Rattus alexandrinus,* and the brown rat, *Rattus norvegicus.* In recent years measures for the control of rats have been carried out, especially in the vicinity of settlements of the British Phosphate Commission and some of the hospitals and foreign homes. In other places little has been done.

Snakes and Other Dangerous Animals. Many species of poisonous sea snakes are found in the waters about the islands. The poison of some of them is highly toxic, whereas that of others is only slightly so. They are not inclined to bite except when forcibly restrained and are reported never to attack bathers in the water. Fishermen are sometimes bitten. Poisonous land snakes are reported to be absent from the islands.

The definite types of scorpions and centipedes to be found are not known, but it is probable that the species which are widely distributed in the Japanese Mandated Islands and other South Sea Islands also are found in the Ellice, Gilbert, Ocean and Nauru islands. The two most common species of scorpions in this area are *Isometrus europaeus* (*Isometrus maculatus*) and *Hormurus australasiae. Scolopendra morsitans* and *S. subspinipes* are the most common species of centipedes. Undoubtedly other species also are present. Scorpions and centipedes frequently are found in thatched houses, under matting floors and in other damp places. They are more active at night and may crawl into shoes, clothing and luggage. Their bites, although extremely painful, are rarely fatal except to children.

Wild pigs are found on some of the islands but as a rule they are not dangerous.

Pests. Various kinds of ants, termites and beetles are found. The large black ant, *Odontomachus haematoda,* called the "South Sea needle ant" by the Japanese, and the brown biting ant, *Camponotus variegatus,* also known as the "South Sea giant red ant," are found throughout the South Pacific islands. The toddy beetles are present on practically all the Micronesian islands. As they gather coconut honey they do much damage to the coconut palms by injuring the male flowers. Since coconut honey and wine are known as "toddy," the beetles are called "toddy beetles." They secrete a material, believed to contain cantharidin, which is irritating to the skin. Giant robber crabs may be found. These crabs should be handled carefully to prevent minor personal injury. Fruit-eating bats are present. Lizards are recorded but apparently are not troublesome. Dogs are numerous.

Dangerous Marine Life

Morays or tropical eels (Muraenidae) are greatly feared by the natives. They have well-developed hollow teeth through which the venom is injected into the wound made by their bite. The venom is hemolytic; large doses produce practically instantaneous death, whereas smaller doses cause rapid and embarrassed respiration, violent cramps and convulsions. Other poisonous fish such as those of the family Scorpaenidae, have poison glands connected with dorsal and lateral spines. After puncture wounds or pricks by these spines, poison enters the wounds. In this general group are included the stonefish, toadfish, weever, zebra fish and others. The flesh of these fish is not poisonous. The sting ray (Trygonidae) is most dreaded. It is fond of basking in shallow water, and when stepped on inflicts serious wounds. It has a long flexible, whip-like tail which terminates in a bony spine. Along its tail there are many barbed spines. When the ray attacks it strikes its tail around some part of the victim and forces its spines into the flesh, causing deep lacerated wounds which are slow to heal because of the poison deposited in them. Poisonous jellyfish are found. Their stings are painful. Some species of coral also have tentacles which contain poisonous fluid.

Many fish whose flesh is poisonous are members of the genus Tetraodon. They are commonly known as puffer fish. Porcupine fish also are poisonous. The poison of these fish exists chiefly in the ovaries and testes. It has a physiologic action somewhat like that of curare and is thermostable. Fish of this group may fail to cause poisoning at one time, but may do so at another. It is particularly noted that poisoning occurs during spawning.

Man-eating sharks, sea urchins and octopuses are found in the waters about these islands; the latter generally are not dangerous as they swim away at the least provocation. The giant clam, *Tridacna gigas,* which sometimes becomes more than 2 feet (0.6 meter) long, also is present. It may do serious injury to the unwary person who happens to place a hand or foot between its valves.

Poisonous or Irritating Plants

Sour toddy made from the flowers of coconut palms formerly was extensively used by the natives of these islands. Its content of vitamin B is high. Sour toddy wine, however, is extremely intoxicating and is reported to have a deleterious effect on the urinary and nervous systems. Its use has been made illegal, but it is probably still used by some of the natives.

Food and Dairy Products

Supplies of food are hardly adequate for local use. Non-natives living on the islands ate many imported foods, most of which were too expensive for the natives to use. In general, the native diet is high in starchy foods and inadequate in fruits and vegetables. Their food is described as being improperly cooked, hard to digest and deficient in fat and protein. It consists almost entirely of products raised locally. The most widely produced food is the coconut. It is almost the only food plant that grows on some of the islands; it produces essentially all that the native needs. Coconut milk commonly is fed to infants. The meat is eaten; as copra, it is the chief export of the islands. Taro, breadfruit and pandanus (fresh and dried) furnish additional supplies of food. The papaya, lime, mango and banana are recorded as occurring on Nauru and may also be grown on some of the other islands. Very few vegetables are grown, because fertile soil is not abundant on the islands. Rice has been used on the islands, especially for feeding Chinese and native laborers; but since it is imported, it is too expensive for native consumption. Flour usually spoils after two or three months.

Miscellaneous Problems of Sanitation

Social customs, tabus, and climatic and geographic conditions through the years have interfered with the development of the Ellice, Gilbert, Ocean and Nauru islands. On the other hand, in spite of the fact that death rates were high, birth rates were still higher, so that until the entrance of the white man and his diseases, the natives were able to maintain their population. As a group the Gilbertese were afflicted with fewer natural or imported diseases than any other race in the Pacific. The white man brought tuberculosis, measles, influenza, pneumonia, venereal and other diseases which caused many deaths among the natives. He probably was responsible also for introducing yaws-infected natives into the islands in 1864. In recent years enforcement of quarantine and public health measures has decreased the morbidity and mortality rates. Ventilation in homes is poor. Coughing and spitting are uncontrolled; sputum is commonly deposited beneath floor and sleeping mats.

MEDICAL FACILITIES

Hospitals

Available reports indicate that before the onset of hostilities there were 35 hospitals of all kinds in the Ellice, Gilbert, Ocean and Nauru islands (Ellice, 8; Gilbert, 20; Ocean, 4; Nauru, 3). The Central Hospital for the Ellice Islands was located at Funafuti; each of the other islands, excepting Niulakita, which has no indigenous population, had island hospitals. The Central Hospital in the Gilbert group and the asylums for lepers and patients with nervous and mental diseases were situated at Tarawa. The others were island hospitals; two on Nonouti, two on Tabiteuea, and one on each of the other islands. The island hospitals, with a native medical practitioner or native dresser in charge, were much smaller than the central hospitals. During 1938, 61,019 outpatient and 3,373 inpatient treatments were administered in the island hospitals (Gilbert and Ellice Islands), and 2,828 operations were performed. The small asylum for patients with nervous and mental diseases at Tarawa had 10 inpatients at the end of 1938. The leper asylum of limited capacity was located on a small island near the Tarawa atoll. It served as a temporary abode for Gilbertese lepers before they were transferred to the Central Asylum at Makogai in the Fiji Islands. Outpatient departments were attached to each of the hospitals. In addition, there was a small dispensary at the King George V School at Tarawa and another at the London Mission School on Beru Island.

On Ocean Island the British Phosphate Commission maintained three separate hospitals; namely, one for Occidentals, one for Chinese, and one for natives. The government hospital on Ocean Island was situated near the hospitals of the British Phosphate Commission and served the local native inhabitants not in the employ of the phosphate company.

On Nauru Island there were three hospitals; one maintained by the British Phosphate Commission and the other two by the government. The hospitals of the British Phosphate Commission treated employees of the commission and their dependents; one government hospital gave medical care to the other persons living on the island; and the other, the government leper station and hospital, served the lepers of the island.

Equipment. The best-equipped hospitals in these islands were those maintained by the British Phosphate Commission. These hospitals had well-equipped operating rooms, and x-ray and clinical laboratories. On Ocean Island arrangements were made whereby the facilities of the hospitals of the British Phosphate Commission were made available to the government hospital. Both the Nauru Island hospitals were equipped with operating rooms, x-ray and laboratory facilities. At Tarawa the Central Hospital is described as consisting of a dispensary, an office, and a drugstore room in one block, operating and instrument rooms in another block, and a large rain-water cistern between the two. On one side of the main road of the hospital were located the patient wards—10 houses, each 24 feet long and 12 feet wide, built on more or less the same principle as an ordinary village house but of imported materials. On the opposite side of the road there were six more similar houses for the accommodation of the dressing staff and their families, and six houses built of native materials to house convalescent patients when the hospital was crowded. In addition there were outpatient rooms, dining and cooking houses, and various other houses. No reports were found concerning the presence of x-ray apparatus in any of the Ellice or Gilbert island hospitals. A typical island hospital is similar in type and construction to that of the Central Hospital, but is built on a smaller scale.

Supplies. All hospital and medical supplies used in the islands were imported. The Ellice and Gilbert island hospitals received medical and surgical supplies from central depots located at Funafuti and Tarawa.

Medical Personnel

Physicians. In 1938 there were seven or eight non-native physicians, distributed as follows: Ellice Islands, one; Gilbert Islands, one; Ocean Island, two; and Nauru Island, probably three or four. All were employed by either the government or the British Phosphate Commission. In addition there were at least 10 native medical practitioners; eight in the Gilbert and Ellice Islands and one each on Ocean and Nauru islands. The native medical practitioners were all graduates of the Central Medical School at Suva in the Fiji Islands.

Nurses. In 1938 there were two non-native nurses on Ocean Island. One served as matron at the hospital and the other was in charge of infant welfare. On Nauru Island there were also two non-native nurses. Nauru Island also had several nurse girls. There were about 50 or 55 locally trained medical dressers who performed most of the work that is done by the nurses in the usual European or American hospital. There were no facilities for the training of nurses.

Dentists. There were no dentists on the islands.

Others. On Nauru Island there was one non-native medical assistant who acted as radiologist and dispenser. There was also a laboratory assistant. In addition there were many native helpers who assisted in various ways.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. Dysentery and the common diarrheas are widespread throughout the islands. Typhoid fever and paratyphoid fevers are said to be spreading in the South Pacific islands, but they are either absent or rare in the Ellice, Gilbert, Ocean and Nauru islands. Only one record was found indicating the presence of typhoid fever in the Gilbert Islands. The use of polluted water, the prevalence of flies, the insanitary dietary habits of the people, in company with the general unhygienic conditions and the large number of human carriers of disease are the chief causes for the prevalence of dysentery and diarrhea. Both amebic and bacillary dysentery are endemic and occur throughout the year. In 1906 and 1907 an outbreak of dysentery, probably of the Shiga type, occurred among the Chinese employees of a phosphate company on Nauru Island. In 1938 the Tarawa Central Hospital treated 35 patients with dysentery (type not specified), and reported six deaths as caused by amebic dysentery. Common diarrheas are especially frequent among children. They are probably caused by the ingestion of contaminated food; since facilities for refrigeration are lacking among the natives, the opportunities for ingestion of such food are many.

Intestinal Helminthiasis. Infection with hookworm occurs among the natives of these islands. In the Ellice Islands the number of worms per person is high and ancylostomiasis is an important problem. In the Gilbert Islands the opposite is true; ancylostomiasis there is said to be almost nonexistent. This situation probably is due to the fact that the natives of the Ellice Islands have practiced promiscuous defecation, whereas the Gilbert Islanders have defecated on the beaches below the high-tide mark. *Necator americanus* is the predominant type of hookworm found; *Ancylostoma duodenale* occurs chiefly among outsiders, especially Chinese laborers. A survey of four of the Ellice Islands made in 1920, in which 404 stools were examined, gave a rate of infection of 53 per cent (adults, 58 per cent; children, 47 per cent). In the same year, 952 specimens of stool from natives of the Gilbert and Ocean islands were examined; it was found that 85 per cent of the stools contained ova of hookworms.

Infection with *Ascaris lumbricoides* occasionally has been reported from Ocean Island, rarely from the Gilbert Islands, and never from the Ellice Islands. Infection with *Trichuris trichiura* is widespread in the Gilbert and Ellice Islands. It also occurs on Ocean Island. In 1920 a survey in which 404 specimens of stool were examined showed a rate of infection of 47 per cent among the natives of the Ellice Islands, whereas 21 per cent of 952 specimens of stool from natives of the Gilbert and Ocean islands were found to contain the parasites. Infection with *Enterobius vermicularis* is recorded from Gilbert and Ocean islands but is reported to be absent in the Ellice Islands.

Infection with tapeworm has not been reported from any of the islands.

Paragonimiasis. A few cases of infection with lung flukes have been reported from Nauru Island, but none from the Gilbert, Ellice or Ocean islands. Since there are no streams of fresh water in the islands, it is not likely that this form of parasitism will become established.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Pneumonia, a frequent complication of influenza in these islands, is a common cause of death.

Influenza. Influenza often occurs in the islands. The first record of its occurrence in the Gilbert Islands was in the year 1898; another epidemic occurred in 1904; since then the disease has been reported almost yearly. It is common for outbreaks to occur after the visits of ships; such visits also bring common colds. In some years the infections are especially virulent. In 1934, for instance, a severe outbreak of influenza occurred after the arrival of two vessels at Tarawa. The disease soon spread over most of the other Gilbert Islands, and was responsible for the death of 73 people, most of whom were elderly. In 1935 a severe epidemic of influenza occurred on Ocean Island, where the Gilbertese and Banaban (natives of Ocean Island) laborers were affected. There were 38 deaths among the Gilbertese and three among the Banabans. Ninety-five per cent of the police and prisoners, 32 per cent of the non-natives and 7 per cent of the Chinese contracted the disease. In the next year on Ocean Island another epidemic involving some 400 persons occurred. In 1938 there were 513 cases. In that year 163 patients were treated in the Funafuti Central Hospital.

Tuberculosis. Tuberculosis, especially of the cervical glands, is prevalent throughout the Gilbert and Ellice Islands. Thousands of radical operations to remove these glands have been performed; in 1934 alone, 72 such operations were performed at the Tarawa Central Hospital. Pulmonary tuberculosis also occurs; meningeal and peritoneal tuberculosis occasionally is reported in children. Lesions of the bones and joints, however, are not common. Prevalence of tuberculosis is shown in part by the fact that about 30 per cent of the deaths in the Gilbert Islands annually are caused by tuberculosis. On Ocean Island tuberculosis is not so prevalent, but 14 of 44 deaths in 1937 were caused by tuberculosis. On Nauru Island tuberculosis is considered to be the second most important disease. In recent years tuberculosis has become less prevalent due, no doubt, to the efficient work of the health departments.

Smallpox. This disease never has been reported from the islands.

Diphtheria. Diphtheria occurs rarely in the Gilbert Islands, but never has been reported from Ocean and Nauru islands.

Poliomyelitis. In 1933 a few cases of anterior poliomyelitis were reported from the Ellice Islands. The disease did not spread from these islands.

Measles. Only two cases of measles were reported from the Gilbert Islands prior to 1936. That year measles was introduced from the Fiji Islands; a severe epidemic occurred in which 14,282 cases were reported in a total population of about 27,000. There were only 100 deaths. In the same year measles in epidemic proportions also occurred in the Ellice Islands.

Chickenpox. A few cases of chickenpox are reported from time to time. In 1931 more than 60 cases were reported from Tarawa in the Gilbert Islands. Twenty-two cases were reported from Ocean Island in 1934.

Diseases Spread Chiefly through Contact

Venereal Diseases. The most important venereal diseases among the natives of the Ellice, Gilbert and Ocean islands were reported to be gonorrhea and granuloma inguinale. These diseases were said to be less common among the natives of Nauru Island. Gonorrhea probably is more widely disseminated in the Gilbert and Ellice Islands than is generally thought. In 1937 it was stated that the disease was becoming more prevalent. Many ships bring new gonorrheal infection. In these islands the disease among the natives is reported to be mild, however, and rarely produces stricture or salpingitis. Chancroid and lymphogranuloma venereum have not been reported. Syphilis, except for its occurrence among foreign sailors and others visiting the islands, has not been reported.

Yaws. This disease, caused by *Treponema pertenue,* entered the Gilbert and Ellice Islands in 1864 from Samoa and Tahiti. Since then it has become widely distributed throughout these islands, and is perhaps the most common disease found. It is less prevalent on Ocean and Nauru islands. In 1931 it was stated that practically all the natives suffered from the disease at some time in their lives. Most native children formerly suffered from the disease during the period from three months to two years of age; yaws was a common cause of death among infants less than the age of one year. It is only in recent years that the health departments have been able to control yaws. One observer in 1924 saw only three patients with gangosa (considered to be a form of tertiary yaws) among thousands of natives examined; in 1938 secondary yaws and tertiary yaws were even more rare. The lessened demand for injections of neoarsphenamine (given by the native dressers) indicated the decrease in the number of cases. In 1929, it was reported, 16,261 such injections were given in the entire colony; 16,963 were given in 1935. By 1937 the figure was reduced to 11,044; and by 1938 to only 9,253. The natives soon learned the value of the treatment and came willingly for the injections.

Leprosy. Leprosy occurs in all the Gilbert Islands and on Ocean and Nauru islands, but is said to be nonexistent in the Ellice Islands. In 1909 only one leper was known to exist on Nauru Island; but from 1920 through 1934 there were 110 lepers reported among the 1,100 natives. Because of the rapid increase in the incidence of leprosy monthly physical examinations of all persons living on the island were required by law. Prior to 1935, lepers were segregated and treated at the leper station at Naanikai near the northern end of Tarawa. From 1928 through 1934 there were on the average about 30 lepers under treatment in this institution, but in November, 1935, all the 48 known lepers in the islands were sent to the Central Leper Asylum at Makogai, Fiji. Eleven of the lepers were Banabans, 36 were Gilbertese, and one was a Chinese. From 1935 to the occupation of the islands by the Japanese the hospital at Naanikai served as the temporary asylum until the lepers could be transferred to the central asylum at Makogai. Nineteen lepers, including one non-native, were transferred to the central asylum at Fiji in 1938.

Diseases of the Eyes. In the health report of 1928 for the Gilbert and Ellice Islands Colony it was said that catarrhal conjunctivitis occurred frequently among the natives. One patient with trachoma was treated at the Tarawa Central Hospital and two at the hospital of the British Phosphate Commission on Ocean Island.

Diseases of the Skin. Diseases of the skin are fairly common among the natives of the Ellice, Gilbert, Ocean and Nauru islands but, compared with other peoples of the Pacific islands, these natives are relatively free of cutaneous infections. Scabies, said to have been introduced from Rotuma in 1864, is prevalent. Ulcers and abscesses are common; they often result from lack of care given to small abrasions and bites of insects. Infection with ringworm such as tinea circinata and tinea imbricata is rare. Erythrasma has been reported from Nauru Island. Leukoderma frequently occurs, and is considered to be a mark of beauty by the natives.

Tetanus. In 1938 one case of tetanus was reported from Ocean Island.

Diseases Spread by Arthropods

Filariasis. Filariasis is prevalent throughout the Ellice Islands; reports made in 1928 indicated that these islands had a higher incidence of filariasis than have any of the other Pacific islands. Recently the disease was introduced into the northern Gilbert Islands. Cases are reported from Ocean and Nauru islands. In the southern Gilbert and Ellice islands, where the nonperiodic type of filariasis is prevalent, *Aedes pseudoscutellaris* is the vector, whereas on Ocean and Nauru islands, where the periodic type of disease is found, *Culex fatigans* is the vector. Both types are caused by *Wuchereria bancrofti*, but the strain causing the nonperiodic type of filariasis sometimes is spoken of as *W. pacifica*. Examination of the blood of certain unselected natives of the Ellice Islands in 1920 showed that 61 per cent had filariasis. Elephantiasis was known to occur on Nukunau (one of the southern Gilbert Islands). In 1937 and 1938 examinations of the blood made on five of the northern Gilbert Islands showed that the disease also had spread into that area. On Maiana the blood of 155 unselected persons was examined; 10 had the periodic type of disease and 10 had the nonperiodic type. Farther north at Butaritari only one person of 908 had the disease; in another survey no patients were found among the 414 persons examined. During 1938 only one person with filariasis was admitted to the Tarawa Central Hospital; four were admitted to the Ocean Island hospitals, and 10 to the Funafuti Central Hospital. Prior to present hostilities the Government Health Department was seeking to check the spread of filariasis into the northern Gilbert Islands.

Malaria. Malaria does not occur in these islands; neither do anopheline mosquitoes.

Yellow Fever. Yellow fever has never been reported from these islands, but its chief vector, *Aedes aegypti,* is present. It is not impossible that infected Aedes mosquitoes could be brought in by airplane from areas in which the disease is endemic.

Dengue Fever. Dengue fever is not reported. The disease is known to occur sporadically in the Palau, Caroline, Marshall and Hawaiian islands as well as in some of the other islands of the South Pacific. It is therefore possible that the disease could be introduced at any time and could spread rapidly due to the abundance of its vector, *Aedes aegypti.*

Plague. Plague has not been recorded from this area, although it is endemic in the Hawaiian Islands, Netherlands East Indies, New Caledonia and other areas with which communication may be frequent.

Typhus Fever. Typhus fever has not been reported from the Ellice, Gilbert, Ocean or Nauru islands.

Nutritional Diseases

In spite of the somewhat inadequate diet of the majority of the natives, nutritional diseases are surprisingly rare. Toddy (a drink made from flowers of the coconut palms and not to be confused with sour toddy wine), used by adults and also given to infants, has done much to prevent diseases having a basis in deficiency of vitamin B. Since the entrance of the white man with rice, biscuits and tinned goods, beriberi has appeared. It occurs, however, almost entirely among the laborers of the phosphate commission who have been subsisting on an inadequate diet. In 1934 beriberi was unusually prevalent among the Banaban and Gilbertese laborers on Ocean Island; 157 cases were reported, with 29 deaths (13 adults; 16 infants). Both the wet and dry types of beriberi were present. Ninety-six cases of beriberi were reported in 1935; in 1936 there were 110 cases and nine deaths; in 1937 the figure was 50 cases and three deaths. In 1938 there were 32 cases and six deaths. Other deficiency diseases have not been reported from this region.

Miscellaneous

In the health report of the colony for 1934 it was said that two patients with jaundice were admitted to the Tarawa Central Hospital. The cause of the jaundice was not given. Instances of catarrhal jaundice have been reported from the Marshall Islands; a type of malignant jaundice of unknown etiology has been recorded from Samoa. The true diagnosis in these cases is not known.

SUMMARY

Prior to the war the public health, medical and hospital facilities in the Ellice, Gilbert, Ocean and Nauru islands were considered to be adequate for the health and medical requirements of the people. Public health was under the direction of English health officers who were assisted by several native medical practitioners and many locally trained dressers. Rainfall and wells furnish the only fresh water available on the islands; the supply is limited, especially in the southern Gilbert Islands. Systems in which sewage is water-borne and a few chemical systems were in operation at the foreign establishments on Ocean and Nauru islands and in a few of the foreign homes. In other foreign homes the pan-and-bucket system was used. Most of the natives use over-the-sea latrines built on the beaches below high-tide mark and connected to the shore by bridges or they use the beach itself. Practically no supplies of food excepting coconuts and a few fish can be obtained locally. Medical and hospital supplies were imported.

Mosquitoes capable of transmitting filariasis, dengue fever and yellow fever are widely distributed. Mosquitoes capable of carrying malaria are not found. Flies and lice abound. Scorpions, centipedes, bats, rodents, poisonous sea snakes, poisonous fish, sharks, wild pigs, and several kinds of ants and beetles are either pests or potentially dangerous animals which vary greatly in distribution.

Diseases of importance are enteric diseases (amebic dysentery, bacillary dysentery and the common diarrheas); venereal diseases (gonorrhea, granuloma inguinale); and diseases of the skin, tuberculosis and hookworm.

BIBLIOGRAPHY

Attems, C.: Die indo-australischen Myriopoden. Archiv für Naturgeschichte, 80, Abt. A, Hft. **4**:1-398, 1914.

——: Myriopoden von Hawaii. Proc. Zool. Soc. Lond., 108, Ser. B: 365-387, 1938.

Bartels: E. Marschall-Inseln. I. Klima und Gesundheitsverhältnisse des Schutzgebietes der Marschall-Inseln, 1898/99. II. April 1899 bis 31. März 1900. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **17**:553-557; 558-560, 1900.

Bartsch, P.: Molluscan Intermediate Hosts of the Asiatic Blood Fluke, *Schistosoma japonicum*, and Species Confused with Them. Washington, Smithsonian Institution, 1936. (Smithsonian Miscellaneous Collections, Vol. 95, No. 5.)

Born: Aus einem Reisebericht über die gesundheitlichen Verhältnisse auf dem Atoll Ebon Marschallinseln, Arch. f. Schiffs- u. Tropen-Hyg., **19**:153-154, 1915.

——: Mitteilungen aus den deutschen Schutzgebieten. G. West-Karolinen. Gesundheitsverhältnisse auf den West-Karolinen im Jahre 1902/03. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **21**:619-21, 1904.

——: G. West-Karolinen. Gesundheitsverhältnisse. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **21**:115-137,1904.

Braunert: Reisebericht über einen Besuch verschiedener Atolle der Marschallinseln. Arch. f. Schiffs- u. Tropen-Hyg., **17**:11-15, 1913.

Brumpt, E.: Précis de parasitologie. Paris, Masson & Cie, 1927.

Buck, P. H.: Vikings of the Sunrise. New York. F. A. Stokes Co., 1938.

Butler, C. S.: Human Yaws. U. S. Nav. M. Bull., **35**:6-8 (Jan.) 1937.

Buxton, P. A.: Researches in Polynesia and Melanesia. Pts. V-VII (Relating to Human Diseases and Welfare). London, The London School of Hygiene and Tropical Medicine, 1928. (Memoir Ser. No. 2.)

——, and Hopkins, G. H. E.: Researches in Polynesia and Melanesia. Pts. I-IV (Relating Principally to Medical Entomology). London, The London School of Hygiene and Tropical Medicine, 1927. (Memoir Ser. No. 1.)

Byam, W., and Archibald, R. G.: The Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1923. 3 vols.

Cheesman, L. E.: Hunting Insects in the South Seas. London, P. Allan & Co., Ltd., 1932.

Christian, F. W.: The Caroline Islands; Travel in the Sea of the Little Islands. London, Methuen & Co., 1899.

Cilento, R. W.: The White Man in the Tropics with Especial Reference to Australia and Its Dependencies. Melbourne, H. J. Green, Govt. Print., 1925.

Clench, W. J., and Kondo, Y.: The Poison Cone Shell. Am. J. Trop. Med. **23**:105-120 (Jan.) 1943.

Cochran, D. M.: Poisonous Reptiles of the World; A Wartime Handbook. Washington, Smithsonian Institution, 1943. (Smithsonian Institution War Background Studies No. 10.)

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 3d ed., Philadelphia, Lea & Febiger, 1943.

Crow, G. B.: Filariasis on the Island of Guam. J.A.M.A. **55**:595-596 (Aug. 13) 1910.

Daniel, H.: Islands of the Pacific. New York, G. P. Putnam's Sons, 1943.

Darling, S. T.: Geographical and Ethnological

Distribution of Hookworm. Parasitology, **12**: 217-233 (Sept.) 1920.
Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.
Earle, K. V.: Echinoderm Injuries in Nauru. M. J. Australia, **28**:265-266 (Sept. 6) 1941.
——: Medical Work in Nauru. The Medical Press and Circular, **207**:38-40 (Jan. 21) 1942.
Elliott, H. W.: Guam. U. S. Nav. M. Bull. (Suppl. No. 11): 30-35 (Oct.) 1919.
Esaki, T.: A Preliminary Report on the Entomological Survey of the Micronesian Islands under the Japanese Mandate, with Special Reference to the Insects of Economic Importance. Proc. Pacific Sc. Congr., 1939, 6th Congr., **4**:407-415, 1942.
——: Injurious Arthropoda to Man in Mandated South Sea Islands of Japan (First report). Volume Jubilare pro Professore Sadao Yoshida. Osaka, Osaka Natural History Society, 1939, **1**:230-252.
Freeman, G. F.: Epidemic Bronchial Asthma of Guam. U. S. Nav. M. Bull. **1**:88-91 (April) 1907.
Furnesse, W. H.: The Island of Stone Money, Yap of the Carolines. Philadelphia, J. B. Lippincott Co., 1910.
Germany. Reichs-Kolonialamt: Medizinal-Berichte über die Deutschen Schutzgebiete. Deutsch-Ostafrika, Kamerun, Togo, Deutsch-Südwestafrika, Deutsch-Neuguinea, Karolinen, Marschall- und Palau-Inseln und Samoa für das Jahr 1911/12. Berlin, E. S. Mittler u. Sohn, 1915.
Gilbert and Ellice Islands Colony. Medical Officer: Medical and Sanitary Report for the year 1938. Suva, Fiji, 1939.
Girschner: D. Karolinen-Inseln. Bericht über Klima and Gesundheitsverhältnisse auf Ponape im letzten Vierteljahr des Jahres 1899. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **17**:550-553, 1900.
——: II. Klima und Gesundheitsverhältnisse auf den Karolinen und Marianen in der Zeit vom 9. April 1900 bis 1. April 1901. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **19**:440-442, 1903.
——: IV. Die Krankheitsverhältnisse auf den Marianen. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **19**:445, 1903.
——: F. Ost-Karolinen. Klima und Gesundheitsverhältnisse auf den Ost-Karolinen im Jahre 1901/1902. Arbeiten aus dem Kaiserlichen Gesundheitsamte, **21**:612-619, 1904.
Grimble, Sir Arthur: War Finds Its Way to Gilbert Islands. Nat. Geogr. Mag. **83**:71-92 (Jan.) 1943.
Grunwell, A. G.: Report on an Epidemic of Acute Anterior Poliomyelitis of Adults on the Island of Guam. *In* U. S. Bureau of Medicine and Surgery. Annual Report of The Surgeon General, 1900. Washington, U. S. Govt. Print. Off., pp. 224-227.
Guam. Governor: Annual Report, 1932-1941. Washington, U. S. Govt. Print. Off., 1933-1942.
Halton, E. P.: Aetiology of Gangosa, based upon Complement Fixation. U. S. Nav. M. Bull., **6**:190-193 (Apr.) 1912.
Hamlin, H.: The Geography of Treponematosis. Yale J. Biol. & Med., **12**:29-50 (Oct.) 1939.
Insects of Guam. Honolulu, Hawaii, The Museum, 1942. (Bernice P. Bishop Museum. Bull. 172.)
Iseki, K.: Untersuchung über die akute juckende Dermatitis hervorgerufen durch "Karasus." Acta dermat., **21(5-6)**:178-179, 1933.
Ito, M., and Yamenouti, G.: A Contribution to the Knowledge of Skin Diseases in the South Sea Islands. Hifuka Hitsunyokika Zassi (J. of Dermatology and Urology) (Jap. J. Derm. Urol.), **49**:278-285 (1941).
Japan South Seas Bureau: Annual Report of the Administration of the South Sea Islands Under Japanese Mandate for the Years 1926-30 and 1934-37. Tokyo.
Keesing, F. M.: The South Seas in the Modern World. New York, The John Day Company, 1941.
Kerr, W. M.: Notes on the Existence of Ancylostoma Duodenale in Guam. U. S. Nav. M. Bull., **5**:145 (Jan.) 1911.
——: A Report on the Prevalence of Framboesia (Yaws) in Guam, and Its Connection with the Etiology of Gangosa. U. S. Nav. M. Bull., **6**:549-552 (Oct.) 1912.
Kindleberger, C. P.: Naval Station, Guam. U. S. Nav. M. Bull., **8**:528-532 (July) 1914.
——: Sanitary Conditions in Guam; Abstract, Sanitary Report, 1911. U. S. Nav. M. Bull., **6**:464-472 (July) 1912.
——: An Epidemic of Measles and Mumps in Guam. U. S. Nav. M. Bull., **8**:243-247 (April) 1914.
——: Intestinal Parasites and Diseases found in Guam. U. S. Nav. M. Bull., **8**:381-410 (July) 1914.
Kramer: Die Medizin der Truker. Arch. f. Schiffs- u. Tropen-Hyg., **12**:456-464, 1908.
Krieger, H. W.: Island Peoples of the Western Pacific: Micronesia and Melanesia. Washington, Smithsonian Institution, 1943. (Smithsonian Institution War Background Studies No. 16.)
Kumm, H. W.: The Geographical Distribution of the Yellow Fever Vectors. Baltimore, The

American Journal of Hygiene, 1931. (Am. J. Hyg. Monographic Ser., No. 12.)

Kuroda, N.: Distribution of Mammals in the Japanese Empire. J. of Mammalogy, **20**:37-50 (Feb. 14) 1939.

Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, Hawaii, The Museum, 1934. (Bernice P. Bishop Museum. Special Publ. 23.)

——: Health Survey of the Gilbert and Ellice Islands with Special Reference to Hookworm Infection. Suva, Fiji, 1924.

——: Medical Conditions in the South Pacific. M. J. Australia, **2**:362-378 (Sept. 22) 1928.

——: Yaws in the South Pacific. Am. J. Trop. Med., **9**:429-437 (Nov.) 1929.

Leach, P.: Sanitary Report on Guam, L. I. *In* Annual Report of The Surgeon General, U. S. Navy, 1900. Washington, U. S. Govt. Print. Off., pp. 208-212.

League of Nations. Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers: IV C. Note on the Central Medical School in Suva in Relation to the Health Problems of the Pacific. Geneva, 1937. pp. 62-68.

——: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers: V. Memorandum on Public Health Organization of the Gilbert and Ellice Islands Colony. Geneva, 1937.

Lever, R. J. A. W.: The Bed Bug in Melanesia. Agr. J. Fiji, 13 (1), p. 26, Suva, 1942. Abst. in Rev. Appl. Entom., 31 (Ser. B): 18 (Feb.) 1943.

Manson, P.: Manson's Tropical Diseases. Ed. by P. H. Manson-Bahr. 11th ed. Baltimore, Williams and Wilkins Co., 1941.

Mayer, A. G.: The Islands of the Mid-Pacific. Scient. Month., N. Y., **2**:125-148 (Feb.) 1916.

Mayer: Augenerkrankungen auf Saipan. Arch. f. Schiffs- u. Tropen-Hyg., **16**:709-710, 1912.

——: Über Helminthen in Saipan. Arch. f. Schiffs- u. Tropen-Hyg. **16**:704-705, 1912.

McCullough, F. E., and Angeny, G. L.: Guam Reports on Health and Sanitation for the Years 1907 and 1908. U. S. Nav. M. Bull., **3**:321-333 (July) 1909.

McCullough, F. E.: History of Epidemics in Guam. U. S. Nav. M. Bull., **2**:22-25 (July) 1908.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

Mears, J. B.: Measles Epidemic in Guam, 1932. U. S. Nav. M. Bull., **31**:334-337 (July) 1933.

Mumford, E. P.: Mosquitoes, Malaria and the War in the Pacific. Science, **96**:191-194 (Aug. 28), 1942.

Mumford, E. P.: Manual on Distribution of Infectious Diseases in the South Pacific Islands. In Press.

——: Preliminary Report on the Infectious Diseases of Enemy Occupied Territories. Part I: The Japanese Mandated Islands and Guam. J. Trop. Med. and Hyg., **46**:15-23 (Apr.-May) 1943.

——, and Mohr, J. L.: Background to Post-war Reconstruction. Part I. Preliminary Report on Parasitic and Other Infectious Diseases of the Japanese Mandated Islands and Guam. Am. J. Trop. M., **23**:381-400 (July) 1943.

Nauru: Report to the Council of the League of Nations on the Administration of Nauru during the year 1940. Canberra, Australia, Govt. Print., 1941.

O'Connor, F. W.: Some Results of Medical Researches in the Western Pacific. Tr. Roy. Soc. Trop. Med. and Hyg., **16**:28-56. 1922-23.

Porter, F. E.: Health Conditions in Guam. Report of the Department of Health for the fiscal year 1931. U. S. Nav. M. Bull., **30**:446-453 (July) 1932.

Potgeiter, M.: Taro (*Colocasia esculenta*) as a Food. J. Am. Dietetic Assn., **16**:536-540 (June-July) 1940.

Price, W.: Japan's Islands of Mystery. Saturday Evening Post, pp. 26-7, 46-50 (Apr. 25) 1942.

——: Hidden Key to the Pacific. Nat. Geogr. Mag., **81**:759-785 (June) 1942.

——: Pacific Adventure. New York, Reynal & Hitchcock, 1936.

Price, W. A.: Studies of Relationships between Nutritional Deficiencies and (a) Facial and Dental Arch Deformities and (b) Loss of Immunity to Dental Caries among South Sea Islanders and Florida Indians. Dental Cosmos, **77**:1033-1045 (Nov.) 1935.

Randall, J. A.: Twenty-two Cases of Poisoning by the Seed of *Jatropha curcas*. U. S. Nav. M. Bull., **8**:290-291 (April) 1914.

Reed, E. U.: Human Intestinal Parasites in Guam. U. S. Nav. M. Bull., **20**:137-140 (Jan.) 1924.

Rife, C. F.: Climatic Buboes in Kusaie, Caroline Islands. J. Trop. Med., **5**:251-252 (Aug. 15) 1902.

Roland, M.: Géographie médicale, Un Archipel peu connu (l'archipel Gilbert). J. d'hyg., Paris, **23**:229-233 (May 19) 1898.

Stafford, W. E.: The Useful Plants of the Island of Guam with an Introductory Account of the Physical Features and Natural History of the Island, of the Character and the History of Its People, and of Their Agriculture. Washington, U. S. Govt. Print. Off., 1905. (Smithsonian Institution. Contributions from the U. S. National Herbarium, Vol. 9.)

Schnee: Augenerkrankungen auf den Marianen. Arch. f. Schiffs- u. Tropen-Hyg., **14**:695, 1910.

——: Die europäischen Infektions-Krankheiten auf den Marschallinseln. Arch. f. Schiffs- u. Tropen-Hyg., **11**:583-587, 1907.

——: E. Marschall-Inseln. Gesundheitsverhältnisse des Schutzgebietes der Marschall-Inseln in der Zeit vom 1. April 1900 bis 31. März 1901. Arbeiten aus dem kaiserlichen Gesundheitsamte, **19**:433-435, 1903.

——: Über Mücken in Saipan. Arch. f. Schiffs- u. Tropen-Hyg., **16**:710, 1912.

Stiles, C. W.: The American Hookworm (*Necator americanus*) in Guam and China. Johns Hopkins Hosp. Bull., **17**:313 (Sept.) 1906.

Stitt, E. R.: A Case of Gangosa in a White Man. U. S. Nav. M. Bull., **1**:96-97 (April) 1907.

——: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed. by R. P. Strong. Philadelphia, The Blakiston Co., 1942. 2 vols.

Strong, W. M.: Nutritional Aspects of Depopulation and Diseases in the Western Pacific, especially in Papua. M. J. Australia, **2**:506-512 (Oct. 22) 1932.

Stuart, M. A., and Slagle, T. D.: Jellyfish Stings, Suggested Treatment, and Report on Two Cases. U. S. Nav. M. Bull., **41**:497-501 (March) 1943.

Sunder: III. Bericht über die Gesundheitsverhältnisse auf Yap. Arbeiten aus dem kaiserlichen Gesundheitsamte, **19**:443-444, 1903.

Tate, G. H. H.: Rodents of the Genera Rattus and Mus from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. Bull. Am. Mus. Nat. Hist., **68**:145-178 (Feb. 11) 1935.

Thompson, G. B.: The Siphunculata or Sucking-Lice Recorded from the Pacific Islands. Entomologist's Monthly Magazine, **74**:90-94, 1938.

Tokunago, N., and Esaki, T.: A New Biting Midge from the Palau Islands, with Its Biological Notes. Mushi, **9**:55-58 (Dec.) 1936. Abstr. in Rev. Appl. Entom. ser. B. 25: 154 (July) 1937.

United States War Department. Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. Washington, Govt. Print. Off. 1943. (Technical Manual TM10-420.)

Voretzsch, A. M.: Ueber die Entwicklung der Gesundheitsverhältnisse insbesondere der wichtigsten Infektions-Krankheiten in Deutsch Neu-Guinea und im Bismarck-Archipel in den Jahren 1922-35. Deutsche Tropenmed. Ztschr., **46**:113-32; 137-52, 1942.

Weckler, J. E.: Polynesians, Explorers of the Pacific. Washington, Smithsonian Institution, 1943. (Smithsonian Institution, War Background Studies No. 6.)

Wendland: Bericht über einige an Bord der von Ponape zurückgekehrten Kriegsschiffe aufgetretene Erkrankungen von Typhus exanthematicus (Flecktyphus). Arch. f. Schiffs- u. Tropen-Hyg., **16**:33-34, 1912.

Wheeler, W. M.: The Ants of Guam. J. New York Entom. Soc., **20**:44-48, 1912.

Whitley, C. P.: Poisonous and Harmful Fishes. Melbourne, Govt. Print., 1943. (Council for Scientific and Industrial Research, Bull. No. 159.)

Wilson, P. W.: Maturation of Ascaris Ova in Sea Water; a Possible Factor in Dissemination of Ascariasis in American Samoa. Am. J. Trop. Med., **22**:305-307 (May) 1942.

Yogi, K.: A Contribution to the Clinical Knowledge of Asthma Bronchiale. I. A Statistical Observation on the Origin of the Disease, Especially Its Regional Specificity. Tawian Igakkai Zassi (J. of the Formosa M. A.), **39**:1989-1998 (1940).

Yukogawa, S.: The Spread of *Wuchereria bancrofti* and Its Relationship to the Human Flea, *Pulex irritans*. Volumen Jubilare Pro Professore Sadao Yoshida. Osaka, Imperial University, 1939. Vol. II:285-290.

18

Guam

GEOGRAPHY AND CLIMATE

The island of Guam, situated at the extreme southern tip of the Marianas Archipelago, was ceded to the United States in 1898 by the terms of the Treaty of Paris. The island lies within the area described by 144 and 145° of east longitude and 13 and 14° of north latitude. It has an area of about 225 square miles. The population in 1939 was 22,800, of whom some 21,000 were considered to be natives—that is, Chamorros. The rest of the population included personnel of the United States Navy and a few persons not native to either Guam or the United States. The Chamorros speak a dialect common to the Marianas and Palau islands; Spanish is used to some degree. English is the official language.

Guam is a volcanic, mountainous island 32 miles long and from 4 to 10 miles wide. A central ridge of hills divides the island into a northern and a southern half. The northern part is a heavily wooded plateau, bordered by high cliffs; the southern part is featured by a mountain ridge which at one point is 1,334 feet high. A strip of lowland, about a half mile wide, partly surrounded by mangrove swamps and marshes, parallels the southwestern coast. Coral reefs almost completely surround the island.

The northern part of Guam has no rivers, but small streams carry a considerable amount of water from the base of Mount Santa Rosa to various inland areas, where it is absorbed in the coralline soil. Five rivers are found in the southern half of the island; they proceed from the mountain ridge and flow through fertile valleys to the eastern shore. Four or five bays indent the coast line of the southern part of the island, but the only good harbor is Port Apra (or San Luis d'Apra) on the western coast.

The climate is hot and humid, but is tempered to some extent by breezes. In the highlands the mean annual temperature is about 80° F. (26.6° C.); coastal temperatures are somewhat higher. In the vicinity of Agaña the mean temperature is approximately 86° F. (30° C.) in January and 89° F. (31.6° C.) in May; the annual mean temperature is 87° F. (30.6° C.). The dry season persists from December to June; the rainy season extends from June to December. During the latter period typhoons are frequent; from December to May the northeastern trade winds are prevalent. The southeastern monsoon blows, generally, from June to December. The average annual precipitation is about 92 inches (2.3 meters); two thirds of this figure is attained during the rainy season (June to December.

PUBLIC HEALTH *

Health Services

Organization. Prior to occupation by the Japanese in 1941, Guam was administered by the United States Navy. The Governor was a naval officer, appointed for a two-year term by the Secretary of the Navy. All administrative officers were selected by the Governor, and all governmental departments were responsible to him. The Health

* Unless otherwise indicated, governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

Department and the Medical Department were closely associated and overlapped.

The Health Department was responsible for public health education, for the administration of all sanitary measures, and for the enforcement of quarantine regulations in Port Apra and at the airport. The head of the department was the Health Officer, who was also in charge of all branches of the Medical Department, and served as Commanding Officer of the Naval Hospital. In his capacity as health officer he supervised inspection of meat, water and sewerage systems and sanitation, and was responsible for the reporting and prevention of communicable diseases, and for the inspection and vaccination of school children. In this work he was assisted by two medical officers, 10 hospital corpsmen, and three native nurses. The latter were paid by the Red Cross.

The Medical Department was responsible for the maintenance of the Naval Hospital, Susana Hospital, the outpatient department (consisting of numerous free clinics), the leper colony at Tumon, and the dispensary at the Marine Barracks, Sumay. The department assigned medical officers to detached duty wherever needed, and provided hospital corpsmen and medical and surgical supplies and equipment to six outlying dressing stations.

Relative Effectiveness. The public health program was considered to be fairly adequate, although in all reports the need was stressed for one naval medical officer or more, especially trained in public health. Under the naval government health conditions improved greatly. Water supply systems and sewage disposal systems had been constructed, but were still not entirely adequate. Water and sewerage projects were paid for in part by the island government, and in part by the United States Government. Garbage was collected regularly in Agaña, but elsewhere refuse was thrown into the yards or fed to pigs. Regular inspection of meat was carried out. Quarantine measures concerning ports and airports were enforced, and a quarantine station was maintained on Cabras Island. The incidence of yaws had been materially reduced by the systematic injection of arsphenamine. The number of lepers on the island had been reduced from 185 in 1908 to four in 1941. The control of tuberculosis was still inadequate.

The Medical Department provided clinics, staffed by hospital corpsmen, in outlying districts; at these clinics first-aid treatment was available. The department encouraged better maternal and infant care through the development of a well-equipped obstetric service at Susana Hospital, through the establishment of a training school for native nurses and through inspection and licensing of midwives. Schools were visited periodically by the health officer and Red Cross nurses, and treatments were administered as needed. All incoming school children were treated for intestinal helminthiasis and were immunized against both typhoid fever and smallpox. Courses in elementary hygiene and physical education were carried on in the schools.

Water Supplies

Rain falling upon the northern part of Guam percolates rapidly through the coralline soil to the strata below, where it either descends to the water table or drains into the sea. In the southern part of the island the formation is both coralline and volcanic, in most places covered with only a very thin layer of soil. In general, most communities were served by springs or wells. Water from rivers was used occasionally, and, rarely, collections of rain water were utilized. In about a dozen communities piped systems of distribution were employed. Dams and concrete reservoirs had been constructed in some places to impound water from streams or springs, particularly when water for purposes of irrigation was needed.

Treatment of water was carried out at a small number of towns; it included filtration and chlorination or chlorination alone. As a rule, however, water from most places on Guam was considered to be unsafe. The geologic structure of the island is not such as to provide natural purification of surface water; contamination present on the surface reaches many of the springs and wells. The danger of contamination of water in open reservoirs was, of course, continually present.

Sewage Disposal

Sewerage systems on Guam were owned by municipalities, schools or private persons. In most cases sewage was discharged directly into the sea, without treatment; but in a few individually owned plants, schools and certain installations for the public, sewage was passed through a septic tank before it was discharged. The problem of satisfactory disposal of water-borne sewage into the sea is not likely to be solved easily, since many of the sewerage systems necessarily are below sea level, a condition which would tend to limit the effectiveness of flushing of the sewers into the sea. In the interior the disposal of excreta was both difficult and unsatisfactory. The pits of latrines often encounter water; and excreta deposited upon the ground are likely to reach underground water-bearing formations.

Insects and Animals

Vectors of Disease. Mosquitoes. There are no anopheline mosquitoes in Guam, and malaria has not been reported, excepting among a few persons who are thought to have contracted the disease elsewhere. Malaria is present, however, in the Philippine Islands, Japan and the Netherlands East Indies; anopheline mosquitoes might easily be imported from those areas. *Aedes aegypti, A. pseudoscutellaris, A. pandani* and *A. oakleyi* are present. *Aedes aegypti* transmits dengue fever in Guam, and is a potential vector of yellow fever. It is a domestic mosquito, seldom found far from human dwellings. It breeds in artificial collections of rain water, such as water in barrels or tin cans. It bites by day as well as by night. *Aedes pseudoscutellaris, A. pandani* and *A. oakleyi* are not reported to be vectors of disease, but are troublesome pests. *Aedes pseudoscutellaris* deposits its larvae in water in tree holes, coconut husks and occasionally in tin cans. *Aedes pandani* breeds in the axils of pandanus leaves. Both these mosquitoes will bite in daytime shade. *Aedes oakleyi* breeds in water in artificial containers, such as water drums.

Culex fatigans, a vector of the nonperiodic form of filariasis, is reported. This disease has been rare or absent in Guam; a few cases were reported in 1910 and 1912. *Culex fatigans* breeds in water in domestic utensils and other artificial containers, and in more or less permanent ground waters containing little or no vegetation. It bites almost exclusively at night.

Lice. *Phthirus pubis* and *Pediculus capitis* have been reported. Louse-borne diseases are not present.

Flies. The housefly, *Musca domestica,* is found commonly. It breeds in excrement, garbage, and other decomposing vegetable and animal substances. Other species of Musca probably are present. *Ophyra chalcogaster* breeds in human feces. Four flies of the genus Sarcophaga are reported. They are *S. misera, S. crinita, S. orientalis* and *S. knabi.* These flies deposit their eggs in human excrement, in carrion and on ulcerated human tissues. They sometimes are mechanical carriers of the organisms of dysentery and yaws. It is probable that species of Calliphoridae also are present.

Ticks. A large brown tick of dogs, *Rhipicephalus sanguineus,* is common throughout the Japanese Mandated Islands, and may be present in Guam. It transmits *fièvre boutonneuse* in the Mediterranean area, but has not been reported as a vector of disease in the central Pacific.

Mites. Mites which attack man have not been reported. An unidentified mite, which probably is a species of Trombicula, causes severe dermatitis in the western Japanese Mandated Islands, and could be introduced into Guam.

Fleas. Fleas are not reported, but probably are present among the natives. They are said to be extremely rare in the Japanese Mandated Islands. The flea of rats, *Xenopsylla cheopis,* a vector of plague and murine typhus fever in areas in which these diseases are endemic, and the flea of cats, *Ctenocephalus felis,* have not been reported in the central Pacific.

RODENTS. Rats are numerous, but probably do not transmit disease. No species are named, but *Rattus exulans* and *R. micronesiensis* are reported from the Caroline and Marshall islands, and *R. alexandrinus* and *R. rattus* are known to be present in the Caroline Islands. It is probable that the same species are found in Guam.

Pests. Pests such as scorpions and centipedes are said to be numerous. The scorpions, *Isometrus maculatus* and *Hormurus australasiae,* and the centipede, *Scolopendra subspinipes,* are present in the Japanese Mandated Islands, and probably are found on Guam. Their bites cause severe pain and swelling, but are not dangerous. They frequently invade homes, hiding in damp places from which they emerge at night. Mosquitoes and flies are severe pests. Rats destroy poultry and crops. Twenty-one species of ants are present; three of them frequently bite man. The fire ant, *Solenopsis geminata rufa,* invades houses, where it crawls into beds. It will attack chickens. *Odontomachus haematoda* is a large black ant which lives under the bark of trees. It may crawl up the legs of a person walking through the woods, and get under the clothing. Wasps, grasshoppers, weevils and termites are present.

DANGEROUS MARINE LIFE

Extremely poisonous sea snakes are present. One species of Enhydrina reported from Guam has a uniformly black dorsal surface, a yellow ventral surface, and a flattened tail. This snake will not attack man unless it is forcibly restrained, but is capable of injecting a deadly neurotoxic poison which produces paralysis of cardiomotor and respiratory centers. Poisonous jellyfish, the stings of which rarely cause death, and moray eels, which can inject a hemolytic toxin into bites made by their teeth, occur in the waters about the island. Fish of the family Scorpaenidae, such as the stonefish, *Synancea horrida* or *S. verrucosa,* have spines connected with poison glands; localized edema and gangrene, generalized circulatory changes and sometimes death have followed wounds inflicted by these fish. Zebra fish, such as *Pterois volitans* and *P. antennata,* are other fish in the vicinity of Guam which can cause dangerous wounds. Sting rays, which have barbed tails that are driven repeatedly into victims, are much feared. Sharks and barracuda occur just beyond the coral reefs which surround most of the island. The flesh and organs of such fish as the porcupine fish, *Diodon hystrix,* parrot fish of the family Scaridae, and globefish of the family Tetraodontidae are poisonous if eaten. Projecting ledges of coral can cause lacerations which seem to heal more slowly than ordinary cuts or wounds.

FOOD AND DAIRY PRODUCTS

A large percentage of staple foods, including rice, meat, fish and sugar, were imported, although the United States Department of Agriculture was working to make Guam entirely self-supporting. Of approximately 50,000 acres of land capable of cultivation, only 18,000 acres were in use in 1941. Approximately three fourths of this land was planted with coconut palms. Corn and rice were the second and third largest crops. Breadfruit, taro, yams, bananas, avocados, pineapples, mangoes, papaya, citrous fruits and coffee also were grown. Rice fields had been planted, but produced only a small fraction of the 10,000 pounds used daily by the population. In 1939 six new varieties of sugar cane were imported.

The agricultural station was gradually improving the local strains of livestock by importing purebred cattle, hogs and poultry, and by offering high-grade stock for sale to the public. The station distributed many free seedlings, advised farmers concerning crops, and conducted an agricultural school in which a few native students were enrolled. In addition, it gave instruction to farmers concerning the care of animals, and maintained a veterinary service. One hundred and thirty-three carabao, 764 cattle and 252 hogs were slaughtered in abattoirs at outstations and in Agaña in 1941. All the meat was inspected by the Health Department. The most serious disease of cattle was infection with liver flukes. Infection with ticks also was a serious problem. Hog cholera was frequent. Chickens were raised in large numbers.

Although edible fish abound in the waters off Guam, the natives appear to have lost the enthusiasm and prowess which won them a widespread reputation as fishermen in the last century. In 1941 there were only 28 licensed fishweirs. These were regularly inspected by fish wardens.

MEDICAL FACILITIES

Hospitals

Number of Beds. The Naval Hospital at Agaña cared for both naval personnel and that portion of the native population which could not afford to pay for hospitalization. In 1941 the hospital had three wards: a service ward of 24 beds, a ward for native males of 54 beds and three cubicles, and a ward for native females of 48 beds, 10 cribs and 10 bassinets. The wards for natives were considered to be barely adequate for existing needs. An isolation ward for the treatment of tuberculosis was under construction.

Susana Hospital, with 18 beds and 10 cribs, was founded to provide adequate care for native women and children and for the families of certain other residents. Although it was partly supported by private funds, it was operated by the naval government. Only patients able to pay for treatment were accepted, but prior to the establishment of free wards for natives at the Naval Hospital, persons who could not pay for hospitalization also were treated.

Equipment. The Naval Hospital had at least one operating room, pathology and bacteriology laboratories, and x-ray equipment. Clinics for the treatment of yaws and diseases of the ears, eyes, nose and throat, and a clinic for women and babies were attached to it.

Susana Hospital was well equipped to care for obstetric patients, and had two operating rooms which could be used for major surgical operations.

Supplies. Supplies were adequate, but were all imported.

Other institutions, not strictly hospitals, were a leper colony at Tumon; the dispensary of the Marine Barracks at Sumay, in charge of a medical officer; six dressing stations in various parts of the island, each conducted by a hospital corpsman; and a clinic for school children at Agaña, operated by the Red Cross.

Medical Personnel

Physicians. In 1941 nine medical officers were attached to the Naval Station. One civilian physician, educated in the United States, was in practice.

Dentists. One dentist was stationed at the Naval Hospital.

Nurses. In 1941 five Navy nurses were stationed at Guam. There were 15 graduate female native nurses, three of whom were employed by the Red Cross; and 13 native girls in training. Three male nurses were employed by the government to care for male natives in the Naval Hospital.

Medical Institutions

The only laboratory facilities were located in the hospitals. A nurses' training school for native girls, supervised by the chief Navy nurse, was established in 1912, in conjunction with Susana Hospital. In 1941 there were 13 nurses in training. Some of these nurses assisted in the hospital, some went into private nursing, and others practiced as midwives.

Social Services. The Guam chapter of the Red Cross was organized primarily to make funds and trained personnel available in case of disasters such as typhoons or earthquakes. In addition, the organization worked to improve health and sanitary conditions among the natives. To carry out this work, three female native nurses were employed, one of whom acted as visiting nurse to outlying districts. The other two worked with school children in the Red Cross clinic at Agaña. In 1940 the Red Cross also employed three male nurses to care for native male patients in the Naval Hospital. The Red Cross nurses were under the supervision of the Chief Medical Officer of the naval government. Almost all school children were enrolled in the Junior Red Cross. The Society of Saint Vincent de Paul was a private organization financed by the people of Guam. Its object was to distribute food to families that were in need. The Boy Scouts and the Girl Scouts assisted the Society of Saint Vincent de Paul in its charitable works, and performed various other small public services.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. Enteric diseases were common throughout the year. The use of polluted water, the presence of flies, and the insanitary native habits were some of the factors in the continued high frequency of these diseases. In recent years, chiefly because of improved water supplies and immunization, typhoid fever seldom occurred among the white population, although it has remained endemic among the natives. Routine immunization of all children entering school has been instituted. In 1939 an epidemic of paratyphoid fever B resulted in 16 deaths. No cases had been reported from that year to the Japanese occupation in 1941. Both amebic and bacillary dysentery were endemic, the amebic form being most frequently reported. An epidemic of the bacillary type was recorded in 1924. *Balantidium coli* and flagellates thought to be *Trichomonas hominis* have been recovered in examination of stools, and in some cases probably were the cause of dysentery.

Intestinal Helminthiasis. Almost every native in Guam was infected with from one to five species of intestinal parasite. In 1924, among 1,957 natives examined, evidence of infection with roundworm was found in 95 per cent; whipworm, in 71 per cent; and hookworm, in 26 per cent. Only 0.9 per cent of the group were found to be uninfected. The parasites most often reported were *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, *Necator americanus* and *Strongyloides stercoralis*. Infection with *Enterobius vermicularis* was rarely observed. Teniasis was never reported.

Cholera. Cholera never has been reported from Guam.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis was the greatest single cause of death among the native population. In 1940 it caused 15 per cent of all deaths on the island. Pulmonary tuberculosis predominates. In 1941 there were 103 new cases of pulmonary tuberculosis reported and 23 cases of extrapulmonary tuberculosis. Factors contributing to the prevalence of tuberculosis were the insanitary native habits, overcrowding in towns, lack of proper ventilation in native houses, and in some cases, dietary deficiencies. No facilities for the isolation and proper care of the patients were available, but in 1941 a ward for the care of persons with tuberculosis was under construction. A survey of the incidence of the disease throughout the island was being undertaken.

Influenza. Influenza occurred frequently, but not in epidemic form.

Diphtheria. In 1930 there were 10 known cases of diphtheria and two deaths.

Chickenpox. Chickenpox was endemic.

Measles. Measles, introduced between 1861 and 1889, frequently was epidemic.

Among children it was often complicated by bronchopneumonia. Severe epidemics occurred in 1913 and 1924. In 1913, it was said, 56 per cent of the population had measles, but only 0.6 per cent died.

German Measles. This disease was endemic. In 1941 a mild epidemic broke out.

Mumps. Mumps was epidemic at times. In 1913 more than 50 per cent of the natives had the disease.

Scarlet Fever. This disease was uncommon.

Smallpox. In 1856 an epidemic of smallpox killed at least 5,000 natives of Guam. In 1904 immunization of the native population was begun; prior to the Japanese occupation each school child was required to be immunized.

Poliomyelitis. Acute anterior poliomyelitis was introduced from Manila in the Philippine Islands in 1899. Since that year sporadic cases have been reported.

Whooping Cough. Whooping cough occurred frequently; in 1937 an epidemic affecting 1,723 persons was reported.

Bronchial Asthma. Bronchial asthma or *guha* was endemic and became common during changes of season. Although the disease occurred among white persons, it was much more frequent among natives. Among infants it caused many deaths. Attacks last three or four days. The causation of this type of asthma is obscure. Coral dust and copra dust may be factors. Pollen from rice fields and the blossoms of sugar cane are possible allergens.

Other Respiratory Diseases. Bronchitis, "acute catarrhal fever" and pneumonia were frequently reported. No description of "acute catarrhal fever" is available, but it may be similar to *missilepik,* a febrile type of "cold" which is widespread in the Caroline Islands, Palau and Yap. These diseases probably are most frequent at the beginning of the rainy season. In 1941 one person was reported as having acute bronchitis, 347 "acute catarrhal fever," 13 bronchopneumonia and 22 lobar pneumonia.

Meningitis. Cerebrospinal fever was reported every few years. Thirty-three patients with the disease were hospitalized in 1936, and in 1939 nine patients were hospitalized. One case of known meningococcic meningitis was reported in 1940, and another in 1941.

Diseases Spread Chiefly through Contact

Venereal Diseases. Gonorrhea was fairly frequent among the natives. Serious complications, such as sterility, stricture and gonorrheal ophthalmia were reported. Syphilis probably was about one third as frequent. Chancroid was rare, and both lymphogranuloma venereum and granuloma inguinale were said to be absent. Organized prostitution had long been established in Agaña.

Yaws. Up to 1914 yaws was said to be the most common disease in Guam, and it was variously estimated that from 74 to 90 per cent of the native population was infected with the disease. Tertiary manifestations, including gangosa, were frequent. In 1918 there were 367 known instances of this deformity. In 1931 yaws was still prevalent; 298 cases of gangosa were reported. Between 1931 and 1941 a strenuous and successful effort was made to reduce the incidence of the disease by means of health education and the repeated injection of arsphenamine. The clinic for the treatment of yaws at the Naval Hospital treated new patients, and followed those with old infection until a five-year cure had been effected. After this, the latter patients were examined once a year. As a result of this program only 14 cases of new infection were reported in 1940. Gangosa and other late manifestations were said to be almost nonexistent.

Leprosy. Leprosy has been endemic in Guam for many years. In 1908 there were 185 lepers on the island. Under the naval government, lepers were segregated and treated, first at Tumon, and later at the larger leper colony in the Philippine Islands.

In recent years the Tumon colony was reopened. The incidence of the disease has been so greatly reduced that, prior to Japanese occupation, there were only four known lepers on the island.

Tetanus. Tetanus was rarely reported. Forty-one patients with tetanus, of whom 21 had tetanus neonatorum, were hospitalized from 1905 to 1924. The tetanus neonatorum was ascribed to the generally unclean procedures employed by native midwives. Between 1925 and 1937 there were 30 patients with tetanus. As the education of midwives improved, the incidence of tetanus among the newborn decreased.

Diseases of the Skin. Diseases of the skin and infections of the subcutaneous tissues were frequent. Impetigo contagiosa was said to be one of the most common diseases on the island. Various forms of ringworm, such as tinea capitis, tinea glabrosa and tinea imbricata, were common. Pityriasis versicolor was present. Many patients with scabies have been observed. Tropical ulcers were said not to occur, but abscesses of all types were common. Two hundred and seventy patients with abscesses were hospitalized between 1932 and 1935. Erysipelas was well known, and "cellulitis" was a frequent cause of hospitalization up to 1935.

Diseases of the Eyes. A chronic follicular form of conjunctivitis was reported commonly. Bacillary conjunctivitis is widespread in the Marianas Islands, and probably occurs in Guam. Gonorrheal ophthalmia was reported. Trachoma was not uncommon.

Stomatitis. Vincent's angina occurred frequently. Mechanical stomatitis, resulting from irritation by the heavy concretions which cover the teeth of habitual chewers of betel nuts, formerly was almost universal among adult natives. Retracted, painful, bleeding gums were the rule, and severe abscesses were frequent. As the result of better health education, chewing of betel nuts was becoming less prevalent.

Diseases Spread by Arthropods

Dengue Fever. Dengue fever, transmitted by *Aedes aegypti*, was endemic and at times epidemic. Sporadic cases were recorded every year. One hundred and forty-seven cases were reported in 1939. Although the fatality rate of this disease is negligible, large numbers of persons may be incapacitated simultaneously by the disease.

Malaria. A few sporadic cases of malaria have been reported, but the disease apparently was contracted elsewhere. Anopheline mosquitoes have not been found in Guam, but the possibility that they might be introduced cannot be overlooked.

Yellow Fever. Yellow fever has not been reported from Guam, but the principal vector, *Aedes aegypti,* is present. The disease is not likely to be introduced because there are no areas in the Pacific in which it is endemic.

Relapsing Fever. Relapsing fever has not been reported, but lice of human beings, potential vectors of the disease, are probably present. After the Japanese occupation, the disease may have been introduced from areas in Japan and China in which it is endemic.

Filariasis. Filariasis, caused by *Wuchereria bancrofti* and carried by *Culex fatigans,* has been reported, but was not common. Eleven cases of the disease were reported from Guam in 1911, on the basis of results of examination of the blood. In the same year one case of elephantiasis was reported; but the patient was a native who had contracted the disease elsewhere. Although no persons with filariasis were admitted to the hospitals of Guam from 1933 to 1941, it is probable that the disease persists.

Typhus Fever. None of the typhus group of fevers has been reported from Guam. Lice, potential vectors of epidemic typhus fever, are probably present. The rat flea, *Xenopsylla cheopis,* a potential vector of endemic typhus fever, and mites capable of transmitting scrub typhus fever are not reported, but may nevertheless be present. There have been questionable reports of "typhus" from the Marshall Islands. Endemic, flea-borne typhus fever occurs in Hawaii, Malaya, Australia and Indo-China. Scrub typhus fever is reported from Malaya, the Netherlands East Indies and Australia. Tsutsugamushi disease, closely allied to, if not identical with, scrub typhus fever, might be introduced from areas in Japan and Formosa in which it is endemic.

Plague. Plague did not occur, but rats are present in large numbers. The rat flea, *Xenopsylla cheopis,* was not reported, and other fleas were said to be few. The disease might, however, be imported. One hundred and forty cases were reported from Yap, in the Caroline Islands, between 1910 and 1911. The disease is endemic in the Netherlands East Indies, New Caledonia and Hawaii.

SUMMARY

Guam was administered by the Navy Department of the United States. One civilian physician was present in 1941; the other physicians were medical officers of the Navy. Public health measures were carried out by the Medical Department and the Health Department; the functions of each department overlapped. In general, the Medical Department supervised the hospitals; the Health Department carried on public health education, administered all sanitary measures, and enforced quarantine measures.

Water was treated in only a very few communities, and natural purification, because of the geologic structure of the island, did not take place. Wells, springs, rivers and catchment areas for rainfall were the sources of water. The water in general was thought to be unsafe without treatment. In most cases sewage was discharged directly into the sea, without treatment. In a few places septic tanks were used. Pit latrines were employed in the interior.

Anopheline mosquitoes are not present, but species of Aedes and Culex occur. Lice, flies, rats, scorpions, centipedes, ants, poisonous sea snakes and dangerous fish occur. Fleas, ticks and mites may be present. Much of the food consumed was imported; but efforts had been initiated to make Guam self-supporting. Coconuts, corn and rice were the chief crops. Some livestock was raised.

Enteric diseases were endemic throughout the year. Nearly every native had some form of intestinal helminthiasis. Tuberculosis was the greatest single cause of death among the natives. Gonorrhea was fairly frequent among the natives; syphilis was known to occur. Yaws apparently had been brought under control; leprosy was a minor problem. Bronchial asthma was common. Various other respiratory diseases seemed to be most frequent during the rainy season.

Diseases of the skin, stomatitis and a chronic follicular form of conjunctivitis were frequent. Dengue fever was endemic. Filariasis occurred, but was not common. Typhus fever, plague, relapsing fever, malaria and yellow fever were not reported.

BIBLIOGRAPHY

Allard, H. A.: The North American Ragweeds and Their Occurrence in Other Parts of the World. Science, **98**:292-294 (Oct. 1) 1943.

American Red Cross, The Guam Chapter. The Guam Recorder, **14**:11 (Dec.) 1937.

Arnold, N. W.: Observations on Tetanus (1905 to 1937) in Guam. U. S. Nav. M. Bull., **37**:289-302 (April 11) 1939.

Bacillary Dysentery. The Guam Recorder, **1**:32 (Aug.) 1924.

Bacillary Dysentery in Guam. U. S. Nav. M. Bull., **20**:417 (March) 1924.

Bartsch, P.: Molluscan Intermediate Hosts of the Asiatic Blood Fluke, *Schistosoma japonicum,* and Species Confused with Them. Washington, Smithsonian Institution, 1936. (Smithsonian Miscellaneous Collections, vol. 95, no. 5.)

Bryan, E. H., Jr.: The Plants of Guam. The Guam Recorder, **13**:22-23, 36-37 (Nov.) 1936; **16**:67-84 (May) 1939.

Butler, C. S.: Gangosa in Guam and the Philippines. U. S. Nav. M. Bull., **9**:58-61 (Jan.) 1915.

Cheesman, L. E.: Hunting Insects in the South Seas. London, P. Allen and Co., Ltd., 1932.

Clench, W. J., and Kondo, Y.: The Poison Cone Shell. Am. J. Trop. Med., **23**:105-120 (Jan.) 1943.

Cox, L. M.: The Island of Guam. Washington, U. S. Govt. Print. Off., 1926.

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 3d ed., Philadelphia, Lea & Febiger, 1943.

Crow, G. B.: Filariasis on the Island of Guam. J.A.M.A., **55**:595-596 (Aug. 13) 1910.

Ditmars, R. L.: Reptiles of the World. New York, The Macmillan Company, 1933.

Ellerman, J. R.: The Families and Genera of Living Rodents. London, The British Museum, 1941.

Elliott, H. W.: Guam. U. S. Nav. M. Bull. (Suppl. No. 11): 30-35 (Oct.) 1919.

Fowler, H. W.: Fishes of Guam, Hawaii, Samoa and Tahiti. Honolulu, Hawaii, The Museum, 1925. (Bernice P. Bishop Museum, Bull. No. 22.)

——: Fishes of Oceania. Honolulu, Hawaii, The Museum, 1928. (Bernice P. Bishop Museum. Memoirs, vol. 10.)

Freeman, G. F.: Epidemic Bronchial Asthma of Guam. U. S. Nav. M. Bull., **1**:88-91 (April) 1907.

——: Report on Vaccination, Island of Guam. *In* Annual Report of The Surgeon General, U. S. Navy, 1905. Washington, U. S. Govt. Print. Off., pp. 182-183.

Fullaway, D. T.: Entomological Notes. *In* Guam Agricultural Experiment Station, Annual Report, 1911. Washington, U. S. Govt. Print. Off.

Grunwell, A. G.: Report on an Epidemic of Acute Anterior Poliomyelitis of Adults on the Island of Guam. *In* Annual Report of The Surgeon General, U. S. Navy, 1900. Washington, U. S. Govt. Print. Off., pp. 224-227.

Guam. Governor: Annual Report, 1932-1941. Washington, U. S. Govt. Print. Off., 1933-1942.

Hamlin, H.: The Geography of Treponematosis. Yale J. Biol. and Med., **12**:29-50 (Oct.) 1939.

Herms, W. B.: Medical Entomology. 3d ed., New York, The Macmillan Company, 1939.

Hog Cholera. The Guam Recorder, **10-12**:132 (Nov.) 1933.

Hornbostel, H. G.: Mosquitoes and Flies of Guam. The Guam Recorder, **2**:268 (Dec.) 1925.

Hornung, R. S.: The Dental Problem in the Island of Guam. The Guam Recorder, **5**:235 (Feb.) 1929.

Imms, A. D.: Insects of Guam. Nature [London], **152**:55 (July 10) 1943.

Insects of Guam. Honolulu, Hawaii, The Museum, 1942. (Bernice P. Bishop Museum. Bull. No. 172.)

Iseki, K.: Investigation on the Acute Itching Dermatitis Caused by "Karasus." Acta derm., Kyoto, **21**:178-179, 1933.

Ito, M., and Yamanouti, G.: A Contribution to the Knowledge of Skin Diseases in the South Sea Islands. Hifuka Hitsunyokika Zoss (Jap. J. of Derm. & Urol.), **49**:278-285, 1941.

Kerr, W. M.: Note on the Existence of *Ancylostoma duodenale* on Guam. U. S. Nav. M. Bull., **5**:145 (Jan.) 1911.

——: A Report on the Prevalence of Framboesia (Yaws) in Guam, and Its Connection with the Etiology of Gangosa. U. S. Nav. M. Bull., **6**:549-552 (Oct.) 1912.

Keesing, Felix M.: The South Seas in the Modern World. New York, The John Day Company, 1941.

Kindleberger, C. P.: An Epidemic of Measles and Mumps in Guam. U. S. Nav. M. Bull., **8**:243-247 (April) 1914.

——: Naval Station, Guam. U. S. Nav. M. Bull., **8**:528-532 (July) 1914.

——: Intestinal Parasites, and Diseases Found in Guam. U. S. Nav. M. Bull., **7**:86-93 (Jan.) 1913.

——: Sanitary Conditions in Guam, Abstract, Sanitary Report, 1911. U. S. Nav. M. Bull., **6**:464-472 (July) 1912.

——: A Study of the Etiology of Gangosa in Guam. Based upon Luetin Reactions and Noguchi Tests on 369 Gangosas, and 16 Controls. U. S. Nav. M. Bull., **8**:381-410 (July) 1914.

Krämer: Die Medizen der Truker. Arch. f. Schiffs- u. Tropen-Hyg., **12**:456-464, 1908.

Krieger, H. W.: Island Peoples of the Western Pacific, Micronesia and Melanesia. Washington, The Smithsonian Institution, 1943. (Smithsonian Institution. War Background Studies, no. 16.)

Kumm, H. W.: The Geographical Distribution of the Yellow Fever Vectors. Baltimore, The American Journal of Hygiene, 1931. (Am. J. Hyg. Monographic Ser., No. 12.)

Kuroda, N.: Distribution of Mammals in the Japanese Empire. J. of Mammalogy, **20**:37-50 (Feb. 14) 1939.

Land Crabs of Guam. The Guam Recorder, **1**:5 (Sept.) 1924.

Larsen, N. P.: Tetrodon Poisoning in Hawaii. Proc. Pacific Sc. Congr., 1939, 6th Congr., **5**: 417-421, 1942.

Leach, P.: Sanitary Report on Guam, L. I. *In* Annual Report of The Surgeon General, U. S.

Navy, 1900. Washington, U. S. Govt. Print. Off., pp. 208-212.
McCullough, F. E., and Angeny, G. R.: Guam Reports on Health and Sanitation for the Years 1907 and 1908. U. S. Nav. M. Bull., **3**:321-333 (July) 1909.
——: History of Epidemics in Guam. U. S. Nav. M. Bull., **2**:22-25 (July) 1908.
McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.
Mears, J. B.: Measles Epidemic in Guam, 1932. U. S. Nav. M. Bull., **31**:334-337 (July) 1933.
Medical Dressing Station for School Children. The Guam Recorder, **10-12**:106 (Oct.) 1933.
Mayer, J.: Augenerkrankungen auf Saipan. Arch. f. Schiffs- u. Tropen-Hyg., **16**:709-710, 1912.
——: Über Helminthen in Saipan. Arch. f. Schiffs- u. Tropen-Hyg., **16**:704-705, 1912.
Mink, O. J.: A Note on the Pathology of Epidemic Asthma. U. S. Nav. M. Bull., **3**:222-223 (July) 1909.
Mumford, E. P.: Manual on Distribution of Infectious Diseases. In Press.
—— and Mohr, J. L.: Background to Postwar Reconstruction. Part I, Preliminary Report on Parasitic and Other Infectious Diseases of the Japanese Mandated Islands and Guam. Am. J. Trop. Med., **23**:381-400 (July) 1943.
Naval Government Sponsors Law and Dental Courses for Two Students. The Guam Recorder, **9**:75 (Aug.) 1932.
Nelson, F. J.: Notes on an Asiatic Cruise. U. S. Naval Institute Proceedings, **62**:390-400 (March) 1936.
Parker, R. R.: New Flies of Genus Sarcophaga from Guam and the Philippines. Proc. U. S. Nat. Mus., **54**:87-97, 1919.
Porter, F. E.: Health Conditions in Guam. Report of the Department of Health for the Fiscal Year 1931. U. S. Nav. M. Bull., **30**:446-453 (July) 1932.
Randall, J. A.: Twenty-two Cases of Poisoning by the seed of *Jatropha curcas*. U. S. Nav. M. Bull., **8**:290-291 (April) 1914.
Rats in Guam. The Guam Recorder, **6**:226-227 (March) 1930.
Reed, E. U.: Health Notes. The Guam Recorder, **1**:9 (March); **9**: (April) 1924.
Reid, C. F.: Bibliography of Guam. New York, The H. W. Wilson Co., 1939.
Sablan, R. M.: A Plea for Better Health Conditions. The Guam Recorder, **5**:240 (Feb.); 260, 265-267 (March) 1927.
Safford, W. E.: The Useful Plants of the Island of Guam with an Introductory Account of the Physical Features and Natural History of the Island, of the Character and the History of the People and of Their Agriculture. Washington, U. S. Govt. Print. Off., 1905. (Smithsonian Institution. Contributions from the U. S. National Herbarium. Vol. 9.)
Satterlee, R. C.: Sanitary Survey of the Island of Guam. The Guam Recorder, **5**:121 (Sept.) 1928.
Schnee: Augenerkrankungen auf den Marianen. Arch. f. Schiffs- u. Tropen-Hyg., **14**:695, 1910.
——: Die europäischen Infektions-Krankheiten auf den Marschallinseln. Arch. f. Schiffs- u. Tropen-Hyg., **11**:583-587, 1907.
——: Über Mücken in Saipan. Arch. f. Schiffs- u. Tropen-Hyg., **16**:710, 1912.
Simmons, J. S.: Dengue Fever. Med. Clin. of N. Am., **27**:808-821 (May) 1943.
Stearns, N. D.: Pillow-Lavas of Guam. The Guam Recorder, **14**:7-8 (Feb.) 1938.
——: Significance of Limestone in Guam. The Guam Recorder, **14**:28-29, 43 (June) 1937.
Stiles, C. W.: The American Hookworm (*Necator americanus*) in Guam and China. Bull. Johns Hopkins Hosp., **17**:313 (Sept.) 1906.
Stitt, E. R.: Contributions of the Medical Corps, United States Navy, to American Medicine. U. S. Nav. M. Bull., **24**:1-2 (Jan.) 1926.
Stuart, M. A., and Slagla, T. D.: Jellyfish Stings, Suggested Treatment, and Report on Two Cases. U. S. Nav. M. Bull., **41**:497-501 (March) 1943.
Sunder: III. Bericht über die Gesundheitsverhältnisse auf Yap. Arbeiten aus dem kaiserlichen Gesundheitsamte, **19**:443-444, Berlin, 1903.
Susana Hospital. The Guam Recorder, **11**:46 (June) 1934.
Susana Hospital Needs Help. The Guam Recorder, **13**:4-5 (Dec.) 1936.
Sweezy, O. H.: Insects of Guam—Bees and Wasps. The Guam Recorder, **13**:19-20, 34 (Nov.) 1936.
Tate, G. H. H.: Rodents of the Genera Rattus and Mus from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. Bull. Am. Mus. Nat. Hist., **68**:145-178 (Feb. 11) 1935.
Typhoid in Guam. Army and Navy Journal, **37**: 609 (Feb. 24) 1900.
U. S. War Dept.: Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. U. S. Govt. Print. Off., 1943. (Technical Manual TM10-420.)
Van Reypen, W. K.: United States Bureau of Medicine and Surgery. Report of the Surgeon

General U. S. Navy, 1901. U. S. Govt. Print. Off., 1901, pp. 33-35.

Van Zwaluwenburg, R. H.: Check List of the *Elateridae* of Oceania. Honolulu, Hawaii, The Museum, 1932. (Bernice P. Bishop Museum. Occasional Papers. Vol. 9, No. 23.)

Water Supply. Naval Station, Guam. U. S. Nav. M. Bull., **35**:535-541 (Oct.) 1937.

Wells, C. R.: Betel Nut Chewing and Its Effects. U. S. Nav. M. Bull., **22**:437-439, 1928.

Wheeler, W. M.: The Ants of Guam. J. New York Entom. Soc., **20**:44-48, 1912.

19

Territory of Hawaii

GEOGRAPHY AND CLIMATE

The Territory of Hawaii consists of a great chain of islands extending about 1,500 miles from the northwest to the southeast, in the area described by 18 and 23° of north latitude and 154 and 161° of west longitude. The islands constituted an independent kingdom for most of the nineteenth century; they were annexed to the United States in 1898 at the express wish of the Hawaiian people. In 1900 the islands became a territory of the United States.

There are 20 islands, with a total area of about 6,400 square miles. The chief islands are Hawaii, with an area of approximately 4,000 square miles; Maui, of some 730 square miles; Oahu, of about 600 square miles; Kauai, of 550 square miles; Molokai, of 260 square miles; Lanai, of about 140 square miles; Niihau, of 73 square miles; and Kahoolawe, of 45 square miles. The population of all the islands in 1940 was, roughly, 423,000. Japanese or natives of Hawaii of Japanese descent constituted more than 35 per cent of the population; 25 per cent were white persons; 15 per cent were Filipinos; 10 per cent were Hawaiians of mixed blood; 7 per cent were Chinese; 5 per cent were Hawaiians of unmixed blood; and about 3 per cent were Koreans.

The islands are of either coralline or volcanic origin. Nearly all are featured by elevated areas which in some cases are 14,000 feet high. Deep canyons are numerous; between the lofty walls of some are fairly extensive plains. Hills tend to be prominent. On the other hand, some of the smaller islands, and particularly those of coralline origin, are of comparatively low elevation. The island of Hawaii consists largely of five volcanic mountains. Maui is composed of two mountains joined by a narrow isthmus; Molokai is similarly formed. Lanai and Kahoolawe are largely single mountains. Oahu, once two immense volcanoes, has been subject to erosion, so that it is now two separate mountain ranges. Kauai has a peak more than 5,000 feet high, but marginal lowlands are found in the northwestern part. Niihau, 15 miles from Kauai, has a tableland 1,300 feet high on the east; the rest of the island is coralline lowland.

The climate is temperate. Northeastern trade winds prevail in nearly all seasons throughout the islands. The temperature is virtually devoid of marked seasonal variations. Severe tropical storms do not occur. Rainfall, on the other hand, is characterized by extreme changes. On the four largest islands—Hawaii, Maui, Oahu and Kauai—there are areas in which the annual rainfall is more than 200 inches (5 meters). Lowlands situated to the west and southwest of mountain ranges are moderately dry; the annual rainfall may be only 20 inches (0.5 meter) or less. Variation occurs seasonally as well as from place to place; rain is more prevalent from November through April than at other times. August and September are the warmest months of the year. January and February are considered to constitute the cool season. The maximal temperature recorded is 100° F. (37.7° C.), at Pahala, at an altitude of 850 feet, on the island of Hawaii; the minimal is 25° F. (approximately −4° C.), at Humuula, at a height of 6,685 feet, on the same island. At Honolulu the daily temperature in the summer ranges between 68 and 84° F. (20 and 28.8° C.); in the winter the range is from 66 to 80° F. (18.8 to 26.6° C.).

PUBLIC HEALTH

Health Services

Organization. Public health work in the Territory of Hawaii is carried on under the supervision of the Territorial Board of Health by the Territorial Health Department. The Governor of the territory nominates and with the consent of the senate of the territory appoints the seven members of the Board of Health for concurrent terms of four years each. He also appoints the president of the board to a four-year term. This board in turn appoints the Director of Public Health, the appointment being subject to the approval of the Governor. The Director of Public Health acts as executive officer of the Health Department. Local health units in the counties of Hawaii, Maui and Kauai function under administrative officers immediately responsible to the president of the Territorial Board of Health. These county programs parallel the program of the Territorial Board of Health.

Bureaus of the Board of Health. *General Administration.* This office is responsible for the direction and co-ordination of the program as a whole. The executive officer is the Director of Public Health; the president of the board is also in charge of the administration of emergency medical and related services. The board issues licenses for the practice of medicine and surgery.

Bureau of Vital Statistics. The regular staff of this bureau consists of a director and registrar general, a deputy registrar general, and clerical help. This bureau keeps the vital records for the territory.

Bureau of Communicable Diseases. The activities of this bureau include supervision of government physicians, public health laboratories and the reporting of cases of communicable disease. In addition to the full-time director, there is a control officer who is in charge of the division of venereal disease. The 37 government physicians employed on a part-time basis report monthly on services rendered to the indigent sick. The bureau furnishes all drugs and supplies necessary for these services and for the control of communicable disease. The 37 government physicians are responsible for directing public health activities in their respective areas. They also serve as registrars of vital statistics and as school physicians in the areas assigned. Many serve as plantation physicians, assigned as such by the Board of Health and responsible for directing health programs in the plantation communities.

In 1942 this bureau assisted in organizing and administering the program of immunization of the entire population of the territory against typhoid fever, paratyphoid fevers and smallpox. The bureau also supervises the public health laboratories. A bacteriologist from the United States Public Health Service was appointed in 1942 to assist in this work.

The division of venereal disease, conducted by a full-time control officer, has functioned in close co-operation with both the Army and Navy in case-finding, case-holding, treatment and education. A military order requiring the reporting of all cases of venereal disease to the Board of Health within twenty-four hours after diagnosis by military as well as civilian physicians has aided greatly in obtaining reports, investigating contacts and surveillance of those infected. The division employs a public health nurse to do investigational and follow-up work. Clinics are held. Arsenical drugs and bismuth are provided to private physicians as well as to clinics.

Bacteriologic laboratories in Honolulu (Oahu), Waiakea (Hawaii), Puunene (Maui), Koloa (Kauai) and Kaunakakai (Molokai) render diagnostic services. Diagnostic services for the Bureau of Sanitation and the Bureau of Pure Food and Drugs are rendered by the laboratories on Hawaii, Maui, Kauai and Molokai islands. These laboratories meet the minimal standards of the American Public Health Association. With the recent enactment of the so-called prenatal law the Board of Health required annual registration of all laboratories performing serologic tests. Standards of the United States Public Health Service are used and all registered laboratories are inspected regularly by representatives of the Board of Health.

Bureau of Tuberculosis. This bureau exercises official surveillance over the care and conduct of those registered as having tuberculosis. The program includes case-finding, early diagnosis, statistical work, promotion of and planning for institutional care, and co-ordination of the work in the territory. In 1942 a total of 398 clinic sessions were held and 246 instances of new infection were found. Follow-up examination and enforced hospitalization of recalcitrant patients were carried out by order of the provost court. A mobile x-ray unit was in use. Members of the Bureau of Public Health Nursing and nurses of the Palama Settlement provided nursing supervision for patients and contacts. Routine testing with tuberculin by private and bureau physicians in 1942 extended to approximately 25,000 persons. The Hawaii Tuberculosis Association co-operated with the bureau in arranging for roentgenologic examination of members of the Hawaii Territorial Guard; lectures and radio programs were jointly sponsored.

Bureau of Maternal and Child Health and Crippled Children. This bureau functions through many channels, including public health nurses, physicians, lay organizations, the Department of Public Instruction, medical societies and the press and radio. Child health and prenatal conferences are held. Forty-six maternity hospitals and lying-in homes are licensed by the Board of Health. This bureau maintains close supervision of midwives, conducts a program for improvement of nutrition, provides the services of pediatric consultants on Oahu and Hawaii islands to any practicing physician for needy cases, and arranges obstetric consultant service on Oahu Island. Crippled children receive medical, surgical, dental and hospital care, roentgenologic services, physiotherapy, convalescent care, and placement in foster homes if required. Clinics for crippled children are held throughout the territory. Children's boardinghouses are supervised.

Bureau of Mental Hygiene. This bureau provides diagnostic clinic services by means of traveling clinics, arranges hospitalization, carries on educational work and sponsors classes in psychiatry and mental hygiene for nurses and students of occupational therapy at Queen's Hospital in Honolulu. In 1942 aid was extended to federal and military organizations. At present the staff and facilities are inadequate; only five of the 10 positions are filled.

Bureau of Public Health Nursing. In June, 1942, this bureau employed 86 nurses. All public health nursing on Oahu Island is consolidated under a chief supervisor of nurses and includes the nursing service in the venereal disease and tuberculosis clinics. Nurses of the Health Department carry on a generalized nursing program.

Health Education. Activities in this field are carried on by the individual bureaus, but a full-time director of health education is employed to co-ordinate the activities.

Bureau of Pure Food and Drugs. In 1941 a new Hawaiian food, drugs and cosmetic act was passed, the enforcement of which is the responsibility of this bureau. Samples of food, drugs and cosmetics are examined by laboratory and field determinations, and those found unsatisfactory are condemned. Samples of milk on Oahu Island are collected and examined by the city and county milk inspector, who works under the supervision of the bureau.

Bureau of Sanitation. This bureau is responsible for the routine supervision of water supplies, disposal of sewage, and the collection and disposal of rubbish. Samples of water and sewage are examined in the laboratory of the bureau and in collaborating laboratories. The Honolulu water laboratory serves the Army, Navy, private persons and agencies as well as the Health Department. Assistance is given to the Army and Navy in problems of sewage disposal plants, water supplies, housing, supplies of food, restaurants, supplies of milk, and the disposal of garbage and refuse. Swimming pools and beaches are supervised, and routine inspections are made of dwellings, institutions, food establishments and food handlers. The control of food handling is a major activity, with four inspectors assigned to this work in Honolulu; it is a part of the general program in other areas. Certificates of health are required of food handlers, but the examination is considered to be of little value because it does not include culture of specimens of stool or roentgenologic examination of the thorax.

The division of industrial hygiene, the chief of which is an engineer, aids industrial companies as well as the Army and Navy.

Campaign Against Plague. This program is carried out actively on the islands of Maui and Hawaii. The public health committee of the Honolulu Chamber of Commerce supplies inspectors. Suppressive measures employed include sanitary improvements, ratproofing and poisoning, trapping, gassing and shooting of the rodents. Laboratory examination of all animals trapped in the territory is carried out. On Oahu Island a limited program of trapping to determine the presence of infection was begun in 1942.

Other Government Agencies Engaged in Health Work. *Department of Institutions.* This department supervises the Territorial Mental Hospital and the Waimano Home for Epileptics and Feeble-Minded.

Board of Leper Hospitals and Settlements. In 1931 this board assumed the program for control of leprosy that had been conducted by the Health Department. The superintendent of the board administers the affairs of the hospitals and settlements for lepers as well as the homes for nonleprous children of leprous parents.

Federal Public Health Service. This service has charge of quarantine activities. An outpatient and quarantine office is housed in the Federal Building in Honolulu. The quarantine station consists of a hospital and detention building of 300 bed capacity. The program is directed chiefly against plague, cholera and smallpox, and includes strict quarantine and inspection of vessels as well as inspection and spraying of aircraft to prevent the introduction of insects.

Territorial Nutrition Committee. This committee co-ordinates community nutritional activities and assists the Territorial Office of Food Co-ordinator in an advisory capacity. Food demonstration classes are held, activities in nutritional education are carried on through the press and radio, and work is done directly with public health nurses.

Relative Effectiveness. Public health work in Hawaii is modern and progressive. Much community interest is evidenced by the large number of voluntary organizations which assist the Health Department directly or which conduct programs of their own. Alert interest in community problems is manifested in the surveys of health and welfare activities in Honolulu conducted in 1929 and again in 1935 with community participation. Since then great strides have been made until the present program can compare favorably with those on the mainland.

The health status of the area is clearly indicated by the low death, infant mortality and maternal mortality rates, the low incidence of enteric infections and intestinal parasitism and the immunization of the entire population against typhoid fever and smallpox. Plague and endemic typhus fever remain to be eradicated; control of rodents is an important problem. The incidence of tuberculosis is high. The incidence of leprosy has been decreasing as the result of improved sanitary conditions, education and the provision of adequate facilities for isolation and treatment.

The supply of medical personnel is satisfactory; the majority of physicians have been trained in mainland schools. Hospitals, sanatoriums and related institutions are well distributed; 51 were registered with the American Medical Association in 1943. Laboratory facilities meet the standards generally employed in the United States.

In 1942 a total of $831,553.73 was spent on the activities of the Health Department.

Water Supplies

Although the average rainfall for the territory as a whole and for many individual islands is sufficient to supply all the needs of the inhabitants, there are extreme variations from place to place within the territory. On the larger islands the underground formations are such that excess rainfall on one part of an island (windward or northeastern part) will be accumulated and stored in these formations; it will then be transported through them to the areas in which the rainfall is much less and thus will become available for use through springs or wells. The smaller leeward islands (Kahoolawe, Lanai and probably Niihau) receive little rainfall and consequently suffer from a shortage of water.

Almost the entire mass of the Hawaiian Islands consists of thin lava flows veneered one on the other and, in general, broken by many openings. As a result the underground formation as a whole is extraordinarily permeable to the movement of ground water.

The soil of the islands in general is poor, with the exception of the valleys and some of the coastal plains, which are limited in extent. Considerable areas are covered by rather thin soil deposited over permeable rock; in many places the permeable rock outcrops. In these areas surface run-off does not occur at all, except during the most torrential downpours. Considerable difficulty is experienced in retaining water in natural reservoirs in such areas. The porosity of the ground, however, varies extremely from place to place. There are areas in which nearly all the rain that falls is shed rapidly by the steep, bare but deeply weathered and compacted slopes. In other areas soil and vegetation occurring over deeply weathered surfaces retard the run-off.

Basal ground water is the fresh water that lies below the main water table of these islands in the permeable basalt and in the limestone, gravel and other permeable coastal plain formations. This water floats upon salt water, the upper level of which is approximately 40 feet below sea level for every foot that the fresh-water level stands above sea level. This basal fresh-water layer is found under large areas of all of the islands excepting Kahoolawe and Niihau. Along parts of the coasts of Oahu and Kauai islands a sedimentary cap rock confines the basal water in the lava rock under pressure; wells drilled through the cap rock encounter artesian basal water.

High-level water is found either confined by intrusive rocks or resting on ash or tuff beds, soil beds or alluvium. This water may issue from the ground at the higher elevations in the form of springs or it may be tapped.

Surface water is used for irrigation in a considerable portion of the cultivated area of the island of Kauai, in several large areas of Maui Island and small areas of Oahu and Hawaii islands. On most plantations surface water is used when it is available, and ground water is used when the supply of surface water is inadequate. Part of the water used for irrigation returns to the permeable underground formations after it has passed through the soil. Gauging stations have been established and considerable information has been accumulated concerning the stream flow on all the islands excepting Lanai, Kahoolawe and Niihau.

The quantity of water from surface and underground sources is adequate on the islands of Hawaii, Kauai, Maui and Molokai; is barely adequate on the island of Oahu; and is scarce on the islands of Kahoolawe and Lanai. On Oahu attempts are being made to replenish the supply of underground basal water which has been depleted by the taking of water in the Honolulu area. The level of sea water underneath the island has been gradually rising over a period of years of excessive consumption of water in Honolulu. If this were permitted to continue there would be, ultimately, no available fresh water under the city. By proper conservation of the available water resources, however, and by the development of additional supplies from as yet unused sources, Oahu Island should be provided with an adequate supply. On Lanai Island it may be possible to develop supplies of water, from high-level sources, which will be adequate for the island. Kahoolawe Island must continue to depend upon the storage of rain water in cisterns and upon surface water obtained from streams in flood and, in periods which follow droughts, upon water brought by boat from Maui Island.

A number of water supplies on the islands are owned by the territory, a county, a plantation or some other private concern or person. These include artesian and nonartesian basal-water wells, tunnel systems and wells which draw water from the dike complexes and other high-level sources, and supplies depending on spring-fed streams or rain-water catchment areas. When a survey was made in 1938, the total population of the islands was 411,485. At that time approximately 349,484 persons lived in communities served by 310 water supplies. Seventy-seven of these supplies are county owned and in the aggregate have 670 miles of mains with 37,493 individual connections.

There are at least 132 storage tanks or reservoirs on the islands, with a total capacity of more than 520,000,000 gallons; more than 139,000,000,000 gallons of water is available for use annually. The most important supply is that of the city of Honolulu. About 90 per cent of the entire city is supplied with untreated water from basal artesian wells and high-level sources. More than 325 miles of mains deliver the water from 12 pumping stations and 25 reservoirs to the 26,000 individual connections. Additional supplies of water are being developed, and it has been proposed that surface water be collected and passed through a filtration plant at Nuuanu to augment the present supply.

The permeable lava formations in which the water is found or through which it passes on its path from the surface of the ground provide no filtration. Moreover, on most parts of the islands the soil cover is thin and the water passing through it is not purified. Sedimentary rocks usually are limestone; in such strata the openings are large and water is not purified in its passage through the rocks. When surface water is used for the irrigation of cultivated areas, large amounts of contaminated material may be carried in the water and thus into the underground formations. Where there is a large amount of underground water of fairly good quality there may be sufficient dilution to reduce the concentration of pathogens in the underground water to a safe number. On the other hand, where the rainfall is low or where there are many people residing in an area, ground water, as obtained, is likely to be unsafe for drinking purposes. In areas in which it is possible to prevent the deposition of polluting material on the surface of the ground over the watershed it may be possible to obtain water from wells, springs or tunnels which usually would be safe for use without treatment.

Sewage Disposal

Of the 115 sewerage systems concerning which information is available 84 are plantation owned, six are owned by the territory, 12 by the county and 13 by some private concern or person. Eighteen of the installations provide at least primary treatment of the sewage before it is discharged. At two places activated-sludge treatment is provided to supplement sedimentation; at four additional places either filtration or chlorination is utilized or else both processes are provided. Sixty-one of the sewerage systems discharge the sewage into the ocean and in 43 of the systems some method of soil absorption or irrigation on land is utilized. A large part of the sewage which is disposed of onto the surface of the ground and even into the streams soon finds its way into the underground water-bearing formations, and results in the contamination of the ground water.

The city of Honolulu has a well-developed sewerage system which discharges raw, untreated sewage through a number of sewer outfalls into the ocean. Fine screening and chlorination of this sewage have been proposed. In 1935 about 55 per cent of the city was served by approximately 165 miles of sewers and the system was being rapidly extended. The rest of the city depends upon cesspools which are pumped out when necessary.

Insects and Animals

Vectors of Disease. Mosquitoes. Anopheline mosquitoes as yet are unknown in Hawaii, and as a result malaria is nonexistent. Because of increased air and marine communication with other areas of the Pacific in which these mosquitoes are found, the danger of their importation is ever present.

Two species of Aedes are known in the Territory of Hawaii; both are potential vectors of dengue fever and yellow fever. *Aedes aegypti* breeds and passes its life span in the immediate environment of man and is urban in distribution. This mosquito breeds in artificial collections of water such as that in cisterns, barrels, pails, bottles, cans or empty tire casings, in or near dwellings. It is an alert and vicious feeder. Only the female bites; it feeds during the morning and afternoon hours—much less commonly at night, except in the presence of light. *Aedes albopictus* breeds particularly in artificial receptacles in the vicinity of dwellings as well as in holes in trees. In general habits it resembles *A. aegypti.*

Culex fatigans is an important vector of *Wuchereria bancrofti.* Although the filariae of *W. bancrofti* are found in Hawaii, clinical elephantiasis is virtually unknown. The larvae of *Culex fatigans* occur most frequently in water contained in artificial receptacles, but are found also in ground pools, even far from habitations. This mosquito is active at night.

Lice. *Pediculus capitis,* the head louse, and *Phthirus pubis,* the pubic louse, occur in Hawaii. *Pediculus corporis* has not been recorded. Louse-borne typhus fever is not reported from Hawaii, nor is relapsing fever.

Flies. Flies found in this area include the stable fly, *Stomoxys calcitrans;* the housefly, *Musca domestica;* and species of Sarcophaga, Lucilia and Synthesiomyia. Species of the latter genera sometimes are involved in the production of myiasis of wounds.

Ticks. *Rhipicephalus sanguineus,* the dog tick, is known to occur in Hawaii. This tick will bite man. The types of fever transmitted in other areas by this tick (spotted fever and Q fever) are not reported from Hawaii.

Fleas. Fleas are of major importance in Hawaii because of the presence of plague and flea-borne typhus fever. The rat fleas are the most dangerous; the others are potential vectors of rat-borne diseases. *Pulex irritans,* the flea of human beings, has been found on rats and mongooses in Hawaii. This flea has not been proved to be an important natural vector of plague. *Xenopsylla cheopis,* the Oriental rat flea, is found on rats near human habitations and elsewhere, but is rare on mongooses and mice. It is an important vector of bubonic plague and endemic typhus fever. *Xenopsylla hawaiiensis,* the Hawaiian rat flea, is found on field rats, but has not been found on rats examined in Honolulu. This flea transmits bubonic plague and endemic typhus fever. *Nosopsyllus fasciatus,* the European rat flea, has been found on rats on Maui and Hawaii islands, in or near buildings and mostly at elevations of 1,200 to 2,500 feet. It is rare on mongooses and mice. It is a vector of bubonic plague and probably is a carrier of endemic typhus fever. *Ctenopsyllus segnis,* the flea of the common house mouse, is not known to bite man, although it ingests blood. It has been found on rats and mice on Maui and Hawaii and is involved in the spread of sylvatic plague. *Echidnophaga gallinacea,* the flea of fowls, is found on chickens, rats and mongooses. It is one of the worst known pests of poultry.

RODENTS. Rodents are of importance in Hawaii as carriers of plague. The species known to occur are *Rattus alexandrinus, R. rattus, R. hawaiiensis, R. norvegicus* and *Mus musculus,* as well as mongooses; all have been found infected with plague. Many rats in the territory also are infected with species of Leptospira, as are mongooses. Weil's disease occurs in Hawaii and is maintained by the large rat population. Natural conditions make the control of rats difficult and eradication almost impossible. Gulches, vegetation and other natural harborages offer ready shelter for rodents. *Rattus hawaiiensis* is found particularly in gulches and old pineapple fields; it is considered to be the ultimate reservoir of plague. About 80 per cent of infected rats trapped are either *R. alexandrinus* or *R. rattus.* These rats frequently rest in algarroba trees. They serve also as the reservoir of endemic typhus fever. Like plague, endemic typhus fever is transmitted from rat to rat and from rat to man by rat fleas.

Snakes and Other Dangerous Animals. No poisonous snakes are found on the islands of this area. *Latrodectus mactans,* the black widow spider, is found on most of the islands, with the exception of Kauai. In its natural habitat this spider is found in protected darkened locations such as vacated rodent burrows, under stones, logs and long grass, in hollow stumps and brush piles, but may be found in man-made structures. In Hawaii a favorite habitat of the spider is the vicinity of pineapple plants. *Latrodectus geometricus,* a closely related but less poisonous species, also occurs.

Pests. Sixteen species of cockroaches are known in Hawaii. *Periplaneta americana, P. australasiae, Blatella germanica* and *Supella supellectilium* are the most common. They are of importance as pests and have been incriminated as mechanical carriers of pathogenic organisms. The cone-nosed or kissing bug, *Triatoma rubrofasciata,* is an avid bloodsucker and its bite is painful. Although a proved vector of Chagas' disease (infection with *Trypanosoma cruzi*) in Latin America, this bug is of no known medical importance in this area. The fire ant, *Solenopsis geminata,* nests in the ground. It is a reddish ant which stings viciously. Bees, hornets and wasps all are found in the islands; their stings may be painful. *Scolopendra subspinipes* is the only centipede known to bite man in this area. The bite is painful and often produces severe swelling. This arthropod lives under loose bark, leaves, logs and in other débris. Other arthropods which are pests include the mite, *Pediculoides ventricosus,* the bite of which produces acute itching dermatitis, particularly in those handling grain; *Dermanyssus gallinae,* the poultry mite, the bite of which produces dermatitis in man; and *Laelaps echidninus* and *L. hawaiiensis,* blood-sucking mites of rats that are capable of biting man. The body fluids of blister beetles of the genus Sessinia will cause severe blistering if a beetle is crushed on the skin. These beetles often are attracted to light in considerable numbers in coastal regions. *Sessinia collaris* is found on Oahu Island.

DANGEROUS MARINE LIFE

Species of scorpion fish are found on the reefs and shoals about the islands; they are dangerous to anyone walking, wading, swimming or fishing in such places. In many species the strong dorsal spines or the spines of the head are poisonous. These fish are most dangerous during the spawning season. Morays or tropical eels of the family Muraenidae are greatly feared throughout the area. They have well-developed hollow teeth through which the venom is injected into the wound made by their bite. The venom is hemolytic; large doses produce practically instantaneous death. Smaller doses cause rapid and embarrassed respiration, violent cramps and convulsions.

Sting rays of the family Trygonidae occur in lagoons, shallow bays and estuaries, and often lie concealed in the sand or mud. They have a long, whip-like tail which is armed with a sharp, hard spine with serrated edges. This spine can be driven into the victim with enough force to penetrate both flesh and bone, causing serious wounds and severe pain. The eagle ray, a type of dangerous sting ray, *Aetobatus narinari,* is found.

A poisonous cone shell or marine snail, *Conus striatus,* has been found off the island of Oahu. This snail is a distinct hazard because it has a proboscis, armed with teeth, which may shoot out and prick anyone handling the shell. At the same time poison is injected into the wound. Cases of this poisoning have ended in death.

Deaths from poisoning by the eating of puffer fish, although rare, have been reported in Hawaii. The fish *Tetraodon hispidus* and *T. lacrymatus* were noted. The eggs, bile, liver, testes, flesh and urine of these fish all have been found to contain poison. The poisonous principle seems to be an alkaloid somewhat like muscarine.

Dangerous or Irritating Plants

There are only a few poisonous plants of real danger to man. Reported deaths caused by plants are rare, but many of the known species can cause extreme discomfort. In general, plants which have a milky sap (with the exception of the wild fig) and an unpleasant taste are avoided.

The ragweed *Ambrosia artemisiifolia,* has been reported to be abundant in parts of the islands of Oahu and Molokai. It is important because it produces hay fever. Many types of grass which might be potential allergens are found in the islands, including sugar cane and bamboo.

Food and Dairy Products

The principal industries of the Hawaiian Islands are agricultural. Sugar and pineapples are the leading crops; potatoes, rice, bananas and taro also are produced. The principal product of taro is *poi,* a fermented paste much used as an article of food. Taro is high in nutritional value and is used in the production of flour. Although the trend has been toward attempts to make the islands self-sufficient, only 35 per cent of the fresh fruits and vegetables consumed in 1938 were produced locally; the rest were imported. The dietary habits of the natives of Oriental extraction, however, lead to consumption of a preponderance of rice, with the result that the diet is likely to be deficient in vitamins.

Nearly all land available for agriculture which is not actually cultivated is used for ranching. In 1938 nearly half the total area of the territory was so utilized. Practically all milk produced is bottled. Only a small amount is available for by-products. Much imported canned milk is consumed because it costs less than bottled milk. The majority of the surplus milk is used in the production of ice cream. Most dairy products are imported. The production of milk is carefully controlled by the Health Department, which inspects dairies and plants in which milk is handled. Samples of milk are collected and examined at laboratories of the Board of Health. The Division of Animal Husbandry of the Territorial Department of Agriculture inspects imported livestock and tests herds for evidence of tuberculosis and brucellosis. In 1942 there were 103 dairies and 16 pasteurization plants in the islands. In that year an average of 73,000 quarts of milk were consumed daily. Of this number 50,500 quarts were pasteurized milk, 8,300 were certified milk and 14,200 were raw milk. Pasteurized milk is not available on Maui or Molokai islands and certified milk is found only on Oahu Island.

Since a large proportion of persons of Oriental ancestry in Hawaii do not eat meat, the consumption per capita of this food is lower than that in the continental United States. Beef cattle, hogs, sheep and lambs are produced. Poultry and hog farms are numerous in the vicinity of the leading markets; they are inspected by the Health Department. Although eggs produced locally are of high quality, most eggs consumed are imported from the United States, as is poultry. The two meat inspectors of the city and county of Honolulu, working under the direction of the Bureau of Pure Food and Drugs, examine animals at slaughterhouses and markets. Fisheries and canneries are found in the territory; more than 650 species of fish are found in the waters about the islands. Fish sold in markets and from fish wagons on Oahu Island are examined by the county fish inspector.

MEDICAL FACILITIES

Hospitals

Number of Beds. In 1940 there were 70 institutions with beds for medical care in the Territory of Hawaii, with a total of 6,501 beds, or 15.4 beds per 1,000 of population (based on a total population of 423,000). Sixty-eight of these institutions were hospitals or sanatoriums; one was a nursing home of 125 beds controlled by the government; and one was a nonprofit institution with an infirmary and five beds. Twenty-seven were located in Honolulu County; 21 in Hawaii County; 12 in Maui County; nine in Kauai County; and one in Kalawao County. About a fourth of the 68 hospitals mentioned above were not registered; these, however, provided only about 8.6 per cent of the total number of beds. Sixty-two per cent of all beds in 1940 were provided by government-controlled hospitals, in spite of the fact that such hospitals constituted only 26 per cent of the total number. Most hospitals in the territory are small; 44 per cent in 1940 had less than 25 beds each. Utilization of hospital and sanatorium facilities in that year was 73 per cent of capacity.

Equipment. It is not possible to detail the equipment of the 70 hospitals in the islands; but x-ray apparatus is found in such hospitals as Queen's, Japanese and Kahuku hospitals, Leahi Hospital for Tuberculosis, and Kauikeolani Children's Hospital, all in Honolulu County; Kula Tuberculosis Sanatorium and the Robert W. Shingle Junior Memorial Hospital in Maui County; Kona Hospital and Hilo Memorial Hospital in Hawaii County; the G. N. Wilcox Memorial Hospital in Kauai County; and at several other hospitals and institutions. All these hospitals, with the possible exception of the Kona Hospital, have laboratory facilities. Equipment as a rule is imported from the United States.

Supplies. Supplies for the most part are imported.

Medical Personnel

Physicians. Physicians practicing in Hawaii in 1943, excluding interns, but including physicians in the institutions of the islands, numbered 287, distributed as follows: Oahu Island, 206; Hawaii Island, 41; Maui Island, 20; Kauai Island, 16; Molokai Island, three; and Lanai Island, one. All physicians practicing in the territory are licensed by the Health Department after recommendation by the Board of Medical Examiners.

Nurses. The latest available figure for the total number of registered nurses in the territory was 711 for 1938. Eighty-six were employed by the Health Department in 1938. The Oahu Island unit had 73 field nurses, four clinic nurses, six supervisors and one chief nurse doing work for the city and county of Honolulu.

Dentists. In 1938 there were 185 dentists in Hawaii, distributed as follows: Oahu Island, 134; Hawaii Island, 27; Maui Island, 12; Kauai Island, 10; Lanai Island, one; and Molokai Island, one. Seventeen dentists were rendering part-time service in the schools in 1940.

Others. Fifty-seven midwives were practicing in the territory in 1942. The number has been steadily declining. As both hospital facilities and public health work improve, the demand for the services of midwives is decreasing. All midwives must be registered with the Health Department. Twenty-nine dental hygienists were assisting dentists in the public schools in 1940.

Medical Institutions

There are no medical schools in the territory. Schools of nursing are located in the city of Honolulu at the Queen's and Saint Francis hospitals. Both of these schools are accredited by the Board of Nurse Examiners. Postgraduate courses in public health nursing are offered at the University of Hawaii. Dental hygienists are trained in the school for dental hygienists at the University of Hawaii, where a four-year course leading to a bachelor's degree is offered.

The Hawaiian Territorial Medical Association, with district societies in Hawaii, Honolulu, Kauai and Maui, is active in the medical affairs of the islands. Other societies in the territory are the Hawaii Society of Clinical Pathologists, the Oahu Dental Society, the Hawaii Territorial Society for Mental Hygiene, the Hawaii Society for the Hard of Hearing, the Hawaii Society for the Control of Cancer, the Hawaii Social Hygiene Association, the Children's Service Association, Inc., and the Tuberculosis Association of Hawaii.

Social Services. In addition to the many government agencies which are engaged in health work, the number of voluntary agencies thus engaged reflects the interest of the people of the islands in health work. Many agencies work in close co-operation with the Board of Health.

The Palama Settlement, organized in 1896, is supported by private funds and the United Welfare Fund. This organization, which serves an average of 50,000 persons a year, offers medical, nursing and dental services.

The Chamber of Commerce Public Health Committee in 1940 sponsored the Department of Human Parasitology at the University of Hawaii in co-operation with the Agricultural Experiment Station of the university. In 1940 special studies were conducted on infectious jaundice and the mode of transmission of typhus fever. The committee actively participates in the program for the control of rats. An anti-mosquito league formed by the Chamber of Commerce assists in the inspection of airplanes, receives and investigates complaints, provides lectures and demonstrations and carries out work designed to abolish breeding places.

The Hawaiian Medical Service Association was organized to insure medical and surgical care for employed groups and their dependents. This association has a plan providing for physician's care at home or in the office, hospital care and free choice of physician and hospital. The only restriction is that the physician selected must be a member of the Honolulu County Medical Society.

Many other agencies are engaged in health work. The Junior League has employed nutritionists and occupational therapists. The latter have worked with the Bureau of Mental Hygiene of the Health Department. The Hawaiian Sugar Planters' Association has taken an active interest in the health problems on the plantations and has promoted the establishment of preventive and curative services. The Shriners' Clinic at Honolulu renders services to crippled children, as does the Shriners' Hospital for Crippled Children. Two church hospitals are reported, the Saint Francis Hospital in Honolulu and the Robert W. Shingle Junior Memorial Hospital at Hoolehua on Maui Island. The Hilo Shippers' Wharf Committee assists the Health Department in the control of plague and diphtheria by providing personnel. In 1942 the Tuberculosis Associations of Maui and Kauai supplied two public health nurses to the Health Department. The Red Cross is active.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysentery. Amebic dysentery is reported yearly by the Health Department. In 1940 * there were 52 cases and one death; in 1941 there were 10 cases; in 1942 the figure was 18 cases.

Bacillary dysentery likewise occurs; in 1941 there were 72 cases, and in 1942 there were 80. The known forms of bacillary dysentery in the islands are Flexner, Sonne, Hiss and Strong.

Typhoid Fever. Compulsory immunization of the total population of the islands against typhoid fever was completed in August, 1942. This program was carried out with the co-operation of the Health Department and other authorities. Immunization against typhoid fever is carried out for all persons more than three years of age who have not been immunized since January 1, 1941. Since the inauguration of this program the incidence of typhoid fever has notably decreased. Since 1930 an average of 72 cases of typhoid fever have been reported each year. The lowest figure was 38 in 1936; the highest was 121 in 1942.

Paratyphoid Fever. The population is immunized against paratyphoid fever according to the same regulations as those which govern immunization against typhoid fever. Two cases of paratyphoid fever were reported in 1940; one in 1941; and 15 in 1942. There were no deaths during this three-year period.

Helminthiasis. No records are available on the incidence of infection with worms. Ascariasis occurs throughout the territory. Infection with hookworm is reported; in 1940 there were 135 cases; in 1941 there were 137; in 1942 there were only 21. This type of helminthiasis is rare among Hawaiians. When it occurs in the islands it is believed to have been brought in by Filipino laborers. Infection with *Necator americanus* and with *Ancylostoma duodenale* is present. Trichinosis is reported. Clonorchiasis is rare, but exists. In 1934 the liver fluke, *Clonorchis sinensis,* was found in the stools of four lepers who had never left the territory. Intestinal flukes of the genus Heterophyes are present; they become parasites of man when they are ingested in raw fish.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Pneumonia in 1942 was the eighth most common cause of death; 301 cases were reported during that year, and 57 persons died from it. In 1941 there were 178 cases and 81 deaths; in 1940 there were 221 cases and 78 deaths. A nonspecific type of pneumonia, "Oahu fever" or Bowman's pneumonitis, is described but has not been declared reportable. Primary atypical pneumonia has been observed; it is not accompanied by a high fatality rate.

Influenza. Influenza was declared reportable in 1940, when the Board of Health announced that it had appeared in epidemic form. The disease was believed to have been brought in from the west. The number of cases reported in that year was 137, with 18 deaths. By 1941 the figure had increased to 16,818, with 30 deaths. In 1942 there were 293 cases and 13 deaths.

Tuberculosis. Tuberculosis is still a serious problem. There were 645 cases of pulmonary tuberculosis in 1940, with 252 deaths. In the same year there were 70 cases of other forms of tuberculosis, with 14 deaths. In 1941 the figure for the pulmonary form was 703 cases, with 311 deaths; for other forms, 37 cases and 16 deaths. In 1942, the reported cases of pulmonary tuberculosis numbered 728; 246 of the patients died. Thirty-eight persons had other forms of the disease; 23 died.

* Morbidity and mortality statistics of Hawaii are published as of the fiscal year ending June 30. For brevity the fiscal year is listed here as of the calendar year in which it ends.

In 1942 there were 1,551 persons with either active or clinically significant tuberculosis registered with the Health Department. Of 766 patients with new or reactivated tuberculosis, Japanese constituted the group chiefly affected; 309 cases were reported from among them. Second were the Filipinos, 134 of whom had the disease. The greatest number of cases, 417, was reported from the city of Honolulu. In 1942 tuberculosis was the fourth leading cause of death in the islands.

Smallpox. In 1942 a program of compulsory vaccination of all inhabitants was completed; this program has been continued so that it includes those persons more than six years old who have not been immunized since January 1, 1941. In 1937 there were eight cases of "off-shipping" smallpox; in 1940 only one case was reported in the territory. In 1941 and 1942 there were no cases.

Diphtheria. Diphtheria is reported regularly. The predominant type is that caused by *Corynebacterium diphtheriae intermedius;* that caused by *C. diphtheriae mitis* occasionally occurs; but the type caused by *C. diphtheriae gravis* is absent. In 1940 there were 95 cases and six deaths; in 1941 the figure was 95 cases and two deaths; in 1942 there were 73 cases. Immunization is compulsory for all persons between the ages of nine months and 10 years.

Scarlet Fever. A mild form of scarlet fever is recorded. In 1940 six persons had the disease; in 1941 the figure was 17; in 1942 it was 21. No deaths occurred during these years.

Meningococcic Meningitis. Eight persons had this disease in 1940, and three of them died. In 1941 two had the disease and one died. In 1942 six cases, with three deaths, were reported.

Poliomyelitis. An increase in the incidence of poliomyelitis was noted in 1942, with 32 cases and five deaths. Twenty-seven of these were reported from Oahu Island. Only 11 cases and two deaths had been reported in 1941; but in 1940 the figure had been 101 cases and 10 deaths. In 1943 an epidemic occurred. The Shriners' Annex Hospital at Manoa was used as an emergency hospital for patients with the disease. From January through June, 70 cases had been reported.

Measles. Cases of measles are reported annually. The largest epidemic in recent years occurred in 1937 when there were 13,678 cases and 205 deaths.

Whooping Cough. Whooping cough occurs in all the islands, but the number of deaths is small; only 19 in 1940; seven in 1941; and 16 in 1942.

Chickenpox. An epidemic of chickenpox occurred in 1939, causing 1,319 reported cases. The usual number of reported cases averages about 600 per year.

Mumps. In 1943 an epidemic of 2,999 cases of mumps was recorded.

Encephalitis Lethargica. This disease occurs occasionally. One case was recorded in 1940; two in 1941 with one death; and two in 1942 with one death.

Rheumatic Fever. This disease occurs, but is rare.

Diseases Spread Chiefly through Contact

Venereal Diseases. In 1874 syphilis, which seems to have been introduced by white men, was said to be an important cause of depopulation in the islands. At the present time about a hundred cases of syphilis are reported each month to the Board of Health; two thirds of them from houses of prostitution on Oahu Island. Recently a law was enacted which requires that all pregnant women undergo blood tests. So-called "off-shipping" granuloma inguinale is reported. A few instances of chancroid have been recorded. It is said that gonorrhea is spread chiefly by occasional or clandestine prostitutes, and not by professional prostitutes. Some degree of control of gonorrhea among the latter is claimed as a result of the weekly medical examination which they undergo.

Leprosy. Leprosy reached its maximal prevalence in 1894, and since then has been slowly declining. In 1941 the Board of Leper Hospitals and Settlement took over the work in control of leprosy that had been done previously by the Board of Health. In 1941 there were known to be 419 persons with the active stage of the disease. In 1938 there were 46 new cases of leprosy; in 1939 the figure was 36; in 1940 it was 38; in 1941 it was 32. Reduction of the incidence has been attributed to improvement in hospitalization facilities and the spread of knowledge of hygiene and sanitation. The Kalaupapa settlement on Molokai Island has 515 beds for the care of lepers. The Kalihi Hospital and receiving station in Honolulu have 140 beds for the detention and early treatment of recently admitted leprous patients. The United States Public Health Service maintains a station for the investigation of leprosy. The Kapiolani Home for Girls and the Kalihi Boys' Home are run by the Board of Leper Hospitals and Settlement to care for the nonleprous children of leprous parents.

Tetanus. Cases of tetanus are reported annually. In 1940 there were 25 cases and 10 deaths; in 1941 there were 23 cases and 10 deaths; in 1942 there were 30 cases and eight deaths. Tetanus antitoxin is available generally.

Anthrax. Anthrax occurs, but is rare, a case being reported every few years.

Leptospirosis. Leptospirosis, or Weil's disease, was made reportable in 1936. Eighty-two cases were reported from 1936 through 1942; of these, 59 were reported from Hawaii Island. The Public Health Committee of the Chamber of Commerce has provided funds to aid study of the problem. This disease has been found in rats and in mongooses. Contact with water or objects contaminated with their urine or feces is dangerous. In most cases the disease attacks field laborers. Cane fields are heavily infested with rats. The high population of rats provides a reservoir for the disease. In 1940 there were six cases, with one death; in 1941, five cases and one death; and in 1942, six cases and one death.

Diseases of the Eyes. Trachoma is reported at the rate of about one case a month. In 1940 there were 160 cases of acute epidemic conjunctivitis and 27 cases of follicular conjunctivitis; in 1941 there were 72 and 34 cases, respectively; and in 1942 there were 90 and 29 cases, respectively. In the summer of 1941 on Oahu Island the rapid spread of infectious conjunctivitis almost reached epidemic proportions. Since no specific causative organism was found, the disease was not made reportable. Congested living and working conditions favor its spread.

Diseases of the Skin. Among the superficial types of mycosis which are prevalent are various kinds of ringworm. Tinea capitis is rare, but tinea barbae, tinea glabrosa, tinea alba, tinea circinata, tinea cruris and tinea versicolor are prevalent. *Microsporon rhinosum* frequently attacks children. Among 1,171 patients with dermatitis seen consecutively, ringworm was twice as frequent as was contact dermatitis or acne, and four times as frequent as impetigo or furunculosis. Dermatitis venenata of the type caused by plants in Honolulu is reported to be due largely to the blossom of the shrub, *Grevillea banksii,* which contains the sensitizing principle. In 1940 actinomycosis caused one death; in 1941 it was responsible for two cases and one death; in 1942 one case was reported. Lumpy jaw occurs among cattle. One patient with mycetoma or Madura foot was seen in Honolulu in 1942. Sporotrichosis has been seen. Impetigo occurs among children and is reported from all islands. The incidence of erysipelas in 1940, 1941 and 1942 was 39 cases and five deaths, 37 cases, and 27 cases and one death, respectively.

Rat-bite Fever. This disease is rare. One case was reported from Pahala on Hawaii Island in 1942.

Diseases Spread by Arthropods

Typhus Fever. Flea-borne typhus fever is endemic in Hawaii. The first case was reported in the fall of 1933. From 1934 through 1939 there was a total of 199 cases, the majority of which were reported from the city of Honolulu. The disease occurs on all the larger islands, however, and particularly on Oahu. In 1940 there were 77 cases and one death; 66 cases were reported in 1941; 88 cases with one death were recorded in 1942.

The majority of rats captured in areas in which typhus fever has occurred were specimens of *Rattus norvegicus*, the brown rat. In Honolulu examination of rats trapped in seven districts indicated that the highest incidence of typhus fever occurred in the Kaimuki, downtown and Kalihi districts. Infestation with rats was noted in the surroundings of 86 per cent of human beings with the disease. Epidemiologic features of the disease are similar to those of typhus fever as it occurs in the United States. They include a higher incidence of the disease in the summer and fall months, a greater urban incidence, greatest incidence in young adult groups and greatest prevalence among white people. Complications are rare and the fatality rate is very low in Hawaii.

Plague. Plague is endemic on the islands of Hawaii and Maui. Plague of human beings was first reported in Honolulu in 1899, and appeared there in epidemic form in 1900. At present plague persists among both human beings and rats in the Hamakua district of Hawaii, and in rodents on Maui Island. To October 31, 1937, plague of human beings had amounted to 142 cases on Hawaii Island and seven cases on Maui Island. On Maui Island in 1942, of 20,384 rats examined, one was found to be infected. On Hawaii Island 54 rats of 71,474 examined were found to be infected. In 1939 one death from the pneumonic type of plague was reported. No cases or deaths were reported in 1940, 1941, or 1942. In 1943, to August 22, five cases and five deaths from bubonic plague were reported from the Hamakua district of Hawaii Island; in that period 69 plague-infected rats and three infected mice were found in that area.

Dengue Fever. The vectors of dengue fever, *Aedes aegypti* and *A. albopictus*, are present. Several outbreaks of dengue fever have been recorded; a number of cases occurred in 1943. On Oahu Island, where both mosquito vectors and a susceptible population are constantly present, the disease is said to occur only at intervals of several years. This situation suggests that dengue fever actually is not endemic, possibly because there is no reservoir of infection in lower animals and because each epidemic depends on the introduction of the causative agent from abroad.

Malaria. Malaria does not occur; nor do anopheline mosquitoes, the vectors of the disease. Nevertheless, the danger of importation of the disease or its vectors cannot be dimissed.

Yellow Fever. Yellow fever is not present, but the vectors, *Aedes aegypti* and *A. albopictus*, are numerous.

Filariasis. *Wuchereria bancrofti* has been reported, but filariasis apparently is not common. Clinical elephantiasis is virtually unknown. The principal mosquito vector, *Culex fatigans*, is prevalent.

Miscellaneous

Many of the inhabitants of Hawaii are Orientals or of Oriental extraction. Polished rice forms a major part of their diet. Beriberi, which results from such a diet, once was a serious problem in Hawaii. Educational work has done much to alleviate this. Pellagra and scurvy are rare. General malnutrition or undernutrition is common.

Dental caries is prevalent. An intensive school program against the disease is in force, and dental care for indigents is provided.

SUMMARY

Public health work in the Territory of Hawaii is carried on by the Territorial Health Department under the supervision of the Territorial Board of Health. Members of the Board of Health appoint the Director of Public Health, with the approval of the Governor of the territory. The Health Department is divided into bureaus; but in three counties there are local health units which function under administrative officers directly responsible to the president of the Territorial Board of Health. The work of these local units parallels that of the Board of Health. Public health work in general is modern and progressive. Community interest in problems of health is keen. General death rates and infant mortality and maternal mortality rates are low. The supply of medical personnel is adequate. Hospitals and sanatoriums are well distributed.

The supply of water from surface and underground sources is adequate on most of the islands. Wells, catchment areas for rain water and streams are the chief sources of supply. Facilities for treatment, as a rule, do not exist; but water obtained from wells and springs, when it can be assumed that polluting material on the surface of the ground will not reach these sources, usually is safe without treatment. There are many sewerage systems, some of which provide at least primary treatment of the sewage before it is discharged. Most of these systems discharge sewage directly into the sea; some sewage is deposited on the ground.

Anopheline mosquitoes thus far do not exist in Hawaii; but two species of Aedes, potential carriers of dengue fever and yellow fever, are found. *Culex fatigans,* which can carry *Wuchereria bancrofti,* is present. The head louse and the pubic louse of human beings, flies of various kinds, a dog tick, fleas of human beings and of rats, mice and fowl, all occur. Rodents are important as carriers of plague. Poisonous snakes are absent. Cockroaches, centipedes and various mites are pests. Certain fish are poisonous on contact; others produce poisoning if they are eaten. A few poisonous plants are found.

Only about a third of the fresh fruits and vegetables consumed are produced in the islands; the rest are imported. Nearly all the milk produced is bottled; but canned milk is imported because it costs less than bottled milk. Sugar, pineapples, potatoes, rice, bananas and taro are raised. Poultry and eggs are imported from the United States, although quantities of each are produced in the islands. Fish are plentiful.

Plague and endemic typhus fever are important disease problems. Dysentery, typhoid fever and paratyphoid fevers have been controlled; but helminthiasis, and particularly ascariasis, is common throughout the territory. Infection with hookworm, however, is rare among Hawaiians. Pneumonia occurs, but by the year 1942 the incidence had been reduced to such extent that it was only the eighth most common cause of death. Influenza has occurred in epidemic form. Tuberculosis is a serious problem, particularly among the Japanese, Filipinos and the Hawaiians. Smallpox, diphtheria, and scarlet fever appear to have been brought under control recently; but in 1942 an increase in poliomyelitis was recorded. Venereal diseases are prevalent. Leprosy is an important problem among native peoples. The incidence of leptospirosis has increased in recent years. Diseases of the eyes and skin are frequent. Malaria and yellow fever do not occur; filariasis is not common. Dengue appears from time to time.

BIBLIOGRAPHY

Alicata, J. E., and Breaks, V.: A Survey of Leptospirosis in Honolulu. Hawaii M. J., 2:137-142 (Jan.-Feb.) 1943.

Allison, Samuel D.: The Fight Against Syphilis. Hawaii, 3:8 (August 31) 1942.

American and Canadian Hospitals. Chicago, Physicians' Record Company, 1937.

American Medical Association: American Medical Directory. Chicago, American Medical Association, 1938.

Approval of Laboratories for Prenatal Blood Tests. Hawaii Health Messenger, 2:3 (June) 1943.

Arnold, H. L.: Dermatitis Due to the Blossom of *Grevillea banksii*. Arch. Dermat. & Syph., 45:1037-1051 (June) 1942.

——: Incidence of Dermatoses in Office Practice in Hawaii, a Preliminary Report. Proc. Staff Meet. Clin., Honolulu, 7:63-67 (May) 1941.

Babbitt, H. E.: Glimpses of Foreign Water Works. J. Am. Water Works Assn., 24:1-21 (Jan.) 1932.

Binford, C. H.: The History and Study of Leprosy in Hawaii. Pub. Health Rep., 51:415-423 (April) 1936.

Clench, W. J., and Kondo, Y.· The Poison Cone Shell. Am. J. Trop. Med., 23:105-121 (Jan.) 1943.

Continuation of Immunization Program. Hawaii Health Messenger, 2:1-2 (June) 1943.

Dillingham, H. G.: In the Interest of Children. Kauikeolani Children's Hospital. Hawaii, 1:6 (May 10) 1940.

Dillingham, W. F.: Palama Settlement. Hawaii, 1:5 (April 25) 1940.

Doolittle, S. E.: Clinical Observations During the 1940 Epidemic of Influenza in Honolulu. Proc. Staff Meet. Clin., Honolulu, 7:1-8 (March) 1941.

——: Endemic Typhus in Hawaii. Proc. Pacific Sc. Congr., 1939, 6th Congr., 5:725-729, 1942.

——: Endemic Typhus Fever in Hawaii. Ann. Int. Med., 14:2091-2114 (May) 1941.

Dopmeyer, A. L.: Plague Eradicative Measures on the Island of Maui, Territory of Hawaii. Pub. Health Rep., 51:1533-1556 (November 16) 1936.

Dunn, W. T.: President's Address. Trans. 15th Ann. Meeting Medical Society of Hawaii (May 17-19) 1940, pp. 23-25.

Emergency Medical Services. Hawaii M. J. 2: 269-270 (May-June) 1943.

Encyclopedia Americana: Hawaii. New York, Americana Corp., 1940, 14:1-5.

Encyclopaedia Britannica, 14th ed.: Hawaii, 11:264-273, 1941.

Enright, J. A., and Fennel, E. A.: Weil's Disease in Hawaii. Proc. Pacific Sc. Congr., 1939, 6th Congr., 5:337-343, 1942.

Eskey, C. R.: Epidemiological Study of Plague in the Hawaiian Islands. Washington, U. S. Govt. Print. Off., 1934. (Pub. Health Bull., no. 213.)

Fennel, E. A.: Venereal Disease Control. Hawaii M. J., 2:67-71 (Nov.-Dec.) 1942.

Food Handlers' Certificates, editorial. Hawaii M. J., 2:157 (Jan.-Feb.) 1943.

Fowler, H. W., and Ball, S. C.: Fishes of Hawaii, Johnston Island and Wake Island. Honolulu, Hawaii, The Museum, 1925. (Bernice P. Bishop Museum. Bull. No. 26.)

Frachtman, H. J.: Primary Atypical Pneumonia. Hawaii M. J., 2:195-197 (March-April) 1943.

Hawaii (Ter.). Dept. of Public Works: Annual Report of the Superintendent of Public Works to the Governor for the Year Ending June 30, 1941. Honolulu, 1941.

——. Governor: Report to the Secretary of the Interior for the Fiscal Years Ending June 30, 1939, 1940, 1941, 1942. Washington, U. S. Govt. Print. Off.

——. Honolulu Sewer and Water Commission: Reports of the Honolulu Sewer and Water Commission to the Legislature of the Territory of Hawaii, Fourteenth-Fifteenth Regular Session. . . . 1925/26-1927-1928. Honolulu, Honolulu Star-Bulletin, Ltd., 1927-29.

——. Territorial Planning Board: First Progress Report. An Historic Inventory of the Physical, Social and Economic and Industrial Resources of the Territory of Hawaii. 1939. Honolulu, Hawaii, 1939.

——. ——: Surface Water Resources of the Territory of Hawaii, 1901-1939. Honolulu, Hawaii, 1939.

Health Trends. Hawaii Health Messenger, 2:4 (June) 1943.

Herms, W. B.: Medical Entomology. 3d ed., New York, The Macmillan Company, 1939.

Hiscock, I. V.: A Survey of Health and Welfare Activities in Honolulu, Hawaii, 1929. New Haven, Conn., Quinipiack Press, Inc., 1930.

——: A Survey of Public Health Activities in Honolulu, Hawaii. New Haven, 1935.

——: Health Work on a Sugar Plantation in Hawaii. Am. J. Pub. Health, 26:865-871 (Sept.) 1936.

Hoagland, R. J., Harris, F. H., and Chinen, S. S.: Leptospirosis (Weil's Disease). Hawaii M. J., 2:131-135 (Jan.-Feb.) 1943.

Hogue, C. E.: Selling Water in Paradise. Water Works Eng., 92:972 (Aug. 2) 1939.

Holmes, W. J.: Epidemic Infectious Conjunctivitis. Hawaii M. J. (Nov.) 1941.

Hospitals Registered by the American Medical Association: Hawaii. J.A.M.A., **121**:1085 (March 27) 1943.

Izumi, H. M.: The Maui Tuberculosis Case-Finding Program, An Analysis of 10,979 Surveyed Individuals. Trans. 15th Ann. Meeting Medical Society of Hawaii (May 17-19) 1940, pp. 120-129.

Kailua Water System, Hawaii (Jan. 11) 1941, p. 9.

Larsen, N. P.: Tetrodon Poisoning in Hawaii. Proc. Pacific Sc. Congr. 1939, 6th Congr., **5**:417-421, 1942.

Manson, P.: Manson's Tropical Diseases. 11th ed. by P. H. Manson-Bahr. Baltimore, Williams and Wilkins Co., 1941.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

Midkiff, F. E.: Health in Hawaii Where East and West Meet. Med. Woman's J., **47**:213-221 (July) 1940.

Millbery, G.: The Dental Health Education and Service Program in Hawaii. Trans. 15th Ann. Meeting Medical Society of Hawaii (May 17-19) 1940, pp. 61-67.

Moir, W. W. S., Allen, O. N., and Magistad, O. C. and others: A Handbook on Hawaiian Soils. Honolulu, Assn. of Hawaiian Sugar Technologists, 1936.

Morrow, M. K.: Nursing in Paradise. Pub. Health Nursing, **31**:419-425 (August) 1939.

Mumford, E. P.: Mosquitoes, Malaria and the War in the Pacific. Science, **96**:191-194 (August 28) 1942.

New Health Department Administration. Hawaii Health Messenger, **2**:1 (June) 1943.

Ohrt, F.: Honolulu Wartime Water Works Activity. J. Am. Water Works Assn., **34**:1141-1162 (Aug.) 1942.

Pemberton, C. E.: Insects and Other Arthropods of Medical Interest in Hawaii. Hawaii M. J., **2**:191-194 (March-April) 1943.

Pietschmann, V.: Hawaiian Shore Fishes. Honolulu, Hawaii, The Museum, 1938. (Bernice P. Bishop Museum. Bull. No. 156.)

Pinkerton, F. J.: Public Health Committee Work —1940. Hawaii, **2**:10-11 (March 15) 1941.

Poliomyelitis Epidemic. Hawaii Health Messenger, **2**:2-3 (June) 1943.

Politics Versus Health?, editorial. Hawaii M. J., **2**:203-204 (March-April) 1943.

Rat Control Program for Schools. Hawaii Health Messenger, **2**:3 (Jan.-Feb.) 1943.

Rock, J. F.: The Poisonous Plants of Hawaii. The Hawaiian Forester and Agriculturist, **17**: 59-62 (March) 1920 and **17**:97-101 (April) 1920.

Russell, P. F., Rozeboom, L. E., and Stone, A.: Keys to the Anopheline Mosquitoes of the World, with Notes on Their Identification, Distribution, Biology and Relation to Malaria. Philadelphia, American Entomological Society, and the Academy of Natural Sciences, 1943.

Schattenburg, O. L.: Present Status of Maternal Health in Hawaii. Trans. 15th Ann. Meeting Medical Society of Hawaii (May 17-19) 1940, pp. 26-31.

Simmons, J. S.: Dengue Fever. M. Clin. North America (May) 1943, pp. 808-821.

Stearns, H. T.: Supplement to the Geology and Ground-Water Resources of the Island of Oahu, Hawaii, by H. T. Stearns . . . with Chapters on the Resistivity Survey of Schofield Plateau, by J. H. Swartz. . . . Petrography of the Waianal Range, by G. A. Macdonald. . . . Prepared in Cooperation with the Geological Survey, U. S. Dept. of the Interior. Honolulu, Advertiser Publ. Co., 1940. (Hawaii (Ter.) Dept. of Public Lands. Div. of Hydrography. Bull. 5.)

——: Geology and Ground-Water Resourres of the Islands of Lanai and Kahoolawe, Hawaii. . . . With Chapters on the Petrography of Lanai and Kahoolawe by G. A. Macdonald. . . . Geophysical Investigations on Lanai by J. H. Swartz. . . . Prepared in Cooperation with the Geological Survey, U. S. Dept. of the Interior. Honolulu, Advertiser Publ. Co., 1940. (Hawaii (Ter.) Dept. of Public Lands. Div. of Hydrography. Bull 6.)

——, and Macdonald, G. A.: Geology and Ground-Water Resources of the Island of Maui, Hawaii (including Haleakala Section, Hawaii National Park). Prepared in Cooperation with the Geological Survey, U. S. Dept. of the Interior. Honolulu, Advertiser Publ. Co., Ltd. 1942. (Hawaii (Ter.) Dept. of Public Lands. Div. of Hydrography. Bull. 7.)

——, and Vaksvik, K. N.: Geology and Ground-Water Resources of the Island of Oahu, Hawaii. Prepared in Cooperation with the U. S. Geological Survey. Wailuku, Maui, Maui Publ. Co., Ltd., 1935. (Hawaii (Ter.) Dept. of Public Lands. Div. of Hydrography. Bull. 1.)

——, and ——: Records of the Drilled Wells on the Island of Oahu, Hawaii. Prepared in Cooperation with the Geological Survey, U. S. Dept. of the Interior. Honolulu, Advertiser Publ. Co., Ltd., 1938. (Hawaii (Ter.) Dept. of Public Lands. Div. of Hydrography. Bull. 4.)

Stitt, C. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed., by R. P. Strong, Philadelphia, The Blakiston Company, 1942, 2 vols.
Surfing in Sewage, editorial. Hawaii M. J., **2**:158 (Jan.-Feb.) 1943.
Tunnels for Increasing Honolulu's Artesian Water Supply. Publ. Works, **73**:29 (Jan.) 1942.
U. S. Bureau of the Census. Hawaii Hospital and Other Institutional Facilities and Services, 1939, Vital Statistics—Special Reports, **13**: 633-642 (March 10) 1942.
——. Hawaii Summary of Vital Statistics 1940, Vital Statistics—Special Reports, **18**:707-720 (May 17) 1943).
——. United States Summary of Vital Statistics 1940, Vital Statistics—Special Reports, **14**:3-24 (Nov. 7) 1941.
U. S. Dept. of the Interior. General Information Regarding the Territory of Hawaii. Washington, U. S. Govt. Print. Off., 1937.
U. S. War Dept. Annual Report of The Surgeon General, U. S. Army, 1941. Washington, U. S. Govt. Print. Off., 1941.
U. S. War Dept. Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. Washington, U. S. Govt. Print. Off., 1943. (Technical Manual, TM 10-420.)
Weckler, J. E.: Polynesians: Explorers of the Pacific. Washington, Smithsonian Institution, 1943. (Smithsonian Institution. War Background Studies, no. 6.)
Williams, M., Gage, H., and Byers, M.: Nursing in Hawaii Since Dec. 7, 1941. Am. J. Nursing, **42**:349-351 (April) 1942.
Williams, A. G., and Dickey, C. W.: 96 Bed Voluntary Hospital Serves Farthest Hawaiian Outpost. Mod. Hosp., **59**:60-62 (Sept.) 1942.
You Can't Get Malaria Here (Hawaii), editorial. Hawaii M. J., **2**:83 (Nov.-Dec.) 1942.
Zschokke, T. C.: Poisonous Plants Now Found in the Hawaiian Islands. University of Hawaii, Agricultural Extension Service, Bull. no. 49 (May 3) 1933.

20

Japanese Mandated Islands

GEOGRAPHY AND CLIMATE

The Japanese Mandated Islands are the Marianas or Ladrone Islands; the Caroline Islands, usually divided into the eastern Carolines and the western Carolines; and the Marshall Islands. All these islands passed to Japan as mandated territory in 1919 under the terms of the Treaty of Versailles.

Marianas Islands. The Marianas or Ladrone Islands were possessions of Germany from 1899-1919. They are situated between 12 and 21° of north latitude and, from north to south, roughly parallel the 145th meridian east of Greenwich. The northern group consists of 10 islands; the southern group is composed of four islands. Guam, the subject of another chapter, geographically is part of the Marianas Islands but politically is a territory of the United States. The chief islands in the northern Marianas are Agrihan, Anatahan, Alamagan and Pagan; in the southern group, Rota, Agiguwan, Tinian and Saipan. The total area of the Marianas Islands is about 245 square miles. In 1935 the population was 39,700 Japanese and 4,300 natives. The capital is Garapan on Saipan Island, a city of some 10,000 population which has Port Tanapagu for shipping facilities. The Japanese inhabitants are concentrated in the southern islands of Rota, Saipan and Tinian.

The northern group of islands is featured by elevated areas, some of which may be as much as 2,700 feet high. Partly active volcanic craters are present. The southern islands, in contrast, are of low elevation. All the islands are heavily wooded and have luxurious vegetation much like that of the Philippine and Caroline islands. Coral reefs surround most of the islands.

Hydrographic features are not impressive. There are few streams, lakes, springs and wells. Rainfall, however, is torrential in July, August and September, and the annual figure may be as much as 120 inches (3.05 meters). The climate is damp, but the heat is not so intense as it is in the Philippine Islands, and variations in temperature are not great. The average daily temperature is about 86° F. (30° C.). January, February and March are the driest months. Hurricanes are frequent, and earthquakes have been reported.

Caroline Islands. The Caroline Islands, a part of Micronesia, are situated between 5 and 10° of north latitude and 134 and 165° of east longitude. They were purchased by Germany from Spain in 1899, and became a Japanese mandate in 1919. The archipelago is composed of the western group—Palau Islands and the island of Yap—and the eastern group—Truk, Ponape and other important islands. The total area of all the Caroline Islands is about 550 square miles. The Truk Islands and the islands of Ponape, Kusaie and Yap alone constitute fully 307 square miles; the Palau Islands have an area of 175 square miles. The rest are chiefly islets of small importance. In 1935 the population of Ponape was about 11,500; of Yap, 6,500; of the Palaus, 13,000. The population at that time was chiefly Malay; on Ponape, for example, there were approximately 2,500 Japanese and 9,000 natives. In the Palau

Islands there were 6,500 Japanese and 6,000 natives. The population of all the Caroline Islands probably is from 40,000 to 50,000.

The main islands are hilly and even mountainous in some areas. One ridge on Ponape is 3,000 feet high; the islets of coralline origin generally are low. Both vegetation and fauna are almost identical to those of the Marianas Islands. The northern Palau Islands are of volcanic origin; the southern ones are coralline.

The Caroline Islands, with the exception of Ponape Island, have no important hydrographic features. Ponape, with many springs and streams, is said to have an abundance of fresh water scarcely equaled among other islands in the Pacific Ocean. Small streams are present on Kusaie and Truk islands. Some amount of surface water occurs on at least two of the Palau Islands; on Babeldoab, largest of the Palau Islands, there is a small waterfall.

The climate varies little throughout the Caroline Islands; the mean annual temperature, in a series of unspecified years, ranged between 79 and 82° F. (26.1 and 27.7° C.). The maximal recorded temperature is 91° F. (32.6° C.); the minimal temperature is 69° F. (20.5° C.). A high relative humidity is almost constant. Rainfall in the Palau Islands ranges between 79 and 157 inches annually (2 and 4 meters), and the rainy season prevails during July, August and September. In these islands the Asiatic summer monsoon begins in May, when the southern winds prevail. In others of the Caroline Islands the range of precipitation is great—from 100 inches (2.5 meters) a year on Lamotrek Island to a maximum of 255 inches (6.5 meters) on Kusaie Island. On Ponape the reported annual rainfall is 182 inches (4.6 meters); in the Truk Islands it is 129 inches (3.3 meters); on Yap, 130 (3.3 meters). On these islands rainfall occurs almost daily. The so-called rainy season ranges from March to September in the vicinity of Kusaie, and to July and August near Lamotrek and Yap islands.

Marshall Islands. The Marshall Islands, annexed by Germany in 1885-1886, passed to the control of Japan in 1919 by mandate. They are situated between 4 and 15° of north latitude and 161 and 174° of east longitude. The islands have the form of two parallel chains, running from the northwest to the southeast; the upper chain, so to speak, is called Radak; the lower, Ralik. The total area of the Marshall Islands is between 160 and 175 miles. The largest island is Jaluit, administrative center of the Marshall Islands, with an area of 35 square miles. The population in 1935 was approximately 10,000 natives, 500 Japanese, and a very small number of persons of other races.

The islands are coral atolls only slightly elevated above the high-tide mark. The highest island, Likiep, has a maximal elevation of only 33 feet. The surface of most of the atolls is coral sand, excepting where decaying vegetation has produced a sandy type of soil. Coral reefs surround all the islands.

The only hydrographic features are the lagoons, which are nowhere especially deep. The coral sand which is the chief constituent of the terrain has prevented the formation of pools of surface water, since in most places it is so porous that water percolates rapidly through it to the sea.

The climate is moist and hot. The mean temperature is about 80° F. (26.6° C.); the hottest month is January and the coolest is July, but the variation in temperature actually is not great. Eastern winds prevail for most of the year. Observations carried out for a period of 18 years on Jaluit Island showed the mean annual rainfall to be approximately 159 inches (4 meters); but at Ujelang Island in the extreme western part of the archipelago the annual figure is only 80 inches (2 meters) or less. It is said that drought at times persists from December to May on Rongerik and Rongelap islands, in the northwestern part of the archipelago.

PUBLIC HEALTH

Health Services

Organization. Public health work in the Marianas, Caroline and Marshall islands is administered through the police section of the Department of General Affairs of the South Seas Bureau. The South Seas Bureau is a part of the Ministry of Overseas Affairs in Tokyo. The Governor General of the South Seas Bureau maintains headquarters at Koror in the Palau Islands. Branch headquarters of this bureau are situated at Saipan Island in the Marianas, at Yap, Truk and Ponape islands in the Caroline Islands, and at Jaluit Island in the Marshall Islands.

Each branch headquarters has a medical officer who is responsible to the governor of the island group concerned; each governor is responsible to the Governor General of the South Seas Bureau at Koror in the Palau Islands.

In the Marianas Islands, at the last report, the medical officer was assisted by four civilian physicians, a pharmacist, a clerk, an assistant clerk, and five midwives and nurses.

At the same time in the Caroline Islands, excluding the Palau group, there were a medical officer, 11 other physicians, six pharmacists, seven midwives and nurses and seven assistants. In the Palau Islands there were one medical officer, six other physicians, two pharmacists and a number of midwives, nurses and assistants.

In the Marshall Islands there were a chief medical officer, two civilian physicians, a pharmacist, a clerk, an assistant clerk, and three midwives or nurses.

The police in association with the health officials supervise sanitation in the various islands.

Relative Effectiveness. The Japanese have concerned themselves chiefly with attempts at control of epidemic diseases. In their reports it is indicated that they have established medical depots on most of the islands. They have also sought to improve the general sanitary conditions on the islands by the introduction of latrines and attempts at the improvement of water supplies and housing conditions. Efforts were exerted to make the health program more effective by the use of traveling physicians who gave lectures illustrated with slides and moving pictures. Little is known concerning the real effectiveness of the program in the islands but, to judge from the pattern established in other Japanese-controlled areas, it is probable that the natives are only secondarily aided and that the program was designed and is administered almost wholly for the benefit of the Japanese.

Water Supplies

In the Marianas Islands the principal source of drinking water is rain, which is collected on roofs or special rain sheds and is stored in uncovered concrete, metal or wood tanks. It is said that on Saipan and Tinian islands almost every house has a small tank for the storage of rain water. In addition, railways on these two islands have both rain sheds and storage tanks. Wells are present on Agrihan, Pagan, Rota and Tinian islands; but the water is reported to be unsuitable for drinking purposes. A fresh-water spring exists on Agrihan Island and warm- or hot-water springs occur on Alamagan and Pagan islands. An abundant supply of clear water is obtained in a plateau area on Rota Island; a fresh-water lake is found on Anatahan and on Saipan islands. Small streams of fresh water occur on Anatahan, Rota and Saipan islands. A public water supply was under construction in 1939 on Rota Island. On Saipan and Tinian islands condensers have been installed to produce potable water from sea water.

Ponape is the only island in the Caroline Islands proper which has numerous springs and streams containing fresh water. A few small streams, probably intermittent, are found on Truk and Kusaie islands. Rain water is collected in most areas, and wells are utilized. Potable water from wells, however, is likely to be limited, because salt water soon seeps in from the subsoil. Many cisterns or tanks for the storage of rain water have been installed on Yap, Truk, Ponape and Kusaie islands. Fresh water is available on at least two of the Palau Islands. From wells and streams on Malakai Island fresh water is transported by lighters to other islands in the group. In general, however, fresh water is derived from rainfall. So far as is known there are no facilities for purification of water and no piped water supplies.

Surface water in all the Marshall Islands is limited. On the other hand, rainfall is abundant in most areas. As in the other islands of the mandated group, rain water is collected and stored in cisterns or tanks. Water from taro swamps is sometimes employed, and water from holes dug in the ground frequently is used without treatment of any kind. The Japanese government has constructed public tanks, of a capacity of about 5 tons, on such islands as Wotje and Ailuk in the eastern chain, and on Jaluit and Kwajalein in the western chain.

In general, all supplies of water in the Japanese Mandated Islands should be considered to be unsafe for use without treatment. In no place, so far as is known, is water treated.

Sewage and Waste Disposal

The Japanese in the Marianas Islands have provided money for the construction of latrines for the natives, and it is said that on Saipan Island, at least, the natives no longer dispose of excreta on the beaches. On this island, however, night soil is used as a fertilizer, and it is likely that this practice is followed on other islands in this group. Japanese, wherever they are located, probably use bucket latrines. On no island, so far as is known, is there a system in which sewage is water-borne. The disposal of garbage and refuse is accomplished by the use of wagons on Saipan Island, and is supervised by Japanese police.

In the Caroline Islands the natives customarily use the beaches for sites of defecation; if a beach is not convenient they will utilize any area fairly close to their dwellings. As in the Marianas Islands, the Japanese have sought to promote the construction and use of latrines among the natives of the Carolines, but the progress of this program is not known. Japanese probably use bucket latrines; but they also use night soil as fertilizer, so that the advantages of the former practice are at least partially vitiated by the latter. Systems in which sewage is water-borne may exist in naval installations on Kusaie, Ponape, Truk and Yap. The disposal of garbage and refuse has improved in recent years, under the direction of the Japanese police. The material collected is used to fill in lagoons or is deposited in the sea. The conditions which exist in the Caroline Islands proper also prevail in the Palau Islands. There is nothing to indicate the existence in these islands of water carriage systems.

What has been said of the disposal of sewage and other wastes in the Marianas and Caroline islands applies also to the Marshall Islands. The Japanese, who use bucket latrines, have tried to encourage the use of latrines on the part of the natives. Modern sewerage systems probably do not exist. Garbage and rubbish, as in the other groups of islands, are used to fill in portions of lagoons.

Insects and Animals

Vectors of Disease. Mosquitoes. Mosquitoes are prevalent throughout the Japanese Mandated Islands. They breed throughout the year, but are said to be more numerous after heavy rains. Anopheline mosquitoes do not occur in any of the islands, but other genera are widely distributed. *Aedes aegypti* is present in the Marianas, Caroline and Marshall islands, and it probably occurs in the Palau Islands as well. *Aedes albopictus* is reported from the Caroline Islands proper and the Marshall Islands, and may exist in the Marianas and Palau islands. *Culex fatigans* is reported from Saipan in the Marianas Islands, and from the Caroline Islands proper, Marshall Islands, and the Palau Islands. An unidentified species of mosquito which in the adult form resembles *A. albopictus* has been recorded on Koror and Babeldoab islands in the Palau group. Another unidentified mosquito which bites painfully has been reported from the vicinity of Ponape in the Caroline Islands.

Aedes aegypti and *A. albopictus* are vectors of dengue fever as well as among the worst pests of the western Pacific. These two mosquitoes breed in collections of water in husks and pods of coconuts, holes in trees, and tanks, tins and similar containers. *Culex fatigans*, the vector of *Wuchereria bancrofti*, has breeding habits similar to those of *A. aegypti* and *A. albopictus*, but is not especially active in the daytime.

Measures of Control. Mosquito netting, smudges and incense are used for the control of mosquitoes in some homes, and netting is used over windows in government buildings. Control work of limited extent has been carried out in the vicinity of government establishments. Other than these few measures, little has been done.

LICE. The pubic louse, *Phthirus pubis*, and the head louse, *Pediculus capitis*, have been reported from Jaluit Island in the Marshall group, and probably occur in other islands. Typhus fever, transmitted by lice, has been recorded in the Caroline Islands.

FLIES. Flies, and particularly houseflies, are abundant in the Japanese Mandated Islands, where insanitary conditions and lack of measures of control enhance the opportunities for breeding and sustenance. A tachinid fly, *Microceromasia sphenophori*, was imported to Saipan Island in the Marianas from New Guinea because it possessed the ability to kill the pupae of an insect that was destroying much sugar cane. This fly, consequently, never was killed or otherwise controlled, and ultimately flies of all species came to be tolerated. The species of other flies present are not known.

TICKS. The dog tick, *Rhipicephalus sanguineus*, has been reported from all the Japanese Mandated Islands.

FLEAS. Contradictory reports exist as to the presence or absence of fleas in recent years.

MITES. Mites of the family Trombidiidae, potential vectors of *Rickettsia orientalis*, the causative agent in mite-borne typhus fever, are found in the Caroline and Palau islands, and probably in the Marianas as well. They cause *karasus* or infestation with "red bugs," attacking the feet, lower parts of the legs, genitalia and groins. Mite-borne typhus fever has not been reported from the Japanese Mandated Islands, but "Marshall typhus," a condition of unknown etiology, has been recorded in the Marshall and Caroline islands. *Sarcoptes scabiei*, the cause of scabies, is present in the Truk and other islands in the Carolines, and *Pediculoides ventricosus*, the grain itch-mite which produces an urticaroid type of dermatitis among workers with the straw of various cereals, occurs in the Truk Islands of the Caroline group.

BEDBUGS. The tropical bedbug, *Cimex hemipterus* or *rotundatus*, is present on Ponape in the Caroline Islands and Koror in the Palau Islands. It may be widespread in native dwellings.

RODENTS. Rats and mice are ubiquitous. *Rattus exulans micronesiensis* is found in the Palau Islands and Yap Island in the Caroline Islands, and *R. exulans* is known to be present in the Marshall and Caroline islands. The roof rat, *R. alexandrinus*, a comparatively recent introduction, is found in the Marianas, Caroline and Marshall islands, and probably in the Palau Islands. The black rat, *R. rattus*, and the brown rat, *R. norvegicus*, are recorded in Kusaie and Ponape in the Caroline Islands; a mouse, *Mus musculus momiyamai*, believed to have been introduced on ships, has been found in Saipan Island in the Marianas, Jaluit Island in the Marshall group, and Yap and Ponape in the Caroline Islands. Some degree of control of rats and mice has been attempted in the vicinity of Japanese establishments.

Snakes and Other Dangerous Animals. Dangerous land snakes apparently are not found. A type of wild pig, dangerous when aroused to anger but ordinarily harmless, exists in a few of the islands.

Pests. The Japanese Mandated Islands abound with pests. The great black ant, *Odontomachus haematodes,* and the brown biting ant, *Camponotus variegatus*, occur in most of the islands. They will inflict painful bites upon human beings. Beetles do much damage to coconut palms, and termites infest some wooden dwellings. Wasps and biting midges are reported from Ponape in the Caroline Islands, and doubtless are present on other islands. Robber crabs, which are troublesome if they are not handled carefully, are numerous. A large lizard is an important pest in the Marianas Islands, and another of a different type occurs on the island of Yap in the Caroline Islands. *Isometrus europaeus* and *Hormurus australasiae* are scorpions known to be present in all the islands. Centipedes such as *Scolopendra morsitans* and *S. subspinipes* are common. Both scorpions and centipedes crawl beneath matting on floors, or into shoes and clothing; they are pests, however, rather than dangerous arthropods, because their stings are very rarely fatal. Dogs are found in all the islands.

Dangerous Marine Life

Many poisonous sea snakes of the family Hydrophidae inhabit the waters about the Japanese Mandated Islands. Most of these snakes do not attack man without provocation, but will do so if they are restrained, as in a net. Instances of poisoning arising from the eating of certain fish are fairly numerous among the islanders. Some species of Tetraodon are poisonous if they are eaten at certain periods; other fish, like the porcupine fish, *Diodon hystrix* or *D. holacanthus,* have the same properties. The poisonous principle is contained in the bile, flesh, ovaries and testes; it may occur also in the roe.

The moray, of the family Muraenidae, is a voracious eel with exceptionally sharp, hollow teeth through which hemolytic venom can be injected into wounds. Large doses of this venom can produce almost instantaneous death. Scorpion fish of the family Scorpaenidae have dorsal and lateral spines that are connected to poison glands; the poison frequently enters a wound made by one of the spines. Toadfish, stonefish and weevers are representative types. The sting ray, of the family Trygonidae, has a barbed tail which can inflict severe wounds; poisonous jellyfish are known; and certain species of coral have poisonous tentacles. Poisonous cone shells are reported from the waters about the Caroline Islands. Sharks, gars, swordfish and octopuses are present. The giant clam, *Tridacna gigas,* which can attain a length of 2 feet, has great valves which may snap shut on the foot or hand of an unwary swimmer.

Dangerous or Irritating Plants

Several poisonous plants grow in the Caroline Islands. A poisonous weed, somewhat like wistaria, is present on Ponape Island in the Caroline Islands, where the natives place the roots in the sea so that the milky juice exuded from them will kill fish which happen to be near. On Yap Island in the Carolines the *changot,* or poison tree, is found. It has a white, acrid juice which will cause severe swelling and burning on contact with human skin. *Cerbera lactoria,* the bark and fruit of which contain a powerful toxin, likewise occurs on Yap Island. The sapucaia tree, *Barringtonia asiatica,* is reported from the Marianas Islands. This tree has one-seeded fruit which, crushed and tossed into pools, will kill the fish therein.

The dust of copra, or possibly minute parasites of copra, produce allergic reactions; the blossoms of sugar cane can exert similar effects among susceptible persons.

Kava, a drink prepared from juices of the roots of *Piper methysticum*, is used extensively by many natives in the Japanese Mandated Islands. It is mildly intoxicating. The use of sour toddy wine, made from the flowers of such wine palms as the jaggery palm, *Caryota urens*, has been made illegal, but the wine probably is still consumed. It is highly intoxicating and is said, moreover, to produce deleterious effects upon the urinary and nervous systems. Nuts of the betel palm, *Areca catechu*, wrapped with a little lime in a leaf of the palm, are chewed by many natives. This practice causes the formation of concretions on the teeth. The nut itself contains, in addition to tannin, no less than six alkaloids, including the toxic liquid, arecoline.

Food and Dairy Products

Supplies of food on most of the Japanese Mandated Islands are inadequate. Agriculture is most highly developed on Saipan Island in the Marianas, Ponape Island in the Carolines, and a few of the Palau and Marshall islands.

The common foods of most natives are coconuts, breadfruit or *Artocarpus communis*, and fish. The diet is high in starch, but deficient in proteins and fats. Fruits and vegetables are not common excepting among the Japanese, who import them. Taro or *Colocasia esculenta*, pandanus or *Pandanus tectorius*, arrowroot or *Tacca leontopetaloides*, and mammee apples from species of Mammea, are other foods used in the islands. Attempts have been made by the Japanese to introduce beans, cabbages, radishes, onions, melons and peanuts. Rice must be imported; it is too expensive to be available to the natives. A few hogs are raised, but the number is so small that they usually are eaten only at a native feast. Chickens are plentiful, but the supply of eggs seems to be limited. A small dairy herd is present on Babeldoab Island in the Palau group; on Tinian Island in the Marianas in 1935 there were from 6,000 to 7,000 cattle, as well as deer. Fresh and preserved meat is sold on Saipan Island in the Marianas. Sheep and goats are produced in some islands.

Facilities for refrigeration are limited. An ice plant is operated at Malakai Island in the Palau group; others are maintained on Ponape and Yap islands in the Caroline group, and on Saipan in the Marianas. Smaller installations probably exist in Japanese establishments.

Miscellaneous Problems of Sanitation

Native customs, tabus and ignorance, and geographic and climatic conditions in many respects operate to the disadvantage of the natives. The prevalence of abortion, the forbiddance of marriage to certain persons, insanitary burial procedures, unclean and poorly ventilated native dwellings, and the ravages of certain imported diseases have reduced the general population. Before such diseases as smallpox, tuberculosis, influenza, enteric and venereal diseases were introduced, the natives were able to maintain their populations. In recent years the enforcement of quarantine and other public health measures has reduced morbidity and mortality rates, with the result that the native populations are increasing.

MEDICAL FACILITIES

Hospitals

Number of Beds. There are three hospitals in the Marianas Islands: a government hospital with a capacity of about 370 patients at Garapan on Saipan Island; another hospital of 15 beds, owned by a sugar company on Tinian Island; and the third, an institution of about 60 beds, likewise owned by a sugar company, on Saipan Island. An asylum for lepers exists on Saipan Island.

Four hospitals are present in the Caroline Islands proper. One, on Ponape Island, has facilities for the care of 20 patients; another, at Truk, has facilities for about the same number. The other two hospitals are located on Yap and Kusaie islands. A small asylum for lepers and five hostels for tuberculous patients were built on Yap Island. All these institutions are operated by the government.

In the Palau Islands there are two hospitals: one on Koror Island and one on Angaur Island, both operated by the government. A leprosarium is situated on Koror. Medical depots, each of which generally is conducted by a tribal chief, are established on several islands. They are stocked with first-aid materials and limited quantities of medicines.

There are three hospitals, all on Jaluit Island, in the Marshall Islands. One is operated by the South Seas Bureau; one is a small private hospital for Japanese; and the third is a hospital for natives. A small leprosarium has been built on this island.

There are thus at least 12 hospitals in the Japanese Mandated Islands, eight of which are maintained by the government. In 1929 a total of 29,275 patients was treated in these eight government hospitals. Of these patients 12,170 were Japanese and 16,970 were natives.

Equipment. In 1931 the government hospital on Saipan Island in the Marianas had roentgenologic equipment operated with electric current from storage batteries. The hospitals on Ponape Island and the Truk Islands in the Caroline group have well-equipped operating rooms and roentgenologic apparatus. The hospital in the Truk Islands in the Carolines is less well equipped than the former two. The government hospital on Jaluit in the Marshall Islands probably has an operating room, roentgenologic equipment and a clinical laboratory.

Supplies. All supplies are imported from Japan.

Medical Personnel

Physicians. Five government physicians and two private practitioners are reported to be located in the Marianas Islands. Nine physicians and two student-physicians are said to be practicing in the Caroline Islands proper, and seven physicians are located in the Palau Islands. Four physicians are reported to be situated in the Marshall Islands; three are government physicians and one is a private practitioner. There is thus probably a minimum of 27 physicians in the Japanese Mandated Islands; but the government has announced that other physicians are employed from time to time to attend patients in distant areas remote from hospitals.

Dentists. Three civilian dentists are in practice on Saipan in the Marianas Islands; the number of dentists who are situated elsewhere in the Japanese Mandated Islands is not known.

Others. Recent data as to other personnel are not available.

Medical Institutions

At the hospital on Jaluit in the Marshall Islands there is a school for native medical practitioners which provides from three to five years of training in medicine and surgery for capable graduates of local native schools. Natives graduated from this school are permitted to practice medicine in the islands, but may not use narcotic agents or poisonous drugs, and are not permitted to carry out major surgical operations.

In certain hospitals in the Japanese Mandated Islands about 10 intelligent native girls, chosen from those in the native schools, are trained each year in the wards. These girls return to their native villages after their period of training, and serve as unpaid district nurses, furnishing basic medical and sanitary information to those who need it.

Social Services. The Imperial Bounty Charity Association assists in the support of asylums for lepers in the islands.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysentery. Bacillary and amebic dysentery are endemic throughout the islands; they occur throughout the year. The use of polluted water, primitive methods of disposal of sewage, the generally insanitary conditions, ignorance of fundamental hygiene on the part of the natives and the prevalence of flies are factors which favor the spread of dysentery and contribute to the high incidence. The predominant form of dysentery is the amebic, which occurs irrespective of the season. Seventy-nine patients had amebic dysentery on Saipan Island in the Marianas in 1929, and 13 of them died. Sixty cases were reported from the Truk Islands in the Carolines in the same year, with 12 deaths; and 10 cases were reported from Ponape Island in the same group. Forty-two cases and two deaths were recorded in the Palau Islands in 1929, and in 1931 in those islands 23 cases and 16 deaths were reported. In 1926 a severe outbreak of amebic dysentery broke out in the Marshall Islands; 170 persons were attacked and 33 died. In 1935 there were 23 cases in these particular islands. Hepatic abscess apparently is not a common complication.

Bacillary dysentery is said to have existed in the Japanese Mandated Islands for many years; more than half the population of the islands died of it when it was introduced. Common diarrhea is prevalent among native children. Some observers have said that *ekiri*, an acute and often fatal form of diarrhea of children in Japan, occurs also in the Japanese Mandated Islands. Four Japanese infants were treated for this disease in hospitals of the islands from 1927 to 1929. The incidence of common diarrhea appears to increase during harvesting of breadfruit (*Artocarpus communis*), but in most cases it doubtless is the result of ingestion of contaminated food.

Typhoid Fever and Paratyphoid Fevers. Cases of typhoid fever and paratyphoid fever were reported regularly from the Japanese Mandated Islands from 1922 through 1936. In 1929 on Saipan Island in the Marianas Islands 35 cases of typhoid fever and 199 cases of paratyphoid fever were recorded. Five cases of typhoid fever, with three deaths, and two cases of paratyphoid fever were reported from the Truk Islands in the Caroline group in 1929. The two diseases do not seem to be so prevalent in the Palau and Marshall islands as elsewhere in the mandated region, on the basis of published reports; but the actual incidence everywhere probably exceeds the reported incidence.

Cholera. It was said in 1937 that cholera never had occurred in the Japanese Mandated Islands; but in 1929 two infants were reported as having the disease, and one died of it. The accuracy of the diagnosis is not known but is questionable. In 1930 a Japanese in the islands died of what was said to be cholera. The disease is known to have occurred in these islands in the nineteenth century, and could be re-introduced. The generally insanitary conditions would favor spread of the disease, should it break out.

Helminthiasis. In 1931 and 1932 it was said that between 40 and 50 per cent of all natives in the islands had ancylostomiasis. On Rota Island in the Marianas the rate of infection has been as high as 83 per cent; on Saipan Island in the same group ancylostomiasis has been second in frequency only to diseases of the eyes. Two thirds of 700 stools examined on Saipan Island were found to contain evidence of infection with hookworm, type unspecified. In 1927 results of examination of stools of 935 natives of the Truk Islands in the Caroline group disclosed that 56 per cent of natives who did not use latrines were infected but that only 9 per cent of those who did use latrines were infected. On the other hand, 92 Japanese were treated for ancylostomiasis in the island hospitals in 1928, and 77 were treated in 1929, as opposed to 49 and

85 natives for those two years, respectively.

Infection with the common roundworm, *Ascaris lumbricoides,* is more common than infection with hookworm. In 1926 it was estimated that 90 per cent of the inhabitants of these islands had ascariasis. A year later a survey carried out among 935 residents of the Truk Islands of the Caroline group showed that 95 per cent of those who did not use latrines had ascariasis and 68 per cent of those who did use latrines were so infected. Patients with ascariasis treated in hospitals of the islands in 1928 included 180 Japanese and 786 natives; in 1929 the figure was 226 Japanese and 835 natives.

Infections with the pinworm, *Enterobius vermicularis,* and the whipworm, *Trichuris trichiura,* have been recorded. Infection with another type of roundworm, *Strongyloides stercoralis,* is reported to be generally present where ancylostomiasis occurs. The beef tapeworm, *Taenia saginata,* apparently is not common.

Infection with the common liver fluke, *Fasciola hepatica,* has been recorded; it seems likely that species of Clonorchis, the Asiatic liver fluke, also occur. Three cases of infection with lung flukes were reported from among Japanese and natives in the Marianas Islands in 1926; other cases were reported in 1925 and 1927. The parasite presumably was *Paragonimus westermani.*

Diseases Spread Chiefly through Respiratory Tract

Influenza. Influenza is widespread in the Japanese Mandated Islands; the disease seems especially likely to follow the arrival of ships from areas outside the islands. A condition called "Saipan influenza" occurs in the Marianas Islands and probably throughout the other islands. The etiology of this particular disease is not known.

Pneumonia. Twelve patients with pneumonia were treated in the islands' hospitals in 1926; in 1927 the figure was 13; in 1928 it was 69; in 1929 it was 76. Patients included both Japanese and natives.

Tuberculosis. Tuberculosis is the leading cause of death among the natives. It has been present in the islands since the eighteenth century. In 1929 on Yap Island in the Carolines 119 of 215 deaths, or 55 per cent, were caused by pulmonary tuberculosis, and in 1930 a survey of the inhabitants of that island showed that more than 15 per cent had the active form of the disease. The disease appears to be particularly prevalent in the western Caroline Islands, although it occurs in the rest of the mandated islands as well. In 1927 in the hospitals of all these islands 74 Japanese and 381 natives were admitted because of tuberculosis; in 1928 the figure was 74 Japanese, three foreigners and 314 natives; in 1929 the figure was 81 Japanese, five foreigners and 646 natives. The seeming increase probably is the result of improved facilities for treatment and hospitalization and not a true increase in incidence. Pulmonary tuberculosis is the form usually encountered, but tuberculosis of the bones, glands, viscera and skin also occurs. Such practices as expectoration on the floor, crowded living conditions and use of a common drinking cup in tribal ceremonies are factors in the spread of tuberculosis among the natives.

Common Cold. The common cold is a severe illness among the natives. Like influenza, the common cold often follows the visit of a ship from a region outside the islands. *Missilepik,* a febrile type of cold, occurs throughout the Caroline and Palau islands and on Guam. Some have considered *missilepik* to be "Saipan influenza." In the past *missilepik* has been a cause of death in the Japanese Mandated Islands.

Smallpox. Smallpox has occurred in the Japanese Mandated Islands for more than a century; when it was introduced it almost depopulated the region. Outbreaks of the disease have been reported from time to time, but in recent years a program of compulsory vaccination appears to have controlled it.

Diphtheria. This disease has been reported, but apparently is rare.

Scarlet Fever. Scarlet fever has been reported from the Caroline Islands, but apparently is not prevalent.

Meningitis. In 1926 a total of 389 cases of epidemic meningitis was reported from Angaur Island in the Palau group, Saipan Island in the Marianas Islands, and Ponape Island in the Caroline Islands. Ninety-six Japanese and 293 natives were attacked.

Poliomyelitis. Acute anterior poliomyelitis has been reported from the Marianas Islands, but not from others of the Japanese Mandated Islands.

Measles. In 1929 a total of 573 cases of measles was recorded in the Japanese Mandated Islands; 228 patients were Japanese and 345 were natives. German measles occurred in mild epidemic form in 1941 in Guam, which is geographically but not politically a part of the Marianas Islands.

Whooping Cough. In 1925 on Saipan Island in the Marianas there were 58 Japanese and 89 natives with whooping cough. Epidemics have occurred in the Caroline Islands; in 1927 there were 73 cases in the Palau Islands alone.

Diseases Spread Chiefly through Contact

Venereal Diseases. Venereal diseases are widespread in the islands. A total of 649 persons with venereal diseases of various kinds were treated in hospitals in the region in 1926; there were 353 Japanese, 294 natives and two persons neither Japanese nor natives. The incidence of venereal diseases doubtless is much greater than has been reported because the natives hesitate to seek treatment. Gonorrhea and chancroid appear to be the predominating venereal diseases. In 1929 a total of 630 persons with gonorrhea were treated in island hospitals; 389 were Japanese, 234 were natives and two were neither Japanese nor natives. In 1932 it was said that a third of the natives on Yap Island in the Carolines had gonorrhea. Syphilis is known to be present; 193 persons, of whom 119 were Japanese, were treated for syphilis in the hospitals of the islands in 1926. The Japanese imported Japanese prostitutes; these women must, by the terms of a police regulation, undergo examination at various intervals, and if they are found to have a venereal disease they are required to accept medical treatment.

Yaws. Yaws, at one time widespread in the Japanese Mandated Islands, was said in 1937 to have decreased in prevalence. In 1935, on the other hand, it was acknowledged that the disease was frequent throughout the islands, but only in a mild form. Thirty-nine cases were reported from among the Japanese in 1929, and 2,262 from among natives. Yaws formerly was the cause of death of many infants less than a year old.

Gangosa, once very common in the Caroline Islands in particular, and considered by some to be a tertiary lesion of yaws, has appeared in the Marshall Islands. In 1937 on Jaluit Island 31 cases were recorded, in a total of 49 cases from all the Marshall Islands. The incidence, however, is said to be decreasing. The natives seemingly have recognized the value of early treatment for yaws, and are willing to accept such therapy.

Leprosy. Leprosy apparently was introduced into the Japanese Mandated Islands since 1890. Asylums for lepers are known to exist in the islands. In 1930 six lepers were living in the Marshall Islands and 20 were living in the Caroline Islands. Ten cases of leprosy were reported from the Palau Islands for the years 1926 to 1930, and eight cases were reported from Saipan Island in the Marianas in 1930.

Tetanus. Two Japanese and three natives were reported to have had tetanus in 1928; in the next year only a single Japanese had the disease.

Anthrax. Two natives were attacked by anthrax in this region in 1930; the disease is not common.

Diseases of the Skin. Ringworm, such as tinea imbricata, tinea circinata, tinea cruris and tinea albigena, is widespread, probably because the natives accept it as being an almost inevitable affliction and do not seek treatment for it. Pityriasis versicolor is fairly frequent among school children. Eczema and furunculosis develop as the results of the general lack of cleanliness, and ulcers and abscesses often arise from indifference to the bites of insects or small abrasions of the skin. Scabies is very nearly ubiquitous. Infestation with mites of the family Trombidiidae produces a dermatitis. Impetigo is common.

Diseases of the Eyes. Trachoma appears to be established in these islands; in 1927, of 1,870 school children examined in the region, 451 had trachoma and 142 had other types of ophthalmic disease. In 1929, in the hospitals throughout the islands, 208 Japanese and 105 natives were treated for trachoma; in the preceding year the figure was 469 Japanese and 254 natives. Conjunctivitis in various forms is widespread. Bacillary conjunctivitis, caused by what is called *Bacillus marianensis,* is reported from the Marianas Islands and "bacterial conjunctivitis" is said to have occurred in the Caroline Islands in epidemic form. So-called Samoan conjunctivitis apparently has penetrated to the Marianas Islands. Gonococcic ophthalmia also has been reported. Papillary hypertrophy of the eyelids, believed to be caused by a virus, is reported from the Marianas Islands. It is said that the brilliant sunlight and the reflected glare of the coralline dust on the surface of many islands contribute to the development of various ophthalmic conditions.

Leptospirosis. Two cases of Weil's disease were reported from the Japanese Mandated Islands in 1929. "Catarrhal icterus" was recorded in the islands a year later.

Diseases Spread by Arthropods

Dengue Fever. In 1927 more than 1,000 cases of dengue fever were reported from the Palau Islands; in 1928 the disease appeared on Ponape Island and in the Truk Islands of the Caroline group, and was epidemic on Jaluit Island in the Marshall group. The vectors of dengue, *Aedes aegypti* and *A. albopictus,* are very prevalent, and measures for the control of mosquitoes are few.

Filariasis. Filariasis occurs generally in the islands, but probably is not common. Six patients on Saipan Island in the Marianas had the disease in 1926 and 1927, and in 1930 in the same islands a patient with hydrocele and one with elephantiasis of the foot were seen. Filariasis was observed in the Marshall Islands in 1926 and 1927, and on Ponape and the Truk Islands in the Carolines in the same years. In 1940 it was said that the disease had become manifest among immigrants to the Japanese Mandated Islands from the Ryukyu Islands, a part of the Okinawa prefecture of the Japanese Empire. The vector of *Wuchereria bancrofti,* which causes the type of filariasis seen in the mandated islands, is *Culex fatigans.* This mosquito abounds throughout the region.

Malaria. Anopheline mosquitoes do not exist in these islands, and it has been said that autochthonous malaria never has occurred. On the other hand, reports for the period 1924 to 1929 contained references to cases of malaria, and it is known that in 1900 malaria attacked not only persons foreign to the islands, but also more than 100 natives in the group of what are now the Japanese Mandated Islands. Hence, there is no doubt that the disease could occur in this region if suitable anopheline vectors were introduced and became established.

Yellow Fever. The vector of yellow fever, *Aedes aegypti,* is prevalent in the region, but the disease is not present.

Plague. Plague in serious proportions has not been reported from the islands since 1910-1911, when an epidemic broke out on the island of Yap in the Carolines. In 1936 reference was made to the burning of bodies of natives who died of plague in the Palau Islands, but the presence of the disease was not actually substantiated. The disease is endemic in the Netherlands East Indies; and rats, probably infested with fleas which could transmit the disease, are ubiquitous in the mandated islands.

Typhus Fever. "Marshall typhus" has been reported from Kwajalein Island in the Marshalls and from the Caroline Islands; it is said to be characterized by fever which persists for about a month. The fatality rate is high. The clinicopathological features of the disease have not been reported. Epidemic or louse-borne typhus fever has occurred in the Caroline Islands in past years; but the belief is that the disease does not now exist in any of the Japanese Mandated Islands. The three forms of the disease—mite-borne, louse-borne and flea-borne—occur in the Bonin group of the Nampo Islands, not far to the northwest of the Marianas Islands, and persons from the Nampo Islands have immigrated to the mandated group. Fleas seem to be rare in these islands, but mites of the family Trombidiidae are present, and lice probably are present.

Relapsing Fever. Relapsing fever has not been recorded. Lice which can carry the spirochetes of the genus Borrelia probably infest the natives. Since some cases of this disease are reported annually from Japan, it probably could be introduced.

Nutritional Diseases

Nutritional diseases apparently are not frequent among the natives, possibly because they consume much toddy, which has a high content of vitamin B. Toddy is not to be confused with the intoxicating toddy wine. The diet of the natives is not, however, considered to be adequate. In 1927 there were 345 Japanese and 421 natives with beriberi; in 1928 the figure was 417 Japanese and 178 natives. The natives do not consume as much polished rice as the Japanese do because they cannot afford to buy it. In 1927, of 1,870 school children examined in the islands, 434 were found to have decayed teeth.

Miscellaneous

"Epidemic asthma," called *guha,* occurs in wet, humid months and is most prevalent during the period of change from the dry to the wet season, and from the wet to the dry season. It is said that infants who acquire the disease may die within 24 hours of the onset, but persons of all ages are attacked. The disease has occurred in the Marianas and the Caroline islands. The cause is not determined; some observers believe it is produced by coral dust; others declare that it is the result of specific pollens.

Prickly heat, heat cramps, sunstroke and heat exhaustion occur rarely.

SUMMARY

Public health work in the Japanese Mandated Islands—the Marianas, Carolines (including the Palau Islands) and the Marshalls—is administered under the direction of the police section of the Department of General Affairs of the South Seas Bureau. This bureau is a part of the Ministry of Overseas Affairs of the Japanese government. Branch headquarters of this bureau are situated in various islands in the mandated group, and each branch headquarters has a medical officer who is responsible to the governor of the island group concerned. Each medical officer has physicians, pharmacists, nurses or midwives and clerks as assistants. The entire system is planned and maintained to insure the welfare of the Japanese; it serves the natives secondarily.

Rainfall is the chief source of water on most islands; springs and streams are present on a very few. Water is stored in tanks and reservoirs, and usually is open to contamination. In no place is it safe for use without treatment. An attempt has been made to induce the natives to use latrines, and it is probable that the Japanese use bucket latrines. Night soil is used extensively as fertilizer. Generally, the disposal of excreta and other wastes is unsatisfactory.

Anopheline mosquitoes do not occur, but potentially dangerous species of Aedes and Culex do. At least two species of lice of human beings are present; flies are ubiquitous; ticks, fleas and mites are present but less prevalent. Tropical bedbugs, rodents, ants, beetles, wasps, biting midges, robber crabs, lizards, centipedes and scorpions exist. Poisonous fish, cone shells, sharks and giant clams are found in the waters about the islands. Some poisonous plants are present. Supplies of food are limited, and agriculture has been developed in only a few islands.

Hospitals, for the most part, are operated by the government. Their facilities are designed primarily for the Japanese, although institutions for natives have been built. Schools for native nurses are operated in some hospitals.

The important diseases are bacillary and amebic dysentery, typhoid fever, helminthiasis, influenza, tuberculosis, common colds, meningitis, measles, venereal diseases, diseases of the skin and eyes, dengue fever, and bronchial asthma. Yaws and smallpox appear to have been controlled in recent years. Malaria and yellow fever do not occur. Plague, typhus fever and cholera are either rare or infrequent; but "Marshall typhus" has been reported. Certain kinds of nutritional diseases are known.

BIBLIOGRAPHY

The bibliography which is appended to the chapter on the Gilbert, Ellice, Ocean and Nauru islands may be consulted for references to works dealing with the Japanese Mandated Islands, since most of the reports on the latter are contained in articles dealing with Micronesia, not with any special island group.

21

Johnston Island and Northern Line Islands

GEOGRAPHY AND CLIMATE

The Line Islands, or Central Polynesian Sporades, are situated south of Hawaii not far from the equator. Most of them lie south of the equator. Only those which are north of the equator will be considered in this chapter. They consist of Fanning, Washington and Christmas islands. Palmyra Island, which was annexed to Hawaii in 1862, and Johnston Island, which is not part of the Line Islands, are included herein for reasons of geographic propinquity.

Johnston Island. This actually consists of two coral islets supported by a great reef. The location is approximately 17° of north latitude and 167° of west longitude or 700 miles southwest of Honolulu. The larger islet is about a half mile long; the highest point has an elevation of only 40 feet. Johnston Island, considered to be a part of the Territory of Hawaii, is administered by the United States Navy. It is not permanently inhabited.

Palmyra Island. This island, considered to be within the Territory of Hawaii, and administered by the United States Navy, is situated at approximately 6° of north latitude and 163° of west longitude. It is of coralline origin, with a beach rim of 5 to 6 feet. Like Johnston, Palmyra is composed of islets; in this case no less than 53, which are connected, one with another, by strands of hard sand or coral. The profusion of islets has resulted in the formation of many pools of water, but it is thought that sea water infiltrates these collections and renders the water brackish.

Washington, Fanning and Christmas Islands. These three islands are situated between 1 and 7° of north latitude and 157 and 163° of west longitude. They constitute the Fanning Island district of the British crown colony of the Gilbert and Ellice Islands, 1,800 miles to the west. Washington Island has an area of only 6 square miles; the area of Fanning Island is 15 square miles. Christmas Island, on the other hand, has an area of 160 square miles, and is one of the largest atolls in the world.

The distinctive feature of Washington Island is a lagoon of water which occupies the eastern half. Two peat bogs are located in the western half. At no place does the elevation of the island exceed 15 feet, and the beach rim is from 9 to 10 feet high.

Fanning Island has a beach rim of from 2 to 3 feet high; in the northern part of the island the maximal elevation of 10 feet is reached. It is typically coralline, with a large lagoon. Wells and sumps have been developed. The transpacific cable from Vancouver in British Columbia to Australia passes through Fanning Island.

Christmas Island has an average elevation of about 15 feet, but several hills are 35 or 40 feet high. On the eastern side is the Bay of Wrecks, where landing is extremely hazardous. The island is approximately 13 miles wide in the northern and western parts, but toward the center portion narrows to form a long neck which extends to the southeast for about 14 miles. Salt-water marshes and lakes are numerous.

The population of the islands is not known. Natives have been imported chiefly from Tahiti and the Gilbert and Ellice Islands, but they probably do not exceed 400. The Occidental population is very small.

The principal feature of climate in this group of islands is uniformity, excepting so far as rainfall is concerned. The mean average temperature is 75° F. (23.8° C.), and the maximal temperature does not exceed 90° F. (32.2° C.). A temperature of 70° F. (21.1° C.) obtains only on a so-called winter day. Rainfall varies considerably. On Christmas Island, for instance, the annual rainfall has been from 25 to 35 inches (0.6 to 0.9 meter), whereas on Fanning Island the annual precipitation has been as much as 125 inches (3.2 meters), but usually is between 80 and 100 inches (2.0 and 2.5 meters). On Washington Island the average annual precipitation is 100 inches (2.5 meters). On Palmyra rainfall exceeds 100 inches (2.5 meters) a year.

PUBLIC HEALTH

JOHNSTON ISLAND

This island at present has no permanent population, no vegetation and no natural water supply other than rain water. There is no insect or other animal life on the land. It may be assumed that sharks, sting rays and perhaps poisonous sea snakes are present in the surrounding coral reefs and that they would constitute a hazard to swimmers. Such health problems as may arise, other than those brought in by people going to the island, are those resulting from high temperatures and injudicious exposure to the sun. Slow-healing infections of the skin secondary to cuts are fairly common on coral islands at that latitude. Temporary installations essential for human existence, medical care and sanitation are provided by the United States Navy.

PALMYRA ISLAND

This island has no permanent population. The island is under the administrative jurisdiction of the United States Navy. Health problems related to the natural conditions of the island are, in addition to those noted above for Johnston Island, water supply, disposal of sewage and, possibly, insect-borne diseases. The brackish water which may be obtained from shallow wells or sumps probably is not suitable for drinking. Although no exact information concerning the insect and other animal life on the island is available, it may be safely assumed to be closely similar to that on Washington, Fanning and Christmas islands. In the course of a recent survey mosquitoes were not found on Palmyra, but Aedes and Culex mosquitoes are abundant on the other nearby northern Line Islands and might easily be introduced into Palmyra. The high humidity, heavy rainfall and dense vegetation would be conducive to the propagation of many insect and other animal pests.

WASHINGTON, FANNING AND CHRISTMAS ISLANDS

Health Services

Organization. Practically no public health work is done in these sparsely and transiently populated islands, which are part of the British colony comprising the Gilbert and Ellice Islands. Only on Fanning Island is any continual attention given to health problems. There are two physicians on this island and one of them acts for the island government as district physician. Sanitary inspection is made of the living quarters of the Gilbertese workmen who are brought in from time to time. Inspection of the quarters of the contract laborers on Washington Island is made by the Medical Department of the Gilbert and Ellice Islands Colony.

Water Supplies

The water on all the islands should be considered to be probably polluted and should not be drunk without purification.

On Washington Island there is a large lagoon of fresh water which is used by the natives but which is considered by Occidentals to be "unwholesome" because of its taste and the fact that newcomers suffer episodes of intestinal distress from drinking it. On Fanning Island brackish water is obtainable from a large lagoon and from shallow wells or sumps. The sources of potential contamination are many. Ground water can be obtained on Christmas Island at a depth of 3 feet (roughly, 1 meter). Water taken from some wells and sumps can be made safe for drinking by chlorination. The high water table (3 feet) makes the danger of contamination from surface and subsurface drainage almost impossible to avoid. Rain water is collected in concrete or metal tanks from eaves on roofs, but because the rainfall varies greatly from year to year and from month to month (0 to 20 inches or 0 to 0.5 meter), it cannot be relied upon as a constant source of water supply. As an emergency measure for the quenching of thirst, unacclimated persons can resort with safety to the native custom of drinking the milk of a fresh immature coconut.

Sewage Disposal

On Christmas, Fanning and Washington islands privies are used. In general, the natives use these accommodations faithfully, but pollution of the soil, although not excessive, is practiced in some areas. On Fanning Island there are strict regulations concerning the disposal of sewage, but information is lacking concerning the enforcement of these regulations. It is of importance to note two facts in connection with the construction and use of the privies on these islands. First, the outhouses are not flyproof and therefore must be regarded as potential sources for the dissemination of fly-borne diseases. Second, the ground-water level is high and in many areas drainage is sluggish, with the result that subsurface water is subject to contamination from the privies; in fact, in most localities ground water is so close to the surface that latrine pits soon become inundated and have to be moved at frequent intervals.

Insects and Other Animals

Vectors of Disease. Mosquitoes. Anopheline mosquitoes do not occur on any of the northern Line Islands.

Aedes mosquitoes are present on Fanning and Washington islands. No precise data on species are available, but in view of the practice of importation of laborers from the Gilbert and Ellice Islands, where filariasis is endemic, it is wise to consider the Aedes mosquitoes which are present as potential vectors of that disease. The Aedes mosquitoes on these islands breed chiefly in receptacles used for the catching of rain water.

Culex mosquitoes have been found in great numbers for many years on Washington and Fanning islands, and have been introduced recently on Christmas Island. *Culex fatigans*, a vector of filariasis (of the type caused by *Wuchereria bancrofti*), is reported from Fanning Island. This mosquito breeds around dwellings, notably in dirty household water, street gutters, septic tanks or in any collection of stagnant water.

Lice. *Pediculus capitis* is very abundant on the imported Gilbertese workmen. It is reported that these workmen do not consider infestation with lice to be undesirable. There are no reports of louse-borne diseases, but in view of the temporary or transient nature of most of the population on these islands, past records are of very limited value.

Flies. Houseflies are abundant. Not only are they pests but they may serve as vectors of enteric diseases. They breed in decaying refuse, particularly in rotting coconuts and the carcasses of crabs, which are plentiful. These crabs open and feed on the coconuts. The opened and rotten nuts and the numerous dead crabs constitute an unlimited supply of organic waste in which these flies feed and breed. Flies on Christmas Island and possibly on the other Line Islands are not attracted to flypaper, but traps baited with dead fish are useful.

TICKS. *Dermacentor variabilis,* the common dog tick, occurs on some, and probably all, of the islands when suitable hosts are present.

FLEAS. Fleas have been reported as being absent from Christmas Island, but rats, mice and domestic cats (which have reverted to a wild state) are present. It is therefore likely that some fleas do occur on this island as well as on Fanning and Washington islands.

RODENTS. *Rattus alexandrinus,* a recognized carrier of plague, occurs in large numbers on Washington and Fanning islands, where it causes serious loss to the coconut industry. A small rat of the *Rattus concolor* group, probably *Rattus hawaiiensis,* occurs in small numbers on Christmas Island and possibly on the other Line Islands also. This rat is thought to be the reservoir of plague in Hawaii; infected rats may be already present or might be introduced in the Line Islands.

Snakes and Other Dangerous Animals. No land snakes have been reported from the Line Islands. There are two types of small, harmless lizards. Some of the surrounding waters are infested with sharks and sting rays which may be dangerous to swimmers.

Pests. BLISTERING BEETLES. There are three species of oedemerid beetles, two of which, when crushed on the human skin, cause large blisters which are seldom painful. *Ananca livida* occurs in small numbers on Christmas Island, and *A. decolor* in large numbers on Fanning and Washington islands. Both of these beetles produce severe blistering. *A. collaris,* found on Fanning Island, produces only slight irritation. These night-flying insects are known locally as "coconut bugs" and are attracted by lights.

TERMITES. Two species, *Kalotermes immigrans* and *Cryptotermes hermsi,* occur on Fanning Island and probably on Washington Island. Termites are not reported to be on Christmas Island. These termites riddle fallen coconut trees and may be capable of damaging wooden foundations of buildings.

WEEVILS. Small weevils which infest flour and other cereals occur on Christmas Island and probably on the other Line Islands.

SCORPIONS. Scorpions of a small variety are found on the islands, but it is not known whether or not they are of the venomous species.

ROACHES. Roaches are present in varying numbers. They may be mechanical transmitters of enteric infections.

CRABS. Crabs are serious pests and are indirectly of importance in the propagation of insect vectors of disease. There are three species, *Cardisoma arnifex,* an omnivorous land crab; *Caenobita rugosa,* a very abundant hermit crab; and *Birgus latro,* the coconut crab. The first two can do considerable damage to food supplies if given enough time. As previously said, the dead coconut crabs and rotting coconuts provide food and breeding places for flies. Coconut shells scattered about by the crabs collect water in which mosquitoes breed.

ANTS. A large brown ant which bites but does not produce serious abrasions is present. Small, black nonbiting ants are very numerous and special precautions are required to exclude them from food supplies. Small ants of this general type in an area in which human excreta may be exposed have been suspected of transmitting dysentery.

FOOD AND DAIRY PRODUCTS

The chief problem of food in relation to health on the northern Line Islands is the rapidity with which food spoils. Adequate facilities for refrigeration are not available. Even if sufficient refrigeration is provided, the danger of spoilage is still present in those instances in which food must be kept out of cold storage for even a few hours. Coconuts and edible fish are available in large quantities on all the northern Line Islands, but the usefulness of fish as a major item of diet is limited by lack of facilities for refrigeration. Christmas Island produces no food except coconuts. Tropical fruits and vegetables grow abundantly on

Washington and Fanning islands, but they are not produced in excess of local demands. The dairy products, meats and fresh vegetables which constitute a regular part of the American diet are not available. In view of the insanitary habits of the imported Gilbertese laborers, the fruits and vegetables which are grown by them should be considered to be contaminated. The high incidence of intestinal diseases and the pollution of the soil practiced by Gilbertese workmen on their own islands make it probable that fresh vegetables are subject to contamination in the Line Islands when the Gilbertese are living there.

MEDICAL FACILITIES

No civilian hospital services are available on any of the northern Line Islands. There are two physicians on Fanning Island, but none on the others. Sanitary inspections of Washington Island are made by the Medical Department of the Gilbert and Ellice Islands Colony. No medical supplies are available locally except very limited first-aid materials which are kept by British administrative officers.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Because of lack of facilities for the treatment of water supplies, the difficulty of suitable sanitary disposal of sewage and the presence of large numbers of flies, the danger of the contracting of amebic dysentery, bacillary dysentery, typhoid fever and paratyphoid fever is great. There is a very high incidence of both amebic and bacillary dysentery in the Gilbert and Ellice Islands, and the use of laborers imported from the islands increases the danger of the dissemination of these diseases in the Line Islands.

In the absence of facilities for the treatment of water supplies and for the effective disposal of sewage, conditions are favorable for the spread of cholera if it should be introduced. Although the chances of the introduction are slight, it would be entirely possible to introduce it if carriers of the *Vibrio comma* or patients in the incubation period were transported to these islands.

Diseases Spread Chiefly by Contact

Diseases of the Skin. Dermomycosis, especially trichophytosis, saccharomycosis and aspergillosis, are very common among both the white people and the natives. Among white people these infections often break out with explosive suddenness, and often are stubbornly resistant to treatment. Heat, excessive perspiration, especially in folds and creases in the skin, and irritation from coral dust prepare the skin for and aggravate these infections. Abrasions, cuts and other wounds readily become secondarily infected and heal very slowly. These lesions are the causes of much inconvenience and disability. Bacteriologically, these infections almost invariably are caused by staphylococci.

Diseases of the Ears. Otologic diseases frequently result from fungous invasions of the external auditory canal and from the irritation of coral dust, which produces circumscribed external otitis.

Diseases Spread by Arthropods

Malaria. There is no malaria in the Line Islands, and no anopheline mosquitoes have been reported from this region. Because the factors which have limited the spread of malaria throughout Polynesia are poorly understood, the possibility of the introduction of vectors of malaria, as well as the disease itself, cannot be disregarded. This is particularly true in view of the fact that communications by sea and air have brought the various groups of Pacific islands into closer contact with one another.

Dengue Fever. Dengue fever could be expected to spread if it were introduced, because mosquito vectors of it probably are present. Precise information concerning the species of Aedes which are known to occur is not available, but *Aedes aegypti* is likely to be among them.

Yellow Fever. The mosquito vector of yellow fever, *Aedes aegypti,* probably is to be found in these islands. In view of the distances involved, it is considered extremely improbable that yellow fever will be introduced from areas in South America in which the disease is endemic.

Typhus Fever. Louse-borne typhus fever, flea-borne typhus fever and mite-borne typhus fever are not reported from the Line Islands. Although specific information is lacking concerning the presence of fleas, it is probable that they are present and could spread flea-borne typhus fever if the disease were introduced.

Plague. Plague probably would spread rapidly if introduced because of the large rat population, especially on Washington and Fanning islands. Plague is endemic in some parts of Hawaii.

Miscellaneous

Injuries Caused by Heat. Heat exhaustion, sunstroke, sunburn, actinic conjunctivitis and other injuries resulting from injudicious exposure to solar rays are of potential importance to unacclimated persons. The rays are reported to be particularly penetrating between 10 A.M. and 4 P.M. The fact that a light breeze blows almost constantly on some of the islands often leads new arrivals to minimize the danger of prolonged exposure.

Diseases of the Eyes. A high incidence of affections of the eyes is reported by competent medical observers. Conjunctivitis of the exposed part of the bulbar conjunctiva, with secondary inflammation of the meibomian glands, has been described as being of frequent occurrence. Keratitis is encountered, but less frequently. Refractive errors are accentuated by the glare of the sun. Newly arrived native laborers are afflicted by "running eyes." This is attributed by lay observers to the glare of the sun, but may be a symptom of an endemic communicable disease.

Other Conditions. The diseases mentioned above are of special or potential importance to unacclimated persons, as well as to the inhabitants of these islands. Little information is available concerning diseases in general. The paucity of information is attributed to the fact that the health and medical services are undeveloped and that with the exception of Christmas Island, which has a small permanent population, the islands are sparsely and transiently populated. For the most part, the inhabitants are contract laborers who are imported from the Gilbert Islands and the Ellice Islands. For this reason, conditions of health and the prevalence of disease are subject to considerable variation, but within limits are the same as those on the islands from which the laborers were recruited.

No information is available concerning the care that is exercised in the selection of the laborers, but presumably they are selected on the basis of their physical fitness for work. For this reason, it is probable that those who have chronic and debilitating illness are rejected. It is likely, however, that some laborers who acquired diseases which are prevalent in their homelands, such as yaws, filariasis, ancylostomiasis and tuberculosis, have introduced these diseases into Johnston Island and the Line Islands. Venereal diseases are not a problem on the islands for the reasons that there are no women on Johnston Island and Palmyra Island, and that those few women who reside on Christmas, Fanning and Washington islands are married. No information is available concerning the nature or incidence of the acute communicable diseases in these islands, but it may be expected that they would spread rapidly among the natives if introduced and would pursue the same course in these particular islands as they would in any isolated islands.

SUMMARY

The northern Line Islands and Johnston Island are essentially undeveloped, so far as permanent medical and public health matters are concerned. Two of the islands, Johnston and Palmyra, have no permanent population and the needs of temporary personnel and construction workers are met by the United States Navy. Public health administration on the other three islands, Washington, Fanning and Christmas, is the responsibility of the Medical Department of the British colonies of the Gilbert and Ellice Islands. On Fanning Island there are two physicians, one of whom acts for the government as district physician. There are no other medical personnel and no hospitals on the islands. Some degree of sanitary inspection is carried out on Fanning and Washington islands by the physician who acts for the government.

The securing and maintenance of a safe water supply are major problems on all the islands. On Johnston Island water can be obtained by the use of catchment areas, distillation of sea water, and by importation. Palmyra has a large lagoon of fresh water of questionable quality. Prevention of contamination of ground water by sewage requires unusual precautions because the water table is high.

Mosquitoes capable of transmitting filariasis, dengue fever and yellow fever are probably present. Head lice and houseflies are found in large numbers. Rats and probably rat fleas are abundantly present on Fanning and Washington islands. There are also many animal pests on the northern Line Islands.

The most important group of diseases are the enteric infections, and especially amebic and bacillary dysentery. Venereal diseases are not a problem because of the absence or the scarcity of women. Of potential importance are affections of the eyes and ears resulting from the effects of coral dust and the rays of the sun. Infections of the skin caused by bacteria and fungi are easily acquired and tend to be resistant to treatment. Although plague is not reported, there is a susceptible rodent population. Filariasis probably has been introduced into the Line Islands. Neither malaria nor yellow fever is present.

BIBLIOGRAPHY

Bryan, E. H.: American Polynesia; Coral Islands of the Central Pacific. Honolulu, Hawaii, Tongg Publ. Co., 1941.

—— and collaborators: Insects of Hawaii, Johnston Island and Wake Island. Honolulu, Hawaii, The Museum, 1926 (Bernice P. Bishop Museum Bull. No. 31).

Christophersen, E.: Vegetation of Pacific Equatorial Islands. Honolulu, Hawaii, The Museum, 1927. (Bernice P. Bishop Museum. Bull. No. 44.)

Gt. Brit. Colonial Office: Annual Reports on the Social and Economic Progress of the People of the Gilbert and Ellice Islands Colony, 1935, 1936, 1937. London, H.M. Stationery Off., 1936, 1937, 1938 (Colonial Reports, Annual Nos. 1798, 1834, 1879.)

Herms, W. B.: Entomological Observations on Fanning and Washington Islands. Pan-Pacific Entomologist, **2**:49-54 (Oct.) 1925.

Mumford, E. P.: Native Rats and the Plague in the Pacific. American Scientist, **30**:213-217, 1942.

22

Netherlands East Indies

GEOGRAPHY AND CLIMATE

The Netherlands East Indies consist of a group of islands situated between 6° of north latitude and 11° of south latitude, and 95 and 141° of east longitude. Under the provisions of the constitution of 1922 the Kingdom of the Netherlands was declared to include the Netherlands East Indies as a crown colony. A Governor-General exercised executive and administrative authority. He was assisted by a council of four to six members. This council had no part in executive affairs; its duties were chiefly advisory. A legislative body, a *Volksraad,* was created in 1918.

The main components of the Netherlands East Indies are three large islands and parts of two more. These are Java, Sumatra and Celebes, most of Borneo, and the western half of New Guinea. The lesser components are some 3,000 islands, such as the Spice Islands or Moluccas; and Bali, Lombok, Timor, Flores, Sumba and others which project to the east in the long axis of Java. Some geographers have divided the Netherlands East Indies into four great groups: (1) the main Sunda Islands, or Java, Madura, Sumatra, Celebes and the Dutch territory in Borneo; (2) the Lesser Sunda Islands, or Bali, Lombok, Timor, Flores, Sumba and others; (3) the Spice Islands or Moluccas; and (4) the Dutch territory in New Guinea.

The entire area of the Netherlands East Indies is about 753,000 square miles, an expanse of land almost as large as Mexico (767,000 square miles). In 1940 it was said that the total population was 70,476,000. Indonesians are said to number 68,632,000.

Physically, Sumatra and Java are notable for an extensive mountain chain originating in the northern part of Sumatra. From that region the range dominates all of the west coast of Sumatra, the southern coast of Java, and eastward to the islands situated off the southern coast of the Dutch part of New Guinea. A second group of mountains is found in the northern part of Celebes; a third in Halmahera (the largest of the Moluccas) and other islands west of Halmahera. In almost all these groups active or partly active volcanoes are numerous. Some of the islands, such as Borneo, Celebes and New Guinea, have rugged interior regions which have not been wholly explored. Only Sumatra and Borneo have extensive lowlands, but there are smaller plains in Java. A northern plain and a southern plain are notable features in the Dutch part of New Guinea, but both are mountainous, representing the two slopes of a longitudinal mountain range.

The hydrographic features of the Netherlands East Indies are the innumerable short, turbulent rivers. A few are relatively long, such as the Mamberamo River in New Guinea, which flows toward the north to enter the Pacific Ocean at Cap d'Urville. The Jambi in Sumatra is navigable as far as the town of that name; the Rokan and the Kampar, which empty into the Malacca Strait, are fairly large streams. The Kapuas River of western Borneo, emptying into the Karimata Strait near the equator, is 450 miles long. The Barito, in southern Borneo, flows south for 550 miles to enter the Java Sea below Banjermasin. The Sampara River of Celebes flows to the southeast, emptying into Kendari Bay.

The climate of the Netherlands East Indies is tropical excepting in the higher altitudes. In general the temperature is about 78° F. (25.5° C.). The highest temperature ever recorded in Batavia was 95° F. (35° C.), in 1877. The annual temperature in Java was said to be between 79 and 83° F. (26.1 and 28.3° C.). In Javanese hill stations a mean temperature of 70° F. (21.1° C.) is experienced, but at altitudes of about 6,000 feet the mean may be as low as 59° F. (15° C.). Relative humidity in Java rarely is less than 70 per cent. It is said that in Sumatra the temperature throughout the year varies only from about 77 to 81° F. (25 to 27.2° C.). In Borneo the temperature in the morning is about 72° F. (22.2° C.); in the afternoon it may reach 91° F. (32.6° C.). There is no great seasonal variation in temperature in Borneo. The central longitudinal mountain range of New Guinea influences the temperature, but apparently does not produce great variation, since the annual temperature is reported as from 77 to 81° F. (25 to 27.2° C.).

Rainfall is abundant in Java, where the average at Batavia is about 72 inches (1.8 meters). The northwestern monsoon, which carries with it most of the rainfall, prevails in December, January and February. Rainfall in Java is least from May to August. In the southeastern part of Sumatra rainfall varies between 100 and 140 inches (2.5 to 3.6 meters). On the western coast of this island the annual rainfall ranges from 126 to 184 inches (3.2 to 4.7 meters). At higher altitudes in western Sumatra as much as 250 inches (6.4 meters) of rain has been recorded annually.

In Borneo the average annual rainfall varies from 90 to 120 inches (2.3 to 3.05 meters). The Dutch part of New Guinea, in the south, has a dry season from June until October, the period in which the eastern monsoon prevails. When the western monsoon is blowing, from January until April, the rainy season obtains. The average annual rainfall is about 60 inches (1.5 meters). In the northern part of this territory rain falls almost all year long. The average annual rainfall is about 100 inches (2.5 meters), but in the mountains may attain 280 inches (7.1 meters).

PUBLIC HEALTH *

Health Services

Organization. In 1925 the Civil Medical Service of the Netherlands East Indies was supplanted by the Public Health Service. This change in title was interpreted by some observers as implying that in the future less official emphasis would be placed on individual care of the sick and more on the prevention of disease. The central direction of the Public Health Service was exercised by the chief from his main office at Batavia in Java. The chief was a physician. He was assisted by medical and legal experts, engineers, a pharmaceutical expert and administrative personnel. The entire system was divided into the following 12 branches.

Medical Affairs. Members carried out medical examinations and inspections.

Statistics and Publicity. Members supervised the medical library, interchanged epidemiologic data with the eastern bureau of the League of Nations at Singapore, and corresponded with foreign institutions and officials in connection with legislation affecting hygiene and medicine.

General and Legal Affairs. Legislation affecting hygiene and medicine was prepared in this branch. Enforcement of such legislation also was entrusted to the branch.

Hospital Service. This branch, as the title implies, supervised the various government hospitals.

Asylums for the Insane. This branch supervised the asylums for the insane.

* Unless otherwise indicated, governmental medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

PHARMACEUTICAL. Members supervised all pharmaceutical establishments as well as the distribution of drugs.

SANITATION AND HOUSING. This branch planned projects such as the installation of water mains and drainage systems, provided technical advice concerning such projects, carried out campaigns against malaria, and promoted improvements in housing.

PERSONNEL. Matters pertaining to personnel of the Public Health Service were the concern of this branch.

MEDICAL HYGIENE PROPAGANDA. This branch designed, manufactured and distributed such material as demonstration charts, photographs, films, slides and similar aids to public health education.

ANTIPLAGUE SERVICE. Members of this branch had charge of matters concerning the control of plague.

ADMINISTRATION. This branch was the administrative unit for the Public Health Service.

FILES AND RECORDS. Records, stenographic services, certain interoffice affairs and minor routine details were the concern of this branch.

In addition, the chief of the Public Health Service had at his disposal five special advisers: (1) the medical adviser on quarantine affairs and infectious diseases, (2) the adviser for the organization of hygiene and educational activities, and the leaders, respectively, of the campaigns against (3) malaria, (4) plague and (5) leprosy. These men were employees of the Public Health Service.

In recent years the tendency of the government had been to decentralize all departments. Since 1936 most of the functions of local government had been delegated to municipal councils, regency councils and provincial councils. As a result of this policy of decentralization much of the curative work and part of the preventive work formerly the concern of the Public Health Service had been assumed by local councils. The local councils thus came to be responsible for such ventures as soil sanitation, supervision and construction of water supplies and sewage disposal systems, and hospital care. This meant, for instance, that many of what had been government hospitals were turned over to local authorities in various parts of the Netherlands East Indies. In 1936 there were 58 general government hospitals; in 1938 the government still controlled only 17. Local authorities, similarly, took over 167 government dispensaries. In some of the outer provinces, on the other hand, it was obviously impossible to shift responsibility to local authorities, since such authorities did not exist. In such places the Military Health Service carried out preventive measures for the Public Health Service. Conversely, in the field of curative medicine, members of the Public Health Service often gave assistance to the Military Medical Service. Again, additional work in public health was done by the large industrial companies, estates and missionary organizations. These organizations of course could not be considered part of the official health services of the Netherlands East Indies, but their work in preventive medicine and public health cannot be ignored. The estates and industrial companies, for example, were charged by ordinance with the medical care of the laborers they employed, so that a legal tie between these private medical facilities and those of the government actually did exist.

In 1938 the Public Health Service of the government employed some 400 physicians, 276 of whom were Indonesian practitioners. There were 47 European nurses, 841 native nurses, 421 vaccinators, 103 midwives and 156 public health propagandists in government service. The medical services of the regency, provincial and municipal health services in the same year had 53 physicians, 15 white nurses, 234 native nurses, 45 vaccinators and 55 midwives. Twenty-nine of the 53 physicians were Indonesians. The Antiplague Service employed 350 *mantris*, and about 160 *mantris* were engaged in the campaign against malaria. A *mantri* was a native overseer or, in some cases, a male or female nurse.

RELATIVE EFFECTIVENESS. Wide scope and originality were displayed by the government in various fields in the Netherlands East Indies, and this was especially true of preventive medicine and work in public health. Results in the latter field were the more remarkable in view of the small number of physicians in the region. For instance, cholera and smallpox had practically disappeared, and plague, which had reached epidemic proportions in Java, was under control. The morbidity from typhoid fever was not high. The situation in respect to malaria was much improved, and extensive studies in nutrition produced beneficial results. Regional laboratories in Java, Sumatra and Celebes were well equipped and had efficient staffs. Several important discoveries or developments were made in the Netherlands East Indies, such as recognition of vitamin B deficiency, crystallization of vitamin B_1, and identification of *Wuchereria malayi*.

WATER SUPPLIES

With the exception of a few small islands in the southeastern area, where water is not readily available, there are abundant supplies of water in the Netherlands East Indies. The rural population, which constituted 97 per cent of the total, depends largely upon wells, streams, rivers and collections of rain water. Wells are the most common sources of water for domestic use. They were, as a rule, of the shallow, dug type, and were neither lined nor covered. Water in these wells became contaminated by seepage of surface water; in the rainy season many wells actually were inundated. It was common among natives in many sections to use rivers or streams as places for laundering, bathing and defecation. Water for drinking purposes would be taken at or near the same places. Pollution of the soil contributed to contamination of waterways because runoff from such soil reached the streams and thus introduced organisms and foreign material. The alarmingly high morbidity and mortality rates accompanying the dysenteries among the natives indicated that contamination of water was serious and extensive.

Municipal systems furnished water to only a small proportion of the urban population. Where such systems existed, they usually served the European population and about half the Chinese population. In most cities, with the exception of Batavia, less than 3 per cent of the native population had access to water from the municipal supply system. In Batavia somewhat more than 10 per cent of the natives had water piped to their homes. In certain cities public hydrants situated in the native sections provided safe water that could be secured at slight effort. The vast majority of natives, however, either used water from wells or bought it from water vendors. In either case, the water probably was contaminated.

In 1938 there were 235 water plants in operation, and 46 more were under construction. About half of them were in Java; the rest were in the outer islands. Estates likewise had water supply systems. River water as a rule was treated by preliminary sedimentation, coagulation, secondary sedimentation, rapid sand filtration and chlorination. Water obtained from artesian wells apparently was safe, but water secured from shallow wells contained organic material and sediment, and required coagulation and filtration before it was chlorinated. In 1940 only 101 municipal water supply systems were on an approved list. To be approved, a plant was required to deliver water containing a total bacterial content of less than 10 colonies per cubic centimeter and no organisms of the coli-aerogenes group in a test sample of 100 cc.

SEWAGE DISPOSAL

Indonesians disposed of sewage most primitively. Most common was the practice of defecation directly into a stream; next most common was defecation into shallow holes. The latter practice was frequent in districts in which running surface water was not available. In parts of Sumatra and Borneo, where native homes were supported on stilts, excreta were disposed of through a hole in the floor of the hut. Dogs and hogs which foraged beneath such huts acted as scavengers. Although the government had encouraged the natives to construct and utilize latrines, pollution of the soil was widespread. Latrines would be built, but would not be used. Moreover, those latrines which were erected invariably were poorly built, were not flyproof and did not prevent pollution of the soil.

In cities, the problem of disposal of sewage was complicated by the fact that most cities were built over so extensive an area that the cost of construction of a central disposal system would have been prohibitive. It was believed, moreover, that natives residing in the cities could not be induced to use and maintain even the most simple sanitary installations. For these reasons only a few of the larger cities had sewerage systems. In Bandung, Jokyakarta, Batavia and Surabaya in Java separate storm and sanitary sewers were built; in Medan in Sumatra and Cheribon in Java similar systems existed but were combined. Effluent from the sewers of Bandung was treated in Imhoff tanks; effluent from the sewerage system of Jokyakarta was passed through sedimentation tanks. In all the cities mentioned the areas actually served by sewerage systems were limited. Usually, only the Occidental population had the benefits of these systems. That the systems in at least two cities were inadequate was indicated by tests of water from rivers flowing through Batavia and Bandung. Between 23 and 72 per cent of the samples were heavily contaminated by *Eberthella typhosa,* and this organism was present in concentrations of as high as one colony per 6.3 c.c. That the sewage itself is heavily charged with *E. typhosa* is demonstrated by the results of bacteriologic examination; in Bandung and Jokyakarta sewage examinations showed from 47 to 83 colonies of this organism per cubic centimeter.

Insects and Animals

Vectors of Disease. Mosquitoes. Fifty-seven species and varieties of anopheline mosquitoes have been reported from the Netherlands East Indies. Fifteen are classed as so-called Australian types; the rest are considered to be Asiatic types. Fourteen of the anophelines are vectors of malaria. The older adult forms of some of these anophelines, such as *Anopheles maculatus maculatus, A. aconitus, A. minimus flavirostris, A. leucosphyrus leucosphyrus, A. tessellatus* and *A. vagus vagus,* occur much more often along banks of streams than in houses and streams. Consequently, these older adult forms were captured and dissected less often than the younger forms, yet it was pointed out that the older adults actually were more heavily infected with malaria than the younger ones. As a result, many concepts concerning anopheline vectors had to be revised. It was proved, for example, that in eastern Java *A. maculatus maculatus, A. aconitus* and *A. minimus flavirostris* were important vectors of malaria. But it was possible to prove this only after older adult forms, taken from the banks of streams, had been dissected and examined. Such anophelines as *A. barbirostris barbirostris, A. hyrcanus nigerrimus, A. annularis* and *A. subpictus subpictus* are found only rarely along the banks of streams.

A. sundaicus is the most important vector of malaria in the region. It occurs in Java, the Lesser Sunda Islands and the southern part of Celebes, breeding in collections of brackish water. The so-called salt-water adult form is numerous in Java at the end of the dry season (June, July and August); a fresh-water form is reported inland in Sumatra and along the coast line of Nias Island, even at altitudes of 1,500 to 3,000 feet. In general, it can be assumed that the presence of *A. sundaicus* in appreciable numbers indicates that malaria exists in either endemic or epidemic form. The exception is the northern part of

Sumatra, where this anopheline is found in large numbers but is not a vector.

A. subpictus subpictus is another species which breeds in brackish water along the coast line. This anopheline does not have a natural preference for human blood; hence it is, as a rule, less dangerous than *A. sundaicus*. In the southern and western parts of Celebes, however, it does play a significant rôle in the transmission of malaria. It is also a vector of malaria on Madura Island. *A. aconitus* is a very important vector of malaria in the western part of Java, and in the eastern part it may well be as important in this respect as *A. sundaicus*. It is a vector of malaria in Bali Island, Sunda Islands and the Minahassa Peninsula of Celebes. It feeds on human blood only in districts in which cattle are scarce. It was said that if it occurred in sufficient numbers it could cause endemic malaria. *A. minimus minimus* is found chiefly in running water, less often in rice fields and fishponds. It has been found to be infected in the Minahassa Peninsula of Celebes.

A. minimus flavirostris occurs along brooks and irrigation ditches, in clear, shaded water. It was found to be infected in western Java and on the island of Laut, near south Borneo. *A. maculatus maculatus* is found exclusively in the hills and mountains, near running brooks in the sunlight. It is naturally infected in northern Sumatra and in Java. When the number of cattle in the Netherlands East Indies is small this mosquito is a very dangerous vector of malaria. *A. hyrcanus X* is the proposed term for a newly discovered mosquito widely encountered in Java, Sumatra and Celebes. This type of *A. hyrcanus* is a vector of malaria. Those who recognized *A. hyrcanus X* as being different from *A. hyrcanus sinensis* and *A. hyrcanus nigerrimus* believed that the latter two species actually were very rare in Java and Borneo. On the other hand, *A. hyrcanus nigerrimus* was reported from eastern and western Java and Borneo. In each of these regions it was infected. *A. kochi* is distributed throughout almost all the Netherlands East Indies. It seems to prefer the blood of animals, but in areas in which cattle were scarce a fifth of the mosquitoes caught contained human blood. It is a vector of importance when it exists in large numbers. It was found naturally infected in eastern and southern Sumatra. *A. leucosphyrus leucosphyrus* was found naturally infected in eastern and southern Sumatra and in eastern Borneo.

A. umbrosus was found to be naturally infected in Sumatra, Bangka Island and eastern Borneo. *A. punctulatus punctulatus,* which requires direct sunlight for breeding, was found to be naturally infected with malaria in northern New Guinea. *A. punctulatus moluccensis* was found in an infected state in New Guinea, where it is the most frequent invader of human habitations. *A. bancroftii* was found in the interior of New Guinea, and was infected. *A. barbirostris barbirostris* in 1938 was found to be a vector of malaria in Celebes, where the rate of natural infection was about 13 per cent. The particular type of *A. barbirostris barbirostris* observed in Celebes is different from the species encountered in Java; it was suggested by Venhuis in 1939 that the Celebesian type is *A. barbirostris vanus*.

In 1937 it was said that there were 238 species of culicine mosquitoes in the Netherlands East Indies. They included species of Armigeres, Aedes, Mansonia and Culex. Since 1937 at least 12 additional species were added, but none of the 12 was of medical importance. *Aedes aegypti* and *A. albopictus* abound throughout the region. *Culex fatigans* is almost ubiquitous, but does not seem to be so heavily infected with *Wuchereria bancrofti* as are other mosquitoes. Other mosquitoes of this genus are *C. fuscocephalus, C. whitmorei, C. vishnui* and *C. sitiens*. These possibly are carriers of *W. bancrofti*. At least five species of Mansonia are recognized as vectors of *W. malayi*. They are *Mansonia an-*

nulata, M. indiana, M. uniformis, M. annulifera and *M. longipalpis.* Species of the genus Armigeres ingest human blood, but are not, so far as is known, vectors of disease.

Measures of Control. All the anopheline mosquitoes in the Netherlands East Indies are ground breeders. Measures of control were so numerous that they cannot be detailed herein, but they of course affected genera other than Anopheles. They included draining of marshes, oiling, application of Paris green, careful regulation of the fish culture industry, special attention to rice fields, introduction of larvivorous fish, such as *Haplochilus panchax* or *Gambusia affinis,* and the planting of shrubs which cast considerable shade, which species such as *Anopheles maculatus maculatus* cannot tolerate.

LICE. The body louse of human beings, *Pediculus corporis,* is not abundant in the Netherlands East Indies. The head louse, *Pediculus capitis,* is rather common. The crab louse, *Phthirus pubis,* is infrequent.

FLIES. At least ten species of Musca occur in the Netherlands East Indies. The common housefly, *Musca domestica,* is reported from seaports, where it probably has been introduced. It is not indigenous. *M. sorbens* is the common so-called housefly in this region; its habits are similar to those of *M. domestica* and it presents the same hazards to health as does that fly. *M. vicina* and *M. nebulo* are reported. Several species of Phlebotomus or sand flies have been recorded, but they do not occur in great numbers. They are not regarded as vectors of disease. Midges or punkies are prevalent. Such midges, members of the genera Culicoides, Lasiohelea, Leptoconops and Styloconops, bite human beings viciously, especially in mangrove swamps. Buffalo gnats of the genus Simulium are frequent. The most important tabanid flies, from a medical standpoint, are members of the genera Chrysops, Tabanus and Chrysozona. The stable fly, *Stomoxys calcitrans,* is found throughout the Netherlands East Indies. *Chrysomyia megacephala,* which breeds in carrion and feeds upon human feces, is important in the causation of myiasis of wounds and intestinal myiasis, and *C. bezziana* attacks living tissue. *Calliphora fulviceps, C. malayana* and *C. paradoxa* are known to exist in all parts of the region. *C. augur* and *C. tessellata* occur in New Guinea. *Lucilia papuensis* and *L. porphyrina,* bottle flies with habits like those of houseflies, are present and commonly serve as vectors of enteric disease. *Sarcophaga dux* is a cause of myiasis of tissue, and *S. hirtipes* is believed to be able to contaminate milk and food. *S. ruficornis* is important in the causation of myiasis of wounds. *Siphuncula funicula,* an "eye fly," is said to cause conjunctivitis and, possibly, infections of the skin.

TICKS. Tick-borne diseases were not reported from the Netherlands East Indies, but several species of ticks which attack man are recognized. These are *Argas persicus,* the fowl tick; *Boophilus annulatus australis* or *Margaropus annulatus australis,* which attacks man and other mammals; *Rhipicephalus sanguineus* and *R. haemaphysiloides;* and *Amblyomma testudinarium.*

FLEAS. *Xenopsylla cheopis,* the Oriental rat flea, is common. *X. astia,* the rat flea of India, frequents the coastal areas. *Pygiopsylla ahalae,* the common rat flea of China and Japan, is not of medical importance. *Ctenocephalus felis,* the cat flea, probably occurs wherever cats are found. The flea of dogs, *C. canis,* apparently also is found. *Pulex irritans* has been recorded, but is not abundant.

RODENTS. *Rattus diardi, R. norvegicus, R. concolor, R. argentiventer* and *R. ephippium* are the important species in Java, the only place in this region where plague has occurred in recent years. *R. roquei,* a wild rat, may possibly be important as a reservoir from which other rats become infected. *R. frugivorus, R. wichmani* and

R. vitiensis were identified in various parts of the Netherlands East Indies.

Mites. *Sarcoptes scabiei* is widespread. Information concerning other mites is confusing in respect to this region, but *Trombicula wichmanni,* primarily a parasite of crowned pigeons, has been reported to attack man. Only *T. deliensis* is known definitely to be a vector of mite or scrub typhus fever, but *T. schüffneri* may carry the rickettsia.

Bedbugs. The indigenous bedbug in the Netherlands East Indies is *Cimex hemipterus* or *C. rotundatus. C. lectularius* has been introduced into the white population, chiefly in the seaports.

Snakes and Other Dangerous Animals. Fatal snake bite occurred only rarely, but many poisonous snakes are present. One of the most formidable is *Naja hannah,* the king cobra or hamadryad, which at times attacks without provocation. At least 30 kinds of the family Hydrophidae, or sea snakes, are described, but it is said that they rarely attack human beings. Members of the family Elapidae are distributed throughout the area. The banded krait, *Bungarus fasciatus,* is a common snake, as are also *B. candidus, B. flaviceps* and *B. javanicus. Doliophis intestinalis* and *D. bivirgatus* are found in Java. Some 16 elapoids are reported from New Guinea. A highly venomous snake, the death adder, *Acanthophis antarcticus,* is found in New Guinea and adjacent small islands near Amboina Island. *Python molurus,* the Indian python, is said to occur only in Java. Other snakes, too numerous to be included herein, are reported from many places in the Netherlands East Indies.

Tigers inhabit the jungles of Java and Sumatra. Panthers exist in the higher mountain ranges. Rhinoceroses can be found rarely in Java, and are known to be present in Borneo and Sumatra. Bears inhabit Sumatra and Borneo. Wild boars are ubiquitous in the region, as are crocodiles. The babirusa (*Babirussa babirussa*), a large, hoglike quadruped with dangerous tusks, is reported from Celebes. Ten species of scorpions have been identified. None possesses a seriously potent toxin. Twenty-five different centipedes are known to occur, and the natives are especially afraid of *Scolopendra gigantea.* Millipedes are plentiful in the forests, but since they have no poison fangs, are not considered dangerous. Natives, nevertheless, insist that certain large millipedes can inflict wounds if stepped upon.

Pests. Stray dogs are numerous in the Netherlands East Indies. Cockroaches, ants and leeches are reported. None of these ordinarily is dangerous, but the dogs constitute the reservoir of rabies, and the leeches can become dangerous if they attack a person in sufficient numbers.

Poisonous Fish and Plants

Fish. Certain species of Tetraodon, or puffer fish, are poisonous if eaten in certain periods of the year. The toxic principle apparently is concentrated in the testes and ovaries. The roe are particularly dangerous. *Tetraodon argenteus* seems to be the species most often involved. *Synancea verrucosa,* or the stonefish, possesses spines which can penetrate the skin. These spines frequently break off, causing severe intoxication. A type of stinging catfish is reported. *Plotosus lineatus* can inflict dangerous stings. Sting rays of the family Trygonidae sometimes wound a few persons by blows from their long tails, which have poisonous spines.

Plants. Cassava can cause intoxication if the hydrocyanic acid is not removed from the flour by washing before the flour is used. *Dioscorea hirsuta,* a type of yam, is dangerous if the tubers are not soaked in water for about five days prior to consumption. Various species of the lacquer tree, members of the family Anacardiaceae, cause dermatitis if the sap or wood comes into contact with the skin of a person. A dangerous poison is obtained from the roots of *Gloriosa superba,* a climbing vine.

Natives occasionally use the roots of *Derris elliptica* as suicidal agents. A plant known locally as *djengkol* (*Pithecolobrium lobatum*), with seeds containing a glucoside, produces *djengkol* poisoning when it is consumed. Symptoms are similar to those of renal colic and peritonitis. Lumbar pain, dysuria and sometimes anuria occur.

Food and Dairy Products

The great majority of the people of the Netherlands East Indies subsisted on food that was produced within the region. Dried fish, salted fish and fermented fish products were imported, but other foods, so far as the natives were concerned, were rice, corn, cassava, sago and sweet potatoes. Legumes were important constituents of the diet in Java. Peanuts were consumed in the form of pressed cakes. Soybeans and mung beans were used widely. Coconut oil and other products of coconuts furnished fat for the diet, but in areas in which coconuts did not occur other kinds of fat were obtained rarely. Leafy vegetables and various fruits were eaten in profusion. Durians (*Durio zibethinus*), mangoes (*Mangifera indica*) and avocados were important because of their high caloric values.

Chickens of the region produced eggs poorly, but ducks were raised in large flocks, and duck's eggs were eaten commonly. Oxen and buffaloes were numerous, but only about 10 per cent were slaughtered for food. Generally, they were employed as draft animals. There were only about 20,000 cows in the Netherlands East Indies. Milk was consumed almost entirely by the European and Chinese population, and was never produced in sufficient quantity. Evaporated milk was imported to supplement the inadequate supply of fresh milk. Meat and meat products, similarly, were used chiefly by the European and Chinese population. The incidence of tuberculosis among dairy cattle was known to be high. The meat of animals slaughtered locally was said to be subject to inspection by veterinary surgeons, but diseases of animals, and especially cattle, were very frequent.

In general, under ordinary conditions, the supply of food in the region was sufficient to provide the native population with an adequate diet, assuming that the distribution was ideal. Distribution was not ideal, however. The adequacy of the native diet was influenced by many factors including (1) the kind of crops that could be raised in a particular locality, (2) the dietary habits of the natives, (3) a lack of even the rudimentary principles of nutrition, and (4) overpopulation and poverty. Areas producing corn, for instance, often did not extend into areas in which the principal crop was tubers. In each area the principal crop was the staple food of the natives. Deficiency states were encountered in regions in which the chief item of diet was cassava or sago. Types of avitaminosis were observed among the people who used polished rice and washed corn flour.

Miscellaneous Problems of Sanitation

Barbaric customs were slowly disappearing among the natives. Some of the seminomadic tribes, however, persisted in their custom of migrating from area to area, building flimsy huts which they would abandon as they ventured to a new region. Occidentals and wealthy natives had homes much like European houses, but most natives built huts of bamboo and leaves. In southeastern Borneo, in particular, native huts were built on stilts, and this type of construction was prevalent in many other places. Houses built on rafts were common on the River Musi in Palembang.

The beneficial work of the Public Health Service was reflected in the steadily decreasing mortality rates. Data in this respect are reliable, because in most areas of the Netherlands East Indies a corpse could not be buried until after it had been inspected by a physician or a *mantri*. The last census was taken in 1930. If it is assumed that the population increased by 10 per cent between that year and 1938, the mortality rate in the latter year would range from 12 per 1,000 in Padang to 31 per 1,000 in Macassar. In Batavia the rate would have been 27 per 1,000; in Surabaya, 23; in Bandung, 14; in Cheribon, 21; in Jokyakarta, 22. In 1928 this rate was 9.9 per 1,000 for Europeans and 40.4 for Indonesians, whereas in 1938 these rates were 10.5 per 1,000 for Europeans and 29.0 per 1,000 for Indonesians. It was thought that the reduction in the mortality rate for Indonesians was due chiefly to the campaigns against epidemics which in former years took many lives. Infant mortality rates were still high; so high, in fact, that the total mortality rate among Chinese and Indonesians was greatly influenced by the infant and child mortality rates. In Batavia, for example, the infant mortality rate among the Indonesians was about 36 per cent of the total mortality rate for that part of the population. The mortality rate in Batavia among Indonesian infants less than a year old was 300 per 1,000; among Chinese infants less than a year old it was 150 per 1,000; among European infants of the same age group it was 56 per 1,000. Infant mortality rates in other parts of the Netherlands East Indies generally were not more favorable than the above.

The chief causes of the high infant mortality rates were said to be malnutrition, dysentery and malaria.

MEDICAL FACILITIES

Hospitals

Number of Beds. In December, 1938, there were 546 general hospitals, with a total capacity of 43,952 beds, in the Netherlands East Indies. In addition, there were 79 special hospitals, with 16,837 beds. These 79 hospitals were identified as follows: 48 asylums for lepers, four asylums for the insane, 11 nursing homes for the insane, five hospitals for treatment of ophthalmic diseases and 11 hospitals for the treatment of tuberculosis. Twenty of these special hospitals were situated in Java and Madura. In 1939 and 1940 nine additional hospitals for the treatment of tuberculosis were being built, but it is not known that they were completed. About 960 dispensaries were maintained in the various islands. These were distinct from the outpatient clinics operated in association with general hospitals.

On the basis of an estimated population of 70,000,000, there was approximately 0.9 bed per 1,000 of population, as compared to 9.7 beds per 1,000 of population in the United States. The Outer Provinces actually compared favorably with the cities in the matter of hospital facilities because the coolie ordinance required employers to provide medical and hospital facilities for their workers. In the residency of the eastern coast of Sumatra, for instance, there were 48 hospitals, with a capacity of 12,687 beds, in a population of 1,600,000. In addition to medical care for laborers, many of these hospitals provided care for the general public.

Equipment. In the larger cities and on plantations, the hospitals were completely equipped with roentgenologic apparatus, surgical instruments and laboratory facilities. The equipment of hospitals in small towns or plantations was less complete.

Supplies. No dental or surgical equipment was manufactured in the Netherlands East Indies. All medicinal products, with a very few exceptions, were imported. Quinine was the leading drug produced in the region; in fact, until March, 1942, most of the world supply of quinine was obtained in the Netherlands East Indies. An adequate supply of serums and vaccines was manufactured by the government. A few companies produced proprietary drugs or remedies of various kinds, but these were sold and used chiefly in the regions in which they were made.

Medical Personnel

Physicians. In 1938 only 1,139 physicians were licensed to practice medicine in the Netherlands East Indies. In addition, 168 physicians were members of the army medical corps. The ratio of physicians-to-population was approximately 1 to 60,000—one of the lowest in the world. Of the 1,139 physicians mentioned, 640 were licensed to practice in Holland as well as in the Netherlands East Indies. The rest were *Indische artsen,* or Indonesian physicians, permitted to practice only in the Netherlands East Indies. By far most of the private practitioners were located in urban centers, such as Batavia in Java. In 1938 about 20 per cent of all private practitioners in the Netherlands East Indies were located in that city. In rural parts of Java and in the outer islands medical care was so difficult to obtain that it was extremely limited. In such regions the only type of care available was often that provided by the Indonesian male and female nurses, or *mantris,* attached to various dispensaries.

Nurses. The number of nurses trained in Europe or in accredited schools of nursing in the Netherlands East Indies was very small. In 1938 only about 100 professionally trained white nurses were employed by the Public Health Service, the provincial boards and the councils of the smaller administrative units. In three of the largest general hospitals on Java, for example, there were only 61 fully qualified nurses to serve a total of 2,640 beds. Graduate nurses in private hospitals or on private service must have been very few. Fifty-four graduate nurses served with the medical corps of the army.

On the other hand, there were several thousand *mantris.* These were Indonesians, male and female, who had had a certain amount of training in approved institutions. Most of them served as nurses supervised by physicians or trained white nurses; a few were overseers in dispensaries in the outlying regions.

Dentists. Only 142 dentists were registered. All were engaged in private practice. About a third had settled in western Java, principally in Batavia. These men were fully qualified. The examination for licensure was rigid. A large number of Chinese served as *toekang gigis,* or "tooth practitioners," although a few were graduates of foreign schools of dentistry who had not been able to pass the examination for licensure.

Others. There were 113 pharmacists and 253 assistant pharmacists registered in the Netherlands East Indies. In addition, 20 pharmacists and 44 assistant pharmacists were attached to the medical corps of the army. In 1938 there were 697 licensed midwives, 158 of whom were employed by the Public Health Service. The rest were in private practice.

Medical Institutions

The Netherlands Indian School for Physicians was established at Surabaya in 1913. The curriculum was gradually modernized so that the complete course consisted of eight years of study. Three years were devoted to preparatory work; five were given over to medical and surgical studies. The diploma conferred the right to practice medicine in the Netherlands East Indies, but not in other Dutch possessions. This school had well-equipped laboratories and a large hospital with dispensaries. In 1938 the total enrollment was 362.

The School of Medicine of Batavia was founded in 1927. Medical education at this institution was said to have been equivalent to medical education in Holland. A diploma from this school conferred the right to practice medicine in the Netherlands East Indies and, after a few formalities, in Holland as well. In 1939 this school had 543 students; in the same year it graduated 39 physicians—11 Occidentals, 15 Indonesians and 13 Chinese.

The School for the Training of Netherlands Indian Dentists offered a five-year course. Students of all nationalities were admitted. In 1938 nine students were graduated; the total enrollment was 81. Many students were women. The school had well-equipped laboratories and outpatient departments.

A government Pasteur institute at Bandung manufactured biologic products and functioned as a regional diagnostic laboratory in which about 12,000 specimens of various kinds were examined each year. Production of all the serums and vaccines needed in the Netherlands East Indies gradually developed as a definite policy; originally only smallpox and rabies vaccines were made. About 8,000,000 smallpox immunizations a year were carried out with vaccine made at this institute. A formolized virus was prepared in monkey brains for use in 800 to 900 treatments against rabies annually.

The Eykman Institute at Batavia, founded in 1888, was the central laboratory of the Public Health Service. This laboratory provided advisory services in bacteriologic, serologic, parasitologic and chemical problems; it served both governmental and private agencies. In 1939, it was reported, 62,154 specimens of various kinds were examined.

Regional laboratories were located at Semarang, Surabaya and Bandung in Java, and at Macassar in Celebes. The malaria services were associated with the laboratories at Batavia and Surabaya; at the laboratory at Semarang studies of leprosy were carried out. A veterinary institute at Buitenzorg on Java was concerned with all veterinary examinations, including those for rabies.

Social Services. The Netherlands East Indies Red Cross was established in 1870. Since 1934 this organization had expanded its activities to include blood transfusion services. It supported a hospital in Buitenzorg.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Bacillary Dysentery. Bacillary dysentery was common, particularly in parts of Java, Sumatra and Sumba Island. Epidemics of bacillary dysentery raged in the Bantam area of Java, in Celebes, Timor and the Moluccas, throughout 1937 and 1938. The fatality rate from bacillary dysentery among children less than four years old was 30 times higher than it was among adult persons. The Flexner type of *Shigella paradysenteriae* seemed to predominate, but in recent years the Shiga bacillus was encountered with increasing frequency in parts of Java, Sumatra and Celebes.

Amebic Dysentery. Amebic dysentery was widespread, but exact figures as to incidence were not known, even to public health officials. Twenty per cent of apparently healthy soldiers were found to be carriers of the organisms. It was estimated that in Java and Madura amebae were excreted in the stools of no less than 10,000,000 people. The complications of intestinal amebiasis, such as perforation of the appendix, abscess of the liver, bronchial localization and cutaneous manifestations, were frequently observed at necropsy. Amebic ulcers were found, at necropsy, among those who never had been considered to have the disease.

Typhoid Fever. The morbidity rate from typhoid fever among Occidentals in the Netherlands East Indies was from 20 to 25 times higher than the rate from the same disease in Holland. The disease seemed to attack Occidentals more often than the native inhabitants. In Batavia from 1920 to 1930 the morbidity rate per 100,000 among Occidentals was 365; among natives in the same city it was only 46; among Chinese there it was 191. In Surabaya, from 1925 to 1936 the rate among Occidentals was 270; in Bandung in 1938 among Europeans it was 290. These rates, insofar as they apply to natives and Chinese, are not reliable, since only about 17 per cent of natives and 66 per cent of Chinese were treated by physicians during their last illness. Mortality rates, conversely, are reliable in Batavia, at least, because in that city a funeral could not be held until the body had been examined by a municipal official or a physician.

Paratyphoid Fevers. Paratyphoid fever A was widespread everywhere. At the Eykman laboratory in Batavia, 1,232 positive cultures of *Salmonella paratyphi* were obtained from 1931 to 1938.

Typical paratyphoid fever B apparently was rare in the Netherlands East Indies. *S. schottmuelleri* in a typical form was not isolated there until 1938. Salmonella sp. (Java type) had been isolated from contaminated water and from the stools of patients who had enteritis, but infection with this organism did not produce symptoms like those of typhoid fever or paratyphoid fever A and B. As a matter of fact, 25 different species of Salmonella were identified. They had caused various acute gastrointestinal conditions often associated with the consumption of meat products and raw or insufficiently cooked eggs of pigeons or ducks.

Cholera. Cholera occurred almost annually until about 25 years ago. Strict quarantine and compulsory vaccination have helped to curb the disease since that time. In September and October of 1937 cholera occurred in native hamlets along the southwestern coast of Celebes; it occurred in other districts a few months later. The case fatality rate at that time was 65 per cent, but the cases were few. The outbreak was remarkable in that the organism recovered was hemolytic and seemed to be related to the El Tor vibrio, a Vibrio-like organism originally isolated from pilgrims at the El Tor quarantine station in Egypt.

Balantidiasis. Infection with *Balantidium coli* was rarely described.

Giardiasis. *Giardia lamblia,* a flagellate protozoan parasite which can cause severe diarrhea, was recovered frequently from stools.

Infection with Worms. Widespread pollution of the soil and improper habits of sanitation and hygiene contributed to the widespread incidence of intestinal parasitism. More than 50 per cent of the population in some areas were carriers of some type of Necator—usually *Necator americanus.* In some of the Sunda Islands species of Ancylostoma seemed to predominate. The combination of ancylostomiasis and malaria was especially feared because of the resulting severe anemia.

Ascaris lumbricoides was said to be parasitic among at least 80 to 90 per cent of the rural population. Infection with *Trichuris trichiura* and *Enterobius vermicularis* occurred in nearly all parts of the Netherlands East Indies. The larvae of *Strongyloides stercoralis,* a roundworm, sometimes were seen in stools, associated with the ova of unidentified species of Ancylostoma. *Trichinella spiralis* was demonstrated in dogs and rats in Sumatra, but not among human beings.

The beef tapeworm, *Taenia saginata,* was rare in Java, but was encountered in Bali. The pork tapeworm, *T. solium,* apparently was not common. *Dipylidium caninum,* the common tapeworm of dogs and cats, was recovered from the stools of children. *Hymenolepis diminuta,* a tapeworm of rats and mice, was reported, and *H. nana,* the dwarf tapeworm, was not unknown. *Sparganum mansoni,* a tapeworm of Japan and China, *Raillietina madagascariensis,* a species of tapeworm usually found among fowls, and *Bertiella studeri,* a tapeworm of some of the higher apes, all have been reported. None occurred to such extent as to be serious.

Infection with Flukes. *Schistosoma japonicum* was found only in the vicinity of Lake Lindoe in Celebes at an altitude of 2,700 feet. Human beings, dogs and deer were infected in this area. Snails of the genus Oncomelania do not occur in this lake, nor were other snails discovered which were parasitized with furcocercous cercariae.

Infection with *Echinostoma ilocanum,* an intestinal fluke, was described in Java and the coastal areas of Celebes. Natives about Lindoe Lake in Celebes were parasitized with *E. lindoensis,* which was ingested in raw or insufficiently cooked fresh-water mussels. Two other flukes, *Echinopary-*

phium malayanum and *E. recurvatum*, were not important.

Infection with the Asiatic liver fluke, *Clonorchis sinensis*, the lung fluke, *Paragonimus westermani*, and the Asiatic intestinal fluke, *Fasciolopsis buski*, never has been reported from the Netherlands East Indies.

Dracontiasis. Infection with *Dracunculus medinensis* was found in this region only among Arabs who had become infected in their homeland. The species of Cyclops which acts as an intermediate host is present. Dracontiasis among the native population was not observed, however, because the natives did not drink the muddy, stagnant water which the species of Cyclops involved usually inhabits.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Lobar pneumonia was a frequent and dangerous disease in the Netherlands East Indies. Available statistics suggested that it was one of the chief causes of death among the Indonesians. It was particularly likely to occur, sometimes in epidemics, in places such as institutions, where many people slept together. On some large estates in the outer provinces the mortality rate from pneumonia among coolies was, per 100,000, 195 in 1931, 111 in 1932, 111 in 1933, 145 in 1934, and 211 in 1935. The number of deaths caused by pneumonia exceeded the number caused by typhoid fever and bacillary and amebic dysentery combined. In hospitals to which patients seriously ill with pneumonia were admitted, the fatality rate was about 30 per cent. In 1938 pneumonia was the most frequent cause of death (11.5 per cent of the total deaths) in 167 hospitals of the Netherlands East Indies. Most types of pneumococci were found, but type III was very rare.

Influenza. In 1918 an epidemic of influenza took many lives. Since that time the disease had become much less frequent, but recurred periodically.

Tuberculosis. Tuberculosis was of frequent occurrence. It was estimated that the disease caused about 10 per cent of the total number of deaths in the Netherlands East Indies, but such an estimate should be accepted with caution. In the area of Batavia, where members of the faculty of the School of Medicine of Batavia did much active work in preventive medicine and thus contributed to accuracy of the statistics, deaths from tuberculosis constituted about 10 per cent of the total mortality rate. Carefully conducted necropsies of patients dying in the large hospitals of Batavia and Surabaya showed that from 23 to 25 per cent of deaths were caused by tuberculosis. Necropsies of coolies on the eastern coast of Sumatra indicated a much lower rate—about 10 per cent. It is known that bovine tuberculosis occurred frequently among the 16,000 milch cows that had been imported from Holland and Australia. So far as is known, the native stock of 4,000,000 animals was not affected by bovine tuberculosis.

Smallpox. The last serious epidemic of smallpox occurred in 1913, but the disease broke out in Batavia in 1918, Bandung in 1919, Semarang in 1922, and Surabaya in 1924. In 1929 smallpox occurred in certain areas in the outer provinces, the southern and eastern parts of Borneo, and the eastern coast of Sumatra. In New Guinea the last epidemic occurred in 1917. It was said that the disease had virtually disappeared in recent years, largely because of the success of extensive campaigns for vaccination and revaccination.

Diphtheria. Diphtheria occurred throughout the Netherlands East Indies. In Java and Madura about 800 cases were reported annually, but the true number probably was much higher. Results of culture did not demonstrate a difference between Occidental and Javanese forms of the organisms.

Scarlet Fever. Scarlet fever was rare.

Meningococcic Meningitis. Very few cases of meningococcic meningitis had been reported during the last 20 years. No outbreaks had occurred, but between 1905 and 1919 a small number of cases had been recorded in Java, the eastern coast of Sumatra, and the Minahassa Peninsula of Celebes.

Anterior Poliomyelitis. This disease was reported very infrequently. A true epidemic never was described.

Measles and Whooping Cough. These two diseases were chiefly diseases of children; they were especially dangerous to the children of poor Indonesians.

Mumps and Chickenpox. These diseases affected children in the region about as often as they do children elsewhere.

Bronchospirochetosis. Hemorrhagic bronchitis or bronchospirochetosis, caused by what is called *Treponema bronchialis,* was encountered commonly. It was said that the organism could be recovered from the sputum of many patients who had bronchitis and bronchopneumonia.

Diseases Spread Chiefly by Contact

Venereal Diseases. Venereal diseases abounded. Ten to 15 per cent of the population of Madura and Java were believed to have venereal disease of some kind, although the presence of old infection with yaws often presented difficulty in the differential diagnosis between yaws and syphilis. The rates for gonorrhea were said to be about two times higher than the rates for syphilis. Lymphogranuloma venereum and soft chancre were encountered about a fourth as often as syphilis. Granuloma inguinale was reported only from New Guinea. Statistics were difficult to compile because most patients with venereal disease never reported for treatment, and those who reported for the first treatment often did not complete the series.

Yaws. Yaws was prevalent throughout the region, but especially so in the lowlands. In some places, it was said, from 80 to 90 per cent of the people were infected. Areas notorious as centers of the disease were Madura, Lombok, eastern and southern Borneo, northern and southern Sumatra, some of the Sunda Islands, the southern part of Celebes, and New Guinea.

Diseases of the Skin. Cutaneous diseases prevailed in the Netherlands East Indies to such an extent that they constituted one of the chief reasons for Indonesians' reporting to hospitals or dispensaries. In 1938, for example, 12 per cent of persons admitted to 167 of the larger hospitals had some form of cutaneous disease; only about 8 per cent had malaria. The percentage of Indonesians with cutaneous disease seen in dispensaries would be much higher. Secondary infection in such disease was important. Scabies, for example, occurred frequently, yet the clinical picture seen by the physician actually was scabies dominated by secondary infection. Generally, in areas in which water was scarce the incidence of scabies was high. Furunculosis was common among whites as well as Indonesians. Tropical phagedenic ulcer was prevalent throughout the region, more particularly so in New Guinea. Tinea imbricata occurred almost everywhere, but especially in Borneo and the Moluccas. Tinea albigena likewise was common. Epidermophytosis of the groins, axillae or toes was frequent; it was also highly communicable. Bullous tropical impetigo afflicted children most commonly, but occasionally attacked adult persons. Migrating linear dermatitis or creeping eruption, thought to be caused by larvae of some species of Ancylostoma, Gastrophilus or Gnathostoma, was often seen, but larvae were rarely recovered. Piedra, a disease of the shafts of hairs, was frequent in Batavia, where Europeans were readily infected with it. Redbug dermatitis, caused by the hexapod larvae of *Trombicula irritans,* apparently was the disease called "harvest itch" in other countries. In New Guinea an acute form of dermatitis caused by contact with the tropical plants, *Mangifera caesia* or *Gluta banghas,* was common.

Madura Foot. Autochthonous Madura foot or mycetoma was reported rarely. A few patients with the disease were seen, but they were persons not born in the Netherlands East Indies.

Rabies. Rabies was reported from all parts of the Netherlands East Indies. Each year at the Pasteur institute at Bandung 600 to 900 persons were treated for bites by rabid dogs. The western part of Java and the residency of Java were notorious in this respect. Since 1916 a monkey brain vaccine has been used.

Diseases of the Eyes. If blindness is accepted to be vision of less than $^{2}/_{6000}$, there were some 100,000 blind persons in Java, 10,000 in Sumatra and Celebes, and 10,000 on various other islands. If blindness is accepted to be vision of less than $^{2}/_{600}$, there were about 520,000 blind persons in Java, or 680,000 in the entire Netherlands East Indies. Trachoma was a leading cause of blindness; some 5,000,000 persons in Java alone had this disease. Areas in which this disease was most prevalent were the residency of Bantam in Java, Surabaya, and the vicinity of Cheribon. Twenty to 50 per cent of Javanese school children had trachoma, and there were about 1,400,000 children of school age. Xerophthalmia, gonorrheal conjunctivitis and syphilitic uveitis were said to be frequent. Primary glaucoma was rare; secondary glaucoma was fairly common. Senile cataract was not seen often. Epidemics of kerato-conjunctivitis occasionally broke out.

Leprosy. Leprosy was common throughout the area. Isolation of lepers was not enforced. In 1937 a survey resulted in the discovery of 5,700 new lepers in Java and Madura alone, and 12,000 new lepers in the outer islands. In some areas, such as the regency of Blora in central Java, the disease is extremely common. On Bali 1,829 lepers were registered in 1936; on Lombok, 369. In the Kei Islands 105 were found among 15,697 persons examined. At the end of 1938 there were 5,106 lepers in 47 leprosaria.

Tetanus. Tetanus was common throughout the region.

Undulant Fever. Bang's disease or contagious abortion was common among cows; a small number of cases of undulant fever have been reported.

Anthrax. Anthrax probably occurred in all the islands of the region. Epidemics of the disease among human beings broke out occasionally, usually preceded and accompanied by an epizootic among the carabaos or water buffaloes (*Bubalus bubalus*).

Leptospirosis. Leptospirosis in the Netherlands East Indies presented problems more difficult than those the disease creates elsewhere because in the former region the number of species of Leptospira was remarkably large. Leptospirosis, in most cases, was encountered on the eastern coast of Sumatra. The disease did not often cause death, and jaundice resulted in only about 10 per cent of cases. Mild forms of leptospirosis formerly were called "short spirochetal fever of the Netherlands East Indies." In eastern Sumatra the various species of Leptospira were said to be the so-called Salinem and Rachmat types; the latter apparently corresponded to the Japanese *Leptospira akiyami* or *L. autumnalis* of Occidental classifications. In only one case was *L. hebdomadis* found; several types which did not correspond to any known species were recovered. In Semarang on the northern coast of central Java *L. icterohaemorrhagiae* was isolated from several patients.

In Java, Celebes, Borneo, Bangka and the middle and southern parts of Sumatra several cases of leptospirosis caused by *L. bataviae* were reported. The island of Nusa Kambangan, opposite the city of Chilachap on the southern coast of Java, was a special focus for leptospirosis caused by *L. bataviae*, *L. icterohaemorrhagiae* and *L. hebdomadis*.

The animal reservoir varied. In Java the field rat, *Rattus brevicaudatus*, was likely to be infected by a nonpathogenic or nearly nonpathogenic type, *L. javanica*. In only one of 1,042 field rats examined in Batavia was *L. bataviae* found. The brown rat, *R.*

norvegicus, however, was a dangerous reservoir. In Batavia 50 per cent of such rats were found to be infected with *L. bataviae.* In Semarang *L. icterohaemorrhagiae* was recovered from *R. norvegicus. L. hebdomadis* was recovered from dogs in Sumatra. In Batavia *L. bataviae* and *L. javanica* were isolated from cats.

Rat-bite Fever. Rat-bite fever was reported repeatedly from the Netherlands East Indies. It was not common.

Actinomycosis. This disease was relatively common.

Diseases Spread by Arthropods

Malaria. Malaria was the most important disease in the Netherlands East Indies and was responsible for more deaths than any other disease. As a general rule, the greatest number of cases was reported after the rainy season. The experience has been, however, that an acute outbreak of malaria in this region can occur at any time of the year. In the rural districts of Java the annual total death rate from all causes was about 20 per 1,000 of population; when endemic malaria prevailed this total rate was 25 to 50 per 1,000; when epidemics arose the rate was as high as 400 per 1,000. In areas in which malaria is endemic the general infant mortality rates are high. In such areas the spleen index may be as high as 80 to 90 per cent, or, in other words, much higher, relatively, than the parasite index.

Many places in this region were notorious for malaria. This was true of the coast of Java, the coasts of the Sunda Islands, the eastern and western coasts of Sumatra, the southern coast of Celebes, Nias Island and Buton Island. In these places *Anopheles sundaicus* is prevalent. Other places were the rice-growing districts of Java, Sumatra, Sumba and the Minahassa Peninsula of Celebes, in all of which *A. aconitus* is the vector. The disease was reported from the interior of Java at altitudes of 4,000 to 5,000 feet, where *A. minimus minimus, A. maculatus maculatus, A. sundaicus* and *A. aconitus,* are the recognized vectors. The coast and the interior of Borneo and Bangka Island were particularly notorious for malaria carried by *A. umbrosus.* Malaria in the southern and western parts of Celebes is caused by *A. subpictus subpictus,* and more recently, *A. sundaicus.* In the marshlands of southern Sumatra *A. hyrcanus nigerrimus* is a vector. Malaria was also prevalent in the eastern part of the Netherlands East Indies and in most of the coast and interior of New Guinea. In these areas the vectors are *A. punctulatus punctulatus, A. punctulatus moluccensis* and *A. bancroftii.*

The foregoing areas are those in which the incidence of malaria was particularly high; but as a matter of fact the incidence was low in only a few places, such as a few small islands. In Batavia, for instance, the incidence had been greatly reduced, yet in 1937 severe epidemics occurred in the seaport of Tegal and the residencies of Kedu, Semarang, Japara-Rembang and Bantam, all in Java. In 1938 the disease was reported from Nias Island, the Riouw Islands, parts of Sumatra, and from Celebes. At the same time an epidemic was raging throughout Java.

Tertian malaria was as frequent as the estivo-autumnal form, although the geographic distribution was not the same. Quartan malaria occurred irregularly, but generally was less frequent than either of the former types. It was particularly prevalent in such places as Bali, eastern Sumatra, one part of eastern Java, and the northwestern coast of New Guinea.

Blackwater Fever. Despite the fact that malaria was so prevalent in the Netherlands East Indies, blackwater fever was not correspondingly frequent. It was reported from Java, but the incidence was very low. It had occurred at Deli on the eastern coast of Sumatra, but, again, was exceedingly rare. The disease seemed to be frequent, on the other hand, among Europeans in New Guinea. It was seldom reported from the Moluccas.

Filariasis. Filariasis was widespread in the Netherlands East Indies. Both types—that caused by *Wuchereria bancrofti* and that caused by *W. malayi*—were reported. It was said that in some parts of Sumatra 50 per cent of the native inhabitants had *W. malayi* in their blood, but that the clinical signs of the disease were rarely seen. In certain parts of Celebes about the same percentage of natives were infected with *W. malayi,* but 10 to 20 per cent of them had elephantiasis. Areas in which filariasis was especially prevalent were the northern and eastern parts of Sumatra, the southeastern part of Borneo, much of southern and central Celebes, many of the Sunda Islands, most of the Moluccas, and New Guinea. In Java the only area in which the infection was heavy was near Chilachap.

The mosquito which transmits *W. bancrofti* apparently is not generally the classical vector, *Culex fatigans,* although this species was found, experimentally, to be able to carry the parasites. Vectors mentioned were *Anopheles aconitus, C. alis, C. vishnui, A. bancroftii, A. punctulatus punctulatus* and *A. punctulatus moluccensis.* The chief vector in New Guinea is *A. punctulatus.* On the other hand, *W. malayi* has at least three groups of vectors: (1) all species of Mansonia, and especially *M. annulata* and *M. uniformis;* (2) *A. barbirostris,* which in the Malay Peninsula rarely attacks man, but in Celebes feeds voraciously on human blood; and (3) *A. hyrcanus* (probably *sinensis*) and *A. hyrcanus X* (probably a variety of *A. hyrcanus sinensis*).

Dengue Fever. Dengue fever occurred throughout the region. The so-called five-day fever of Van der Scheer and the *knokkel koorts* ("knuckle fever"), encountered frequently, were found to be dengue fever itself. The last severe epidemic of dengue fever in the Netherlands East Indies occurred in 1901; since that year the disease had been endemic.

Yellow Fever. Yellow fever was unknown in the Netherlands East Indies, although *Aedes aegypti* is present.

Typhus Fever. Mite-borne typhus fever (tropical or scrub typhus fever) occurred in Sumatra, particularly near Deli. About 400 or 450 cases of mite-borne typhus fever were reported from that district each year. Cases were recorded from Java, Celebes and Borneo, especially after the clearing of forested areas. *Trombicula deliensis* was the vector. The disease was considered identical with or closely related to tsutsugamushi disease, but *T. akamushi,* the vector of the latter, did not occur in the Netherlands East Indies, so far as is known. Moreover, tsutsugamushi disease as a rule is associated with a case fatality rate of from 30 to 40 per cent, with leukopenia constant; in the Netherlands East Indies the case fatality rate was only about 4 per cent, with leukocytosis frequent.

So-called shop typhus fever was reported chiefly from urban Javanese areas, among workers in stores and warehouses. It seemed to be closely related to endemic or murine typhus fever. The disease was observed regularly in Batavia, but less often in Sumatra and in Celebes.

Plague. The potential danger of outbreaks of plague was well known for years in the Netherlands East Indies. The hollow bamboo out of which most native houses were constructed was an ideal breeding place for rats, which were ubiquitous. The disease was endemic in Java, but Sumatra appeared to have been free from it. Curiously, the incidence of plague in seaports was always negligible; when the disease did break out, it occurred in hill country or mountainous areas at elevations of more than 900 feet. In Macassar 115 cases were reported between 1922 and 1930. In 1939, from the entire region, 1,541 cases were reported; in 1938 the figure was 2,107. The reservoir of infection was the Malayan house rat, *Rattus diardi,* which prefers to build its nest in bamboo poles such as are used in native homes, in thatched roofs, piles of timber and stores of food. This species has no tendency to migrate; hence, an epizootic usually remained within the original confines. The brown rat, *R. norvegicus,* was not important as a vector of plague; neither was the small house rat, *R. concolor*, or the field rat, *R. brevicaudatus*. The flea which transmits the disease is *Xenopsylla cheopis. Xenopsylla astia, Pigiopsylla ahalae* and *Pulex irritans* are of no importance in this respect.

The government devised extensive schemes for the improvement of houses and exercised careful supervision of the construction of new houses, to prevent the breeding of rats. Vaccination with Otten's live antiplague vaccine was performed. The Public Health Service considered such vaccination to be very valuable, but the first measure—exclusion of rats from homes—was acknowledged to be the more efficacious.

Kala-azar. Kala-azar, when it was encountered, was an imported disease. Sand flies of the genus Phlebotomus, which usually transmit the causative organism, *Leishmania donovani,* occur only rarely in the Netherlands East Indies.

Nutritional Diseases

Beriberi occurred only infrequently among the rural population in Java, but it was reported from Bangka Island, Nias Island, the Riouw Islands, parts of the western coast of Sumatra, and some of the Molucca Islands. Deficiency of vitamin B_2 and vitamin C were rare throughout this area. Disturbance of calcium metabolism and avitaminosis D were scarcely ever observed. Avitaminosis A was common in many districts, especially among children. In the severe form this deficiency state produced xerophthalmia. Xerophthalmia was particularly evident in western Java, central Java and in some of the Molucca Islands. In most of these places the nutritional status was low. Vesical lithiasis, possibly associated with avitaminosis A, was frequent in some areas. Edema caused by hypoproteinemia was reported from eastern Java. Tropical sprue did not occur among the Indonesians, but did occur among Occidentals and Chinese of long residency in the Netherlands East Indies. Deficiency of iron may have played some part in the numerous cases of anemia reported, but this part cannot be assessed accurately because so many native inhabitants had intestinal parasitism. Nutritional macrocytic anemia was observed, but not often. Endemic goiter was prevalent in certain mountainous areas—in Java, Bali, Lombok, parts of Sumatra, western, southern and eastern Borneo, lofty districts of Celebes, and the islands of Alor, Sumbawa, Flores and Buru. Western Java and Timor, in contrast, were practically free from this condition.

Miscellaneous Conditions

Allergic States. Persons who were allergic to certain substances elsewhere discovered that their difficulties continued when they came to the Netherlands East Indies. Occasionally, persons who had encountered no such distress elsewhere became allergic when they visited the region. The pollens of bamboo, sugar cane, rice, palm trees, tobacco plants and coffee trees or shrubs were some of the substances which produced allergic reactions.

Injuries Caused by Heat. Such injuries were very rare.

Rhinoscleroma. Rhinoscleroma, ascribed to *Klebsiella rhinoscleromatis*, was known to occur in the Netherlands East Indies. About 105 cases had been recorded. Areas in which this disease was endemic were the Batak lands, Minahassa in Celebes and Bali. A few patients were seen in the middle and eastern parts of Java.

Melioidosis. Melioidosis, or Whitmore's disease, a glanders-like condition of rodents transmissible to man, was observed occasionally. The clinical condition usually consisted of a chronic pulmonary lesion or a lesion of the skin. The causative organism presumably was *Malleomyces pseudomallei.*

SUMMARY

The Public Health Service of the Netherlands East Indies carried out an active program for the maintenance and improvement of public health and sanitation. Since 1937 a policy of decentralization had been pursued, so that much of the curative and part of the prophylactic medical program had been delegated to municipal, regency and provincial councils. The Public Health Service supervised all the local public health organizations. In the Outer Provinces the policy of decentralization had been slower in application; most of the public health work was still carried out by the Public Health Service. Well-equipped central and regional laboratories had been built. Special antiplague and antimalarial services were operating.

Water was plentiful in most areas, but water taken from rivers and wells usually was contaminated. Central water supply systems had been built in many cities and towns. Systems in which sewage was waterborne were found in only a few cities. Septic tanks were employed by most Occidentals and wealthier Indonesians. Pollution of the soil was common among the great majority of Indonesians.

Supplies of locally grown food, such as rice, cassava and sago, were adequate. In most areas tropical fruits were plentiful. Fish were abundant in some areas. The quantity of dairy products available was negligible. Meat as a rule was imported.

Mosquitoes which could transmit malaria, dengue fever, filariasis and yellow fever were widely distributed. Flies, lice, ticks, mites, fleas and bedbugs were indigenous. Rats, poisonous snakes, centipedes, scorpions, leeches, wild dogs, tigers, crocodiles and rhinoceroses were pests or potentially dangerous animals.

The chief diseases were malaria, dysentery, venereal diseases, scrub typhus, yaws, and infections of the skin. Typhoid fever, paratyphoid fever A, diarrhea, leprosy, murine typhus, dengue fever, filariasis, pneumonia and plague were important. Cholera was potentially but not actually important. Epidemics of kerato-conjunctivitis had occurred. Yellow fever never had been reported. Tuberculosis, intestinal parasitism, influenza, rabies, tetanus, actinomycosis, anthrax, trachoma and leptospirosis occurred.

BIBLIOGRAPHY

Baars, J. K.: Vergelijkend onderzoek van *V. cholerae* en *V. El Tor* glucose dissimilatie (Comparison of glucose dissimilation by *V. cholerae* and *V. El Tor*). Geneesk. tijdschr. v. Nederl.-Indië, **80**:334-346 (Feb. 6) 1940.

Backer and Haack: The toxic principle of *Renghas* (*Semecarpus heterophylla*). Recueil travaux chimiques des Pays Bas, **57**:225-232, 1938.

Bakar Aboe: *Hymenolepis nana*-infectie in het krankzinnigen gesticht te Lawang (*Hymenolepis nana*-infection in the asylum at Lawang). Geneesk. tijdschr. v. Nederl.-Indië, **82**:85-86 (Jan. 13) 1942.

Bakker, C.: Verslag van een onderzoek naar een heerschende oogziekte op Ambon en de Oeliassers (Report on an investigation of a prevalent eye disease on Amboina and the Oeliasian Islands). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **16**:500-557, 1927.

Bakker, C., and Joesoef, M.: Trachoom onderzoek op Java (Trachoma investigation on Java). Geneesk. tijdschr. v. Nederl.-Indië, **68**: 1-60, 1928.

Bakker, S.: The cattle stock in the Netherlands Indies and the Veterinary Service. Bulletin of the Colonial Institute of Amsterdam, **2**:193-203, 1939.

Beeuwkes, H., and Siegenbeek van Heukelom, A.: Pneumococcen typen en lobaire pneumonie (Pneumococcus types in lobar pneumonia). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1082-1099 (May 20) 1940.

Benjamins: Over hooikoorts (pollenosis) in Indië (On hay fever or pollenosis in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **72**:1016-1027 (August 2) 1932.

Beukema, W.: Een infectie met *Hymenolepis nana* (Infection with *Hymenolepis nana*). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2014-2020 (Sept. 23) 1941.

Boenjamin, R.: Enkele gegevens over het voorkomen van lepra in Batavia 1929-1931 (Leprosy in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **80**:322-333 (Feb. 6) 1940.

Bokma, H.: Doodelijke vergiftiging door den beet van een zeeslang *Enhydrina schistosa* (Daudin). (Fatal intoxication by sea snakebite [*Enhydrina schistosa* Daudin].) Geneesk. tijdschr. v. Nederl.-Indië, **81**:1926-1931 (Sept. 9) 1941.

——: Nog eens een beet van een zeeslang (New case of snakebite). Geneesk. tijdschr. v. Nederl.-Indië, **82**:87 (Jan. 13) 1942.

Bonebakker, A.: Serumtherapie bij pest (Serum treatment in plague). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2502-2512 (Oct. 22) 1940.

Bonne, C.: Over *Bertiella studeri* (Blanchard, 1891) (Anatomy and life cycle of *Bertiella studeri:* occurrence in man). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2222-2230 (Sept. 17) 1940.

——: Echinostomiasis aan het Lindoemeer in Celebes (Echinostomiasis at the Lindoe Lake in Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1139-1167 (May 27) 1941.

——: Eenige verdere waarnemingen over echinostomiasis (Further observations on echinostomiasis). Geneesk. tijdschr. v. Nederl.-Indië, **80**:537-547 (Feb. 27) 1940.

——: De lintwormen van den mensch in Nederl.-Indië (Tapeworms in man in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2376-2384 (Oct. 1) 1940.

——: Vier Echinostomen van den mensch in Ned.-Indië (Four echinostomes occurring in man in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1343-1356 (June 24) 1941.

——, Borstlap, A. J. P., Lie Kian Joe, Molenkamp, W. J. J., and Nanning, W.: Voortgezet bilharzia onderzoek in Celebes (Continuation of the investigation on bilharziosis in Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **82**:21-36 (Jan. 6) 1942.

——, ——, ——, ——, de Moor, C. E., and Nanning, W.: Voortgezet onderzoek over echinostomiasis in Celebes (Continuation of the investigation on echinostomiasis in Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **82**:3-20 (Jan. 6) 1942.

——, Henneman, J. Ph., and Schijveschuurder, W.: Merkwaardig geval van bronchostenosis door melioidosis (Remarkable case of bronchostenosis by melioidosis). Geneesk. tijdschr. v. Nederl.-Indië, **79**:877-884 (April 4) 1939.

Bonne, C., and Lie Kian Joe: Darmwandhelminthiasis (Helminthiasis of intestinal wall due to *Ancylostoma duodenale*). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2782-2788 (Nov. 26) 1940.

——, ——: Darmwandhelminthiasis teweeg gebracht door spargana (Intestinal wall helminthiasis due to Sparganum). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2788-2792 (Nov. 26) 1940.

——, ——, Molenkamp, W. J. J., and Mreyen, F. W.: *Wuchereria malayi,* de macrofilaria behoorende bij de microfilaria (*Wuchereria malayi,* the macrofilaria belonging to the microfilaria malayi). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1487-1501 (July 15) 1941 (with English summary).

——, and Mreyen, F. W.: Over *Raillietina madagascarensis* (Description of *Raillietina madagascariensis* (Davaine 1869)). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1310-1317 (May 21) 1940.

——, and Sandground, J. H.: *Bilharzia japonicum* aan het Lindoemeer (*Bilharzia japonicum* in Lindoe Lake region of central Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **80**:477-481 (Feb. 20) 1940.

Bonne, W. M.: Croupeuze pneumonie te Bentjoeloek (Lobar pneumonia in Bentjoeloek). Geneesk. tijdschr. v. Nederl.-Indië, **76**:16-39 (Jan. 7); 87-97 (Jan. 7); 146-154 (Jan. 21); 234-239 (Jan. 28); 289 (Feb. 4); 342-358 (Feb. 11); 428-436 (Feb. 18) 1936.

——, and Neuhaus, K.: Vergiftiging door steek van een visch (Poisoning due to the sting of a *Synancea verrucosa*). Geneesk. tijdschr. v. Nederl.-Indië, **76**:2402-2405 (Sept. 22) 1936.

Bonne-Wepster, J.: Een nieuwe gastheerplant voor de larve van *M. uniformis* Theo. (New host-plant for the larvae of *M. uniformis* Theo.). Geneesk. tijdschr. v. Nederl.-Indië, **77**:1055-1056 (April 27) 1937.

Bosma, M. J.: Vergelijking tusschen de zuigelingensterfte te Batavia en te Medan (Comparison between infant mortality in Batavia [Java] and Medan [Sumatra]). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1582-1609 (July 29) 1941 (with English summary).

Brand, W.: Sterfte te Batavia 1929-1931 (Mortality in Batavia between 1929 and 1931). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1470-1477 (June 11) 1940.

Brug, S. L.: *Dracunculus medinensis* in Nederl.-Indië (*Dracunculus medinensis* in the N.E.I.). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **19**:162-168, 1930.

——: *Filaria Bancrofti* overbrengers op Kabaena (*W. bancrofti* vectors in Kabaena, Celebes).

Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **27**:88-97, 1938.

Brug, S. L.: Filariasis in Nederlandsch-Indië, III (Filariasis in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **71**:210-240 (March 1) 1931.

——: De vooruitzichten der filaria bestrijding in Nederl.-Indië (The prospects of the anti-filaria campaign in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **77**:3202-3206 (Dec. 14) 1937.

——: Tropische ziekten, die niet in Nederl.-Indië voorkomen (Tropical diseases which do not occur in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **76**:259-271 (Feb. 4) 1936.

——, and de Rook, H.: De overbrenging van *Filaria malayi* (The transmission of *W. malayi*). Geneesk. tijdschr. v. Nederl.-Indië, **70**: 451-474 (May 1) 1930.

——: Het voorkomen van *Balantidium coli* in Nederl.-Indië (*Balantidium coli* in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **59**:894, 1919.

——, and de Rook, H.: Filariasis in Nederlandsch-Indië, IV (Filariasis in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **73**:264-279 (Feb. 28) 1933.

——, and Tesch, J. W.: Parasitaire wormen aan het Lindoemeer (Parasitic worms around the Lindoe Lake, Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **77**:2151-2148 (Sept. 7) 1937.

Buitelaar, L.: Lepra onder de Sa'dan Toradja's (Leprosy among the Sa'dan Toradja's, Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **75**:1211-1222 (July 22) 1935.

Chasan Boesoirie: Vischvergiftiging door een ikan nogi-nogi (Fish poisoning by an ikan nogi-nogi). Geneesk. tijdschr. v. Nederl.-Indië, **80**: 1338-1340 (May 21) 1940.

Cool, P.: Filariasis in de Molukken (Filariasis in the Moluccas). Geneesk. tijdschr. v. Nederl.-Indië, **67**:314-315, 1927.

Darwis, Amar, and Grevenstuk, A.: Bijdrage tot de kennis van de bonkrek vergiftiging (Contribution to the knowledge of the bonkrek intoxication). Geneesk. tijdschr. v. Nederl.-Indië, **75**:104-116; 366-382, 1936.

Dinger, J. E.: Samenhang tusschen seizoen en typhus te Batavia (Connection between season and typhoid fever in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **78**:1106-1126 (May 10) 1938.

——, Marseille, A., and Tesch, J. W.: Epidemiology of typhoid in Batavia. Geneesk. tijdschr. v. Nederl.-Indië, **79**:2690-2760 (Oct. 24) 1939.

——, Tesch, J. W., Marseille, A., and Gispen, R.: De epidemiologie van de bacillaire dysenterie in de studiewijk voor Hygiene (Epidemiology of bacillary dysentery in the experimental health area of Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1670-1695 (July 9) 1940.

Droop, V.: Actinomycose van het ovarium (Actinomycosis of the ovary). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2178-2183 (Sept. 10) 1940.

Duyster, M.: Giftige Indische planten en plantenbestanddeelen (Poisonous plants and plant-substances from the N.E.I.). Bandung, 1927.

Elsbach, E. M.: *A. barbirostris bancrofti* als overbrenger van *filaria Bancrofti* (*Anopheles bancroftii* as a vector of *W. bancrofti*). Geneesk. tijdschr. v. Nederl.-Indië, **77**:1536-1543 (June 22) 1937.

——: Orienteerend malaria en filaria onderzoek in Nieuw Guinea (Investigation on malaria and filaria in New Guinea). Geneesk. tijdschr. v. Nederl.-Indië, **77**:1036-1054 (April 27) 1937.

Encyclopaedie van Nederlandsch-Indië (Encyclopaedia of the N.E.I.), edited by D. G. Stibbe and F. J. W. H. Sandbergen under collaboration with P. A. Tellings. 's Gravenhage, Nijhoff, 1917-1939, Vols. I-VIII.

Erber, M.: Nieuwe salmonella typen bij den mensch (New Salmonella types in man). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2123-2138 (Oct. 7) 1941.

——: Salmonella aanteekeningen (Notes on salmonellosis). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **29**:56-75, 1940.

Essed, W. R.: De malaria te Tandjong Pinang (Malaria at Tanjongpinang). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **14**:307-325, 1925.

——: Onderzoek naar de malaria in Poeloe Toedjoeh (Investigation on the malaria in Poeloe Toedjoeh). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **14**:298-307, 1925.

Esseveld, H., and Collier, W. A.: Leptospirosis bij katten te Batavia (Leptospirosis in cats in Batavia). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **27**:250-261, 1938.

——, ——, and Mochtar, A.: Leptospirosis in the Netherlands East Indies with special reference to the virus reservoirs. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **29**: 1-9, 1940.

Fleischer, D.: Epidemisch optreden van miltvuur bij menschen (Epidemic of anthrax in man). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **22**:150-161, 1933.

Fossen, A.: Vergiftiging door den beet van zeeslangen (Poisonous sea snakebites). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1164-1166 (April 30) 1940.

Flu, P. C.: Beschouwingen naar aanleiding van een onderzoek over de verbreiding van *filaria Bancrofti* onder de inlandsche bevolking te Weltevreden (Incidence of *W. bancrofti* among the Indonesian population in Weltevreden). Geneesk. tijdschr. v. Nederl.-Indië, **61**:317, 1921.

Flu, P. C.: Verslag van het Laboratorium gedurende het jaar 1918 (Report of the Central Laboratory in Batavia over 1918). Geneesk. tijdschr. v. Nederl.-Indië, **59**:345, 1919.

Freeman, J., and Hughes, W. H.: Biological polyvalence of antigens, with special reference to hay fever. Lancet, **1**:941-943 (April 23) 1938.

Gardjita, M.: Systematische trachoombestrijding in de kampong (Systematic anti-trachoma campaign in the village). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2063-2071 (Sept. 30) 1941.

Girard, G., and Robic, J.: La vaccination antipesteuse avec le vaccin vivant E. V. à Madagascar. Acta Conventus tertii de Tropicis atque Malariae Morbis, Part I, Amsterdam, 1938.

Goelam: Orienteerend onderzoek naar de volksgezondheid op het eiland Enggano, res. Benkoelen (Investigation on health conditions on Enggano island in Benkoelen res.). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **18**:68-79, 1929.

Gomperts, C. E.: Orienteerend oogheelkundig onderzoek bij de Atjeh'sche bevolking van Groot Atjeh in 1937 (Eye diseases in Achin in 1937). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1192-1238 (May 7) 1940.

Grasset, E.: Plague immunization with live vaccine in South Africa. Tr. Roy. Soc. Trop. Med. & Hygiene, **35**:203-211 (January) 1942.

——: Live plague vaccine as a prophylactic against plague. South African Med. J., **15**: 373-375 (Oct. 11) 1941.

Greshoff, M.: Indische Vergiftrapporten (Intoxications in the N.E.I.). 's Gravenhage, Gebr. van Cleef, 1914.

Grevenstuk, A.: Over *Rhengas* en Japanlak vergiftiging (On rengas and Japan lacquer intoxication). Geneesk. tijdschr. v. Nederl.-Indië, **75**:2065-2076 (Nov. 26) 1935.

Gunther, C. E. M.: A survey of endemic typhus in New Guinea (Australian Mandate). M. J. Australia, **2**:564-573 (Nov. 30) 1940.

——, and Schroeder, A. G.: Further observations on endemic typhus in New Guinea. M. J. Australia, **1**:688-691 (May 6) 1939.

de Haas, J. H., and Meulemans, O.: Tinned milk in the Netherlands Indies. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **26**: 48, 1937.

——, Posthuma, H., and Meulemans, O.: Xerophthalmie bij kinderen in Batavia (Xerophthalmia in children in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **80**:928-950 (April 9) 1940.

Hadibroto, S.: Enkele suggesties in verband met de trachoom-bestrijding (Suggestions for the anti-trachoma campaign). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2072-2077 (September 30) 1941.

Hardjoloekito, S.: Reunghas intoxicatie. Geneesk. tijdschr. v. Nederl.-Indië, **81**:397-400 (Feb. 25) 1941.

ter Heege, F. H.: Over mechanische prikkelingen van het neusslijmvlies door in de lucht zwevende partikels (Mechanical irritation of the nasal mucosa by air-borne particles). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2512-2516 (Oct. 22) 1940.

——: Tropische hooikoorts (Tropical hay fever). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1231-1245, 1941.

Hijman, A. J., and van Veen, A. G.: Over het djengkolzuur, een nieuw zwavelhoudend aminozuur (On jengolic acid, a new sulfur-containing amino acid). Geneesk. tijdschr. v. Nederl.-Indië, **76**:840-859 (April 7) 1936.

van der Horst, F. C.: Madura voet (Madura-foot, Demonstration). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2756 (Dec. 23) 1941.

Huart, A. J.: Rattenbeetziekte (Rat-bite fever). Geneesk. tijdschr. v. Nederl.-Indië, **81**:900-902, 1941.

Hydrick, J. L.: Intensive rural hygiene work in the Netherlands East Indies. New York, Netherlands Information Bureau, 1942.

Hylkema, B.: De ontwikkeling der parasieten van de quartana in de *M. ludlowi* en haar overdraging op den mensch (Development of *P. malariae* in *A. sundaicus* and its transmission to man). Mededeel. v. dienst d. volksgezondh. in Nederl.-Indië, **29**:51-90, 1940.

Indisch Verslag 1939: Samengesteld door het Centraal Kantoor voor de statistiek van het Departement van Economische Zaken (N.E.I. statistical report for 1939, compiled by the Department of Economic Affairs). Batavia, Landsdrukkerij, 1939.

Ismangil, Wirjoboehardjo: Ondervoedingsoedeem in Bodjonegoro (Nutritional edema in Bojonegoro). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2063-2083 (Aug. 27) 1940.

Kariadi: Aanteekeningen over filariasis (Notes on filariasis). Geneesk. tijdschr. v. Nederl.-Indië, **77**:912-921 (April 13) 1937.

——: *A. hyrcanus X* en filariasis malayi te Martapoera (*A. hyrcanus X* as vector of *W. malayi* in Martapoera [Borneo]). Geneesk. tijdschr. v. Nederl.-Indië, **81**:107-118 (Jan. 21) 1942.

Keizer, D. P. R.: Tuberculose onderzoek bij zuigelingen en kleuters van de St. Melania polikliniek (Tuberculin sensitivity of infants and pre-school age children in a dispensary in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **81**: 676-682 (March 25) 1941.

Ketel, P. A.: Resultaten van een onderzoek naar het voorkomen van longtuberculose bij een vrijlevende Inheemsche bevolkingsgroep in de omgeving van Mojowarno (Oost-Java) (Tuberculosis in the Indonesian population around Mojowarno, East Java). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1567-1594 (June 25) 1940.

Kirschner, L., and Schijveschuurder, W.: De croupeuze pneumonie in Nederl.-Indië (Lobar pneumonia in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **79**:834-852 (April 4) 1939.

——: Bacteriologie en pathologie der diphtherie in Nederl.-Indië (Bacteriology and pathology of the diphtheria in the N.E.I.). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **18**: 81-102, 1929

——, and Kunst, C.: Over het voorkomen van infectieuse abortus bij runderen in Nederl.-Indië en zijn beteekenis voor de humane pathologie (Occurrence of infectious abortion in cattle in the N.E.I. and its significance for human pathology). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **14**:277-298, 1925.

Kisman, M.: Nier-en uretersteenen en het voorkomen daarvan in de Minahassa (Occurrence of stones in kidneys and ureters in the Minahassa, Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2682-2693 (Dec. 16) 1941.

van der Kodde: Het voorkomen van *Xenopsylla astia* in Semarang (The occurrence of *X. astia* in Semarang). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **17**:620-625, 1928.

Kodijat, R.: Systematische trachoombestrijding in de desa (Systematic anti-trachoma campaign in the village). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2057-2062 (Sept. 30) 1941.

Kopstein, F.: Die Gifttiere Java's und ihre Bedeutung für den Menschen (Poisonous animals of Java and their importance to man). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **21**:222-256, 1932.

——: Hygienische studien uit de Molukken (Public health studies in the Moluccas). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **15**:1-89, 1926.

Kotter, G. F.: Leptospirosis in Atjeh. Nederl. tijdschr. v. geneesk., **83**:3590-3594, 1939.

Kouwenaar, W.: De Nederl.-Indische Rickettsioses (Rickettsioses of the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **81**:41-52 (Jan. 6) 1941.

——: De pathologische anatomie van de mijtekoorts bij den mensch (Pathology of mite fever in man). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1119-1140 (April 30) 1940.

Kouwenaar, W., and Esseveld, H.: Onderzoek naar de beschermende werking van mijtekoorts reconvalescenten serum (Protective antibodies in the serum of men and guinea-pigs convalescing from mite fever). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1203-1217, 1941 (with English summary).

von Kuehlewein, M.: Rapport over een reis naar de onderafdeeling Boven-Mahakam (Borneo) Febr.-Mei 1929 (Report on a journey to the upper Mahakam River [Borneo] Feb.-May 1929). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **19**:65-156, 1930.

Kuilman, J.: Een rhinoscleroom geval in West Java (Rhinoscleroma case in W. Java). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2785-2789 (Dec. 30) 1941 (with English summary).

Kündig, A.: Eenige statistische gegevens uit de Minahassa (Vital statistics from the Minahassa, Celebes). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **23**:167-194, 1934.

Lammerts van Bueren, B., and de Haas, J. H.: Bacillaire dysenterie bij zuigelingen (Bacillary dysenterie in young infants). Geneesk. tijdschr. v. Nederl.-Indië, **78**:2871-2880 (Nov. 15) 1938.

Lampe, P. H. J.: Over twee vormen van witte piedra en over het aantoonen van piedraia in kali water (On two forms of white piedra and the demonstration of Piedraia in river water). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2569-2572 (Oct. 29) 1940.

——: Over piedra en het voorkomen van piedra in Batavia (Piedra and its occurrence in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **80**: 1519-1525 (June 18) 1940.

de Langen, C. D., and Lichtenstein, A.: A Clinical Textbook of Tropical Medicine. Batavia, G. Kolff & Co., 1936.

——, and Olivier, P. H.: Het roodvonkprobleem en de acute exanthemen in Nederl.-Indië (The problem of scarlet fever and acute rashes in the N.E.I.). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **17**:742-752, 1928.

League of Nations. Health Organisation. Eastern Bureau, Singapore, Annual Reports, 1938, 1939, 1940.

League of Nations. Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers: Report of the Netherlands Indies, Geneva, 1937.

Leimena, J.: Een geval van scrubtyphus (Tropical typhus). Geneesk. tijdschr. v. Nederl.-Indië, **81**:339-341 (Feb. 18) 1941.

Lewthwaite, R., and Savoor, S. R.: Relation of Sumatra Mitefever to Tsutsugamushi fever of

British Malaya. Brit. J. Exper. Path., **21**:117-125 (June) 1940.

Lewthwaite, R., and Savoor, S. R.: Rickettsia Diseases of Malaya, Identity of Tsutsugamushi and Rural Typhus. Lancet, **1**:255 (Feb. 10); 305 (Feb. 17) 1940.

Lodder, J.: De lepra te Ambon (Leprosy on Amboina). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **21**:41-47, 1932.

——: Rapport over een onderzoek naar het voorkomen van tuberculose op het Eiland Amboina (Tuberculosis on Amboina). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **21**: 15-40, 1932.

Maas: Een oriënteerend oogheelkundig onderzoek in het gewest Palembang (A preliminary investigation on the eye diseases occurring in Palembang residency). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **26**:75-81, 1937 (with English summary).

Machsoes, M.: *Anopheles barbirostris* als malaria overbrenger in de residentie Celebes (*A. barbirostris* as malaria vector in Celebes residency). Geneesk. tijdschr. v. Nederl.-Indië, **79**:2500-2515 (Oct. 3) 1939.

Marjitno, M., and Essed, W. F. R.: Ontwikkelingen van *Dracunculus medinensis* in *Cyclops* (Development of *Dracunculus medinensis* in Cyclops). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **27**:141-146, 1938.

Marseille, A.: Over het voorkomen van dierlijke darmparasieten bij de bevolking van een stads kampong te Batavia (Intestinal parasites of the native population in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **78**:2371-2375 (Sept. 27) 1938.

Mertens, W. K., and Beeuwkes, H.: Haemolyse proeven met cholera, El Tor en Celebes vibrionen (Haemolysis experiments with cholera, El Tor and Celebes vibrios). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1246-1270 (May 14) 1940.

——: Over cultures, welke al of niet naast het typische *Bact. cocovenenans* uit voedsel geisoleerd kunnen worden (Cultures isolated from food with or without simultaneous occurrence of *B. cocovenenans*). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1295-1296 (May 14) 1940.

——, and van Veen, A. G.: Die Bongkrek Vergiftigung in Banjoemas (Bongkrek intoxication in Banyumas [Java]). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **22**: 209-222, 1933.

Mochtar, A.: Absorptie proeven bij de type bepaling van *Leptospira bataviae* (Absorption experiments for the determination of *L. bataviae*). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2670-2679 (Dec. 16) 1941 (with English summary).

——, and Balder Djohnan: Een geval van ziekte van Weil veroorzaakt door leptospira van het "Rachmat"type (Case of Weil's disease caused by leptospira of "Rachmat" type). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2573-2578 (Oct. 29) 1940.

Mochtar, A., Balder Djohnan, and Wahab: Verdere uitkomsten van het onderzoek van leptospirosis gevallen te Batavia (New investigation on leptospirosis in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **81**:11-22 (Jan. 6) 1941.

——, and Collier, W. A.: De *Leptospira javanica* als een zelfstandige leptospira soort (*Leptospira javanica* as an independent strain). Geneesk. tijdschr. v. Nederl.-Indië, **80**:131-137 (Jan. 16) 1940.

——, and Esseveld, H.: Frequency of leptospirosis in the Netherlands Indies. Geneesk. tijdschr. v. Nederl.-Indië, **79**:547-563 (Feb. 28) 1939.

——, and de Reede, C. A.: De klinische beteekenis van zwak positieve agglutinatie bij leptospirosis onderzoek (Clinical importance of a weakly positive agglutination for the diagnosis of leptospirosis). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1382-1403, 1941.

——, ——, and Mrs. Rijkebüsch: Het voorkomen van nanukayami op Java (Occurrence of nanukayami on Java). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2492-2504 (Nov. 18) 1941 (with English summary).

Mohr, E. C. J.: Climate and soil in the Netherlands Indies. Bulletin of the Colonial Institute of Amsterdam, **1**:241-252, 1938.

van der Molen, L.: Een geval van meningococcie behandeld met sulfapyridine (Treatment of a case of cerebrospinal meningitis with sulfapyridine). Geneesk. tijdschr. v. Nederl.-Indië, **81**: 2208-2212 (Oct. 14) 1942.

Nieuw Guinee, onder redactie van W. C. Klein, uitgegeven voor het Moluccen Instituut (New Guinea, edited by W. C. Klein for the Moluccan Institute). Amsterdam, J. H. de Busy, vol. 1 (1935); vol. 2 (1937); vol. 3 (1938).

Mom, C. P., and Schaeffer, C. O.: Typhus bacterien in afvalwater en slib (Typhoid bacilli in sewage water and in sludge). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **29**: 27, 1940.

Mooij, W.: Malaria prophylaxe in het Koninklijk Nederlandsch-Indische Leger (Malaria prophylaxis in the army of the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2231-2241 (Sept. 17) 1940.

de Moor, C. E.: Epidemische cholera in Zuid Celebes, veroorzaakt door *V. El Tor* (Epidemic cholera in South Celebes caused by *V. El Tor*). Geneesk. tijdschr. v. Nederl.-Indië, **79**: 2234-2299 (Sept. 5) 1939; Mededeel. v. d.

dienst d. volksgezondh. in Nederl.-Indië, **28**: 320-356, 1939.

de Moor, C. E., Soekarnen, and van de Walle, N.: Melioidosis op Java (Melioidosis on Java). Geneesk. tijdschr. v. Nederl.-Indië, **72**:1618-1635 (Nov. 22) 1932.

Mreyen, F. W.: Over djengkol intoxicatie (On jengkol intoxication). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2139-2146 (Oct. 7) 1941.

Mulock Houwer, A. W.: De bestrijding der blindheid in Nederl.-Indië, in het bizonder op Java (Campaign against blindness in the N.E.I., particularly on Java). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1997-2016 (Aug. 20) 1940.

Netherlands East Indies. Medical and Sanitary Service Control of Endemic Diseases in the Netherlands East Indies. Weltevreden Landsdrukkerij, 1929.

Netherlands East Indies. Pocket Edition of the Statistical Abstract, Department of Economic Affairs, Central Bureau of Statistics. Batavia, G. Kolff & Co., 1940.

Netherland News, special supplement, Geographical Digest of the Netherlands East Indies. New York, Netherlands Information Bureau, 1942.

Noosten, H. H.: Rheungas dermatitis. Geneesk. tijdschr. v. Nederl.-Indië, **75**:2158 (Dec. 10) 1935.

——, and Visser, J.: Over de vergiftige eigenschappen van *Rheungas* (On the poisonous qualities of rengas). Geneesk. tijdschr. v. Nederl.-Indië, **76**:1346-1404 (June 2) 1936.

Oey Khoen Lian: Twee maanden reizend staar operateur (Two months as a travelling cataract surgeon). Geneesk. tijdschr. v. Nederl.-Indië, **81**:2489-2491 (Nov. 18) 1941.

Oomen, H. A. P. C.: Analyse van de gangosa syndromen (Analysis of the gangosa syndromes). Geneesk. tijdschr. v. Nederl.-Indië, **81**:810, 1941 (with English summary).

Otten, L.: De pest op Java, 1911-1923 (Plague on Java, 1911-1923). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **13**:119-263, 1924.

——: The cholera El Tor problem. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **28**: 13-22, 1939.

——: Het levende pest vaccin en zijn resultaten (Live plague vaccine and its results). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2878-2951 (Dec. 10) 1940.

——: The Government lymph establishment and the Pasteur Institute, 1891-1940. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **31**:214, 1941.

Overbeek, J. G.: Malaria onderzoek in de kolonisatie Belitang (Residentie Palembang) in April 1940 (Malaria survey in Belitang, Palembang res. in April 1940). Geneesk. tijdschr. v. Nederl.-Indië, **80**:2166-2177 (Sept. 10) 1940.

Overbeek, J. G.: Over merkwaardige ludlowi broedplaatsen aan Sumatra's Westkust en de Zuidkust van Java (Remarkable breeding places of *A. sundaicus* at Sumatra's west coast and Java's south coast). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1967-1969 (Aug. 13) 1940.

——: Reorganisatie van de afdeeling malaria bestrijding van den Dienst voor de Volksgozondheid (Reorganization of the anti-malaria service of the Public Health Service). Geneesk. tijdschr. v. Nederl.-Indië, **79**:2370-2373 (Sept. 19) 1939.

——, and Stoker, W. J.: Malaria in Nederl.-Indië en hare bestrijding (Antimalaria campaign in the Netherlands Indies). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **27**:183-205, 1938.

Paneth, O.: Het voorkomen van tuberculose in de Karolanden (Incidence of tuberculosis in the Karo Lands [Sumatra]). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **17**: 635-675, 1928.

Pet, M. A., and Fossen, A.: Melioidosis der inwendige organen (Melioidosis of internal organs). Geneesk. tijdschr. v. Nederl.-Indië, **74**: 976-981 (July 31) 1934.

Peverelli, P.: Geneeskundige voorzieningen te Batavia (Medical organizations in Batavia). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **27**:156-170, 1938.

Voordrachten gehouden op het tuberculose Congres te Bandoeng 28-29 Juli 1939 (Papers read at the Tuberculosis Congress at Bandung July 1939). Geneesk. tijdschr. v. Nederl.-Indië, **79**:3290-3484 (Dec. 19) 1939.

Posthuma, H. H., and de Haas, J. H.: Statistische gegevens van ziekenhuiskinderen te Batavia 1932-1940 (Statistical data about children admitted to the hospitals of Batavia). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1839-1862 (Sept. 2) 1941.

Postumus, S., and Blomberg, C.: Geneeskundig jaarboekje voor Nederl.-Indië (Medical yearbook for the Netherlands East Indies). Batavia, G. Kolff & Co., 1936, Part II; 1940, Part I.

Pruis, G. W. A.: Gadoengvergiftiging (Intoxication by *Dioscorea hirsuti*). Geneesk. tijdschr. v. Nederl.-Indië, **81**:864-873, 1941 (with English summary).

Reddingius, I.: Struma in de heelkundige kliniek te Batavia (Goitre cases admitted to the Department of Surgery in Batavia). Geneesk. tijdschr. v. Nederl-Indië, **81**:507-514 (March 18) 1941 (with English summary).

Rodenwaldt, E. R. K.: Die typischen geomorphologischen Situationen Niederländisch-Indiens im Bezug auf Malaria (Geomorphological conditions in the N.E.I. in relation to malaria). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **27**:98-109, 1938.

——: *Filaria Malayi* im Serajoe Delta (*W. malayi* in the delta of the Serajoe River [South Java]). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **22**:44-54, 1933; **23**:21, 194, 1934.

de Rooy, N.: The Reptiles of the Indian Australian Archipelago. Leyden, M. J. Brill, 1917.

Rosier, H. J.: Woningverbetering en malaria (Improvement of houses and malaria outbreaks). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **26**:337-343, 1937.

Russell, P. F., Rozeboom, L. E., and Stone, A.: Keys to the Anopheline Mosquitoes of the World. The American Entomological Society, The Academy of Natural Sciences, Philadelphia, 1943.

Sapoean: Ontjom vergiftiging (Intoxication by ontjom). Geneesk. tijdschr. v. Nederl.-Indië, **80**:598-601 (March 5) 1940.

Sardjito: De organisatie van den Gezondheidsdienst te Batavia (Organization of the Municipal Public Health Service in Batavia). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **19**:23-42, 1930.

——: Leptospirosis in Midden-Java met de seroreactie op verschillende typen van leptospirae (Leptospirosis in Central Java with seroreactions to different types of leptospira). Geneesk. tijdschr. v. Nederl.-Indië, **80**:280-291 (Jan. 31) 1940.

Schaafsma, N. D. R.: De door het proefstation voor waterzuivering "Manggarai" in 1933 verrichte onderzoekingen (Investigations done by the Institute for the Purification of Water "Manggarai" in 1933). De Ingenieur in Nederl.-Indië, **1**:VI 29, 1934.

Schaeffer, C. O.: Onderzoek over de herkomst van typhus bacterien in het rioleerings systeem van Bandoeng (Investigation on the source of the typhoid bacilli present in the sewerage system of Bandung). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1535-1547 (July 22) 1941.

——: Typhus bacterien in het rioolwater te Jogjakarta en hun gedrag tijdens de bezinking en de biologische reiniging (Typhoid bacilli in the sewage water of Jokyakarta and their biological purification). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **29**:49-56, 1940.

Scheepe, F. L.: Verspreiding der filariasis in Indragiri, Sumatra (Spread of filariasis in Indragiri, Sumatra). Geneesk. tijdschr. v. Nederl.-Indië, **75**:1197-1201 (July 22) 1935.

van der Schroeff, J. P.: Een epidemie van mijtekoorts en tropical typhus in Atjeh en Onderhoorigheden (An epidemic of mite fever and tropical typhus in Achin). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1103-1122, 1941 (with English summary).

Schuurman, C. J., and Schuurman-ten Bokkel Huinink, A. M.: Een pest epidemiologisch onderzoek in West Java, special met het oog op een mogelijke rol van de stinkmuis (Investigation on the epidemiology of the plague in West Java, especially concerning the possible role of the shrew, *Crocidura caerulea*). Mededeel, v. d. dienst d. volksgezondh. in Nederl.-Indië, **19**:427-547, 1930.

——, ——: Een malaria vraagstuk aan Java's Zuidkust (A malaria problem on the south coast of Java). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **18**:45-68, 1929.

——, ——: Proefnemingen met parijsch groen ter vernietiging van Anopheles-larven (Paris green as Anopheles larvicide). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **17**: 293-305, 1928, **18**:37-45, 1929.

Schuurmans Stekhoven, J. H.: De bestrijding der ankylostomiasis (The ancylostomiasis campaign). Geneesk. tijdschr. v. Nederl.-Indië, **63**:392-405, 1923.

Simons, R. D. G. Ph.: Apenpokken en roode hond (Monkey pox and prickly heat). Geneesk. tijdschr. v. Nederl.-Indië, **82**:59-85, 1942 (with English summary).

——: Het onrustbarende aantal geslachtsziekten en de noodzakelijkheid eener sociaal hygienische bestrijding hiervan in Nederl.-Indië (The alarming number of venereal diseases in the N.E.I. and the necessity of a public health antivenereal campaign). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1630-1658 (Aug. 5) 1941.

Sitanala, J. B.: Het probleem der leprozerieën in Nederl.-Indië (The problem of leprosaria in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **80**:1370-1380 (May 28) 1940.

——: Voorkomen van lepra in Ned.-Ind.-Archipel (Occurrence of leprosy in the N.E.I.). Acta Leidensia, **14**:224, 1939.

Slamet, Sudibijo, R. M.: Twee gevallen van huid melioidosis (Two cases of skin melioidosis). Geneesk. tijdschr. v. Nederl.-Indië, **78**:1424-1444 (June 14) 1938.

van Slee, W.: Onderzoek naar het voorkomen van filaria te Mamoedjoe (Investigation of the prevalence of filariae in Mamoedjoe [Celebes]). Geneesk. tijdschr. v. Nederl.-Indië, **70**:444-450 (May 1) 1930.

Snijders, E. P.: Overbrenging van de "Sumatraansche" dengue (Transport of dengue from Sumatra to Amsterdam). Geneesk. tijdschr. v.

Nederl.-Indië, 71:241-249 (March), 345-353 (April), 1931.
Soesilo, R.: Rapport omtrent het onderzoek naar de verspreiding van de malaria op het eiland Nias (Report on the outbreak of malaria on Nias Island). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, 18:1-28, 1929.
——: Voorkomen van *Spirillum minus* var. *morsus muris*, verwekker van de rattebeetziekte bij ratten van Batavia (Occurrence of *Spirillum minus* var. *morsus muris*, cause of rat-bite fever in the rats of Batavia). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, 15: 492-499, 1925.
Soetrisno: De bevolking der Waë Apo-Vlakte en de aldaar voorkomende filariasis (Eiland Boeroe) (Population of Waë Apo plain on Buru Island and incidence of filariasis). Geneesk. tijdschr. v. Nederl.-Indië, 80:2313-2328 (Sept.); 2349-2375 (Oct.) 1940.
Soewadji, Prawirohardjo: Infectie proeven met *microfilaria bancrofti* bij verschillende muskietensoorten in Batavia (Infection experiments with *W. bancrofti* on different mosquitoes in Batavia). Geneesk. tijdschr. v. Nederl.-Indië, 79:1691-1705 (July 4) 1939.
Swellengrebel, N. H.: Het voorkomen van *Xenopsylla astia* in Nederl.-Indië (Incidence of *X. astia* in the N.E.I.). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, 18:79-81, 1929.
——: Malaria in the Netherlands Indies. Bulletin of the Colonial Institute of Amsterdam, 1: 37-46, 1937.
——, and Rodenwaldt, E.: Die Anophelinen von Niederländisch-Ostindiën (The Anophelines of the N.E.I.). Jena, G. Fischer, 1932.
Tellings, J. A.: Allergie voor stuifmeel van den olie palm (Allergy for pollen of the oil-palm). Geneesk. tijdschr. v. Nederl.-Indië, 81:1223-1224, 1941.
Tesch, J. W.: Over filariasis en elephantiasis bij een geimporteerde Javaansche bevolking in Celebes (On filariasis and elephantiasis in a Javanese immigration colony on Celebes). Geneesk. tijdschr. v. Nederl.-Indië, 77:1434-1461 (June 15) 1937.
Thierfelder, M. U.: Bestrijding van granuloma venereum onder de Marindineezen in Nederlandsch Zuid Nieuw Guinea (Campaign against granuloma venereum amongst the tribe of the Marindinesians in the southern part of Dutch New Guinea). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, 17:490-526, 1928.
——: Enkele opmerkingen over het ontstaan van lepra (Remarks on the source of leprosy infection). Geneesk. tijdschr. v. Nederl.-Indië, 76:2133-2137 (Aug. 25) 1936.
Tillema, S.: Enkele gevallen van een steek door een Dajaksche vlieg (*Chrysops fixissima* pikat) (Cases of poisoning by sting of *Chrysops fixissima*). Geneesk. tijdschr. v. Nederl.-Indië, 76: 3330-3331 (Dec. 15) 1936.
Tillema, S.: Huidaandoeningen door manggifera soorten (Dermatitis from Mangifera). Geneesk. tijdschr. v. Nederl.-Indië, 76:2855-2857 (Nov. 3) 1936.
Van Tijn, S. A.: Over het ulcus phagedaenicum tropicum en haar belang voor groote bedrijven in Nieuw Guinea (On tropical ulcer and its economic importance in New Guinea). Geneesk. tijdschr. v. Nederl.-Indië, 80:549-557 (Feb. 27) 1940.
Tijssen, J.: Cataract operaties en xerophthalmie behandeling in Nederl.-Indië (Cataract operations and treatment of xerophthalmia in the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, 80:951-972 (April 9) 1940.
Tutein Nolthenius, A. B.: Overzicht van de literatuur betreffende de Molukken exclusief Nieuw Guinea. Deel II (1922-1933) (Review of the literature dealing with the Moluccas exclusive of New Guinea Vol. II 1922-1933). Amsterdam, Martinus Nijhoff, 's Gravenhage, 1935.
Van Veen, A. G.: De eiwit voorziening in onvruchtbare streken op Java (The provision of protein in the non-fertile regions of Java). Natuurwetenschappelijk Tijdschrift voor Nederl.-Indië, 101:321-323, 1941.
——, and Lanzing, J. C.: Over het koolhydraat en eiwit van cassave (On the carbohydrate and proteins of cassava). Geneesk. tijdschr. v. Nederl.-Indië, 81:2330-2342 (Nov. 4) 1941.
Venhuis, W. G.: *Anopheles aconitus* aan kali wanden (*A. aconitus* on stream banks). Geneesk. tijdschr. v. Nederl.-Indië, 82:99-112 (Jan. 20) 1942.
——: The hyrcanus problem in the Netherlands East Indies with description of a widespread malaria-carrying variety *A. hyrcanus X*. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, 28:376-389, 1939.
——: Het hyrcanus vraagstuk in Nederl.-Indië met beschrijving van een zeer verbreide nieuwe malaria overgrengende varieteit *A. hyrcanus X* (The *A. hyrcanus* problem in the N.E.I.: description of a new malaria vector, *A. hyrcanus X*). Geneesk. tijdschr. v. Nederl.-Indië, 80: 27-43 (Jan. 2) 1940.
——: De vindplaatsen van geinfecteerde *Anopheles maculatus* tijdens een epidemie in Oost-Java (Resting places of infected *A. maculatus* during a malaria outbreak in East Java). Geneesk. tijdschr. v. Nederl.-Indië, 81:2178-2188 (Oct. 14) 1941 (with English summary).
——: Geinfecteerde *Anopheles minimus* var. *flavirostris* aan kaliwanden (Infected *A. mini-*

mus flavirostris on stream banks). Geneesk. tijdschr. v. Nederl.-Indië, **82**:190-194 (Feb. 2) 1942 (with English summary).

Venhuis, W. G.: Voorloopige entomologische mededeelingen omtrent *A. barbirostris* van Celebes (Preliminary entomological study of *A. barbirostris* in Celebes). Geneesk. tijdschr. v. Nederl.-Indië, **79**:2515-2518 (Oct. 3) 1939.

Walch, E. W.: Nederlandsch-Indische Trombiculae en verwante mijten (Trombidiids of the N.E.I.). Geneesk. tijdschr. v. Nederl.-Indië, **67**:922-933, 1927 (with English summary).

——: Over *Trombicula deliensis* en andere Trombiculae van Deli (*Trombicula deliensis* and other trombidiids from Deli [Sumatra]). Geneesk. tijdschr. v. Nederl.-Indië, **62**:530-569, 1922.

——: Over de Trombiculae, welke de Pseudotyphus overbrengen en naverwante mijten uit Deli (On the trombidiid mites which act as vectors of mite fever and related mites from Deli). Geneesk. tijdschr. v. Nederl.-Indië, **64**: 499-529, 1924.

——, and Schuurman, C. J.: Zoutwater visch vijvers en malaria (Salt water fish ponds and malaria). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **18**:249-278, 1929.

Walch-Sorgdrager, B.: Leptospirosis. Quart. Bull. Health Organ., League of Nations, **8**:143-386, 1938.

Walch, E. W., and Soesilo, R.: Malaria control in the Netherlands Indies. Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **24**: 86-94, 1935.

——, ——: Verspreide aanteekeningen over malaria in den Nederlandsch Indischen Archipel (Notes on malaria in the N.E.I.). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **18**:102-112, 1929.

Walch-Sorgdrager, B., Bohlander, L., Schüffner, W. A. P., and Wolff, J. W.: Serologische groepeering van leptospira stammen, afkomstig van gevallen van leptospirosis ter Oostkust van Sumatra (Serological typing of leptospirae, isolated on Sumatra's east coast). Geneesk. tijdschr. v. Nederl.-Indië, **80**:578-598 (March 5) 1940 (with English summary).

van der Walle, N.: De ratten en de rattenvlooien van Makassar (Rats and rat fleas in Macassar), Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **21**:263-276, 1932.

Warouw, S. J.: Resultaten van trachoom onderzoek bij enkele bevolkingsgroepen in Nederl.-Indië (Results of trachoma investigation in several population groups of the N.E.I. [East Halmahera, Celebes, Java]). Leiden, Academisch Proefschrift, 1935.

Wolff, J. W.: Dysenterie Sonne ter Oostkust van Sumatra (Dysentery Sonne at the east coast of Sumatra). Geneesk. tijdschr. v. Nederl.-Indië, **78**:762-780 (April 5) 1938.

——: Epidemiologie der bacillaire dysenterie (Epidemiology of bacillary dysentery). Geneesk. tijdschr. v. Nederl.-Indië, **73**:514-523 (April 25) 1933.

——, and de Graaf, W.: Een geval van shoptyphus (× 19—Rickettsiose) met dier passage (A case of shoptyphus with animal passage). Geneesk. tijdschr. v. Nederl.-Indië, **79**:2985-2992 (Nov. 21) 1939.

——, and Kouwenaar, W.: Onderzoekingen over Sumatraansche mijtekoorts (Investigation of Sumatra mite fever). Geneesk. tijdschr. v. Nederl.-Indië, **76**:272-288 (Feb. 4) 1936.

Ziesel, J. H.: Leptospiren onderzoek in de residentie Palembang (Investigation of leptospirae in Palembang residency). Geneesk. tijdschr. v. Nederl.-Indië, **81**:1320-1321, 1941.

——: Het pelgrimsverkeer uit het Zuiden 1927-1937 (Pilgrim traffic from the N.E.I. to Mecca). Mededeel. v. d. dienst d. volksgezondh. in Nederl.-Indië, **26**:82-92, 1937.

23

New Caledonia

GEOGRAPHY AND CLIMATE

The French colony of New Caledonia proper is an island about 250 miles long and 30 miles wide situated, roughly, between 20 and 23° of south latitude and 161 and 165° of east longitude. It is bounded on the west by the southern reaches of the Coral Sea and on the east by the Pacific Ocean. The area is only about 8,500 square miles, or about that of the state of Massachusetts (8,266 square miles). On this island in 1936 were some 53,000 persons. About 17,000 were white persons; 28,000 were Melanesians or Polynesians, 4,500 were Javanese, 2,300 were Tonkinese, and the rest were of various extraction. Immigrants from France were not numerous. French influence is predominant, but native dialects are widely used. English is used by only a few persons.

New Caledonia has eight dependencies: (1) the Isle of Pines, 30 miles to the southeast; (2) the Wallis Archipelago, northeast of the Fiji Islands; (3) Futuna or Hoorn Islands, south of the Wallis group; (4) the Loyalty Islands of Maré, Lifou, Uvéa and others, 60 miles to the east of New Caledonia; (5) the almost barren Huon Islands, 170 miles northwest of New Caledonia; (6) the Bélep Archipelago, 7 miles northeast of New Caledonia; (7) the Chesterfield Islands, 340 miles northwest of New Caledonia; and (8) Walpole Island, southeast of Maré Island and east of the Isle of Pines.

New Caledonia is almost surrounded by a belt of coral reefs from 1 to 10 miles offshore. These reefs as a rule are interrupted only by the action of waters coming from the mouths of various streams on the island. An irregular mountain chain in two parallel ranges follows the long axis of the island. Toward the center the elevation is between 4,000 and 4,800 feet. There are broad interior plains and many valleys. On the northeastern coast the valleys tend to be heavily forested. Mangroves border the low southwestern shore.

New Caledonia has more than 15 rivers, but they are short and turbulent. During the rainy season the excessive downpours create virtually impassable swamps in the southeastern portion of the island. Other hydrographic features are the excellent natural harbors of the indented coast line, the finest one being that of the capital, Nouméa.

The geographic situation of New Caledonia is tropical, but the climate would compare favorably with that of areas in the temperate zones. The extreme maximal temperature of 99° F. (37.2° C.) was recorded at Nouméa in February. The extreme minimal temperature, 52° F. (11.1° C.), was recorded in the same place in July. Heat is greatest from December to March; least from May to December. Rainfall is uncertain. In some years the total precipitation per month has been less than 1 inch (2.5 cm.); in other years the rainfall during every month but October has exceeded 10 inches (0.25 meter). Cloudiness is a distinctive feature of the area; at Nouméa the sky is overhung with clouds about three fourths of the year. Relative humidity is rather uniformly high. The salient climatic data at four places in New Caledonia are seen in Table 28.

TABLE 28

Salient Climatic Data, Annual Figures, Certain Places in New Caledonia

Place	Temperature, ° F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Nouméa	99	52	74	44	72	E, 28	30
Pagumène	94	57	76	34	71	SE, 42	......
Col d'Amieu	..	..	69	78	..	......	1,150
Gomen	..	..	73	47	..	......	......

PUBLIC HEALTH

Health Services

Organization. Public health activities in New Caledonia and its island dependencies are under the administration of the Director of Health, who is also the inspector of native relief services. There are nine physicians engaged in public health activities and governmental medical services in New Caledonia and one in the Loyalty Islands. In the Wallis Islands the resident or local governmental administrator is a physician who acts in a dual capacity as medical officer and administrator. The principal duties of the medical officers as prescribed by decree consist of (1) medical care of officers, officials and agents of local or municipal colonial services and their families, and of natives of whatever origin or location, and (2) supervision of health activities of the native tribes. Such supervision includes sanitation of the villages, inspections in the schools, and the administration of various vaccines and serums. The decree provides that medical officers shall visit the various stations or communes once each month; in reality, they are visited only about twice each year. The Bourret Institute (Pasteur) in Nouméa is under the direction of an unattached army medical officer. Sanitary police were organized in 1922 to combat communicable diseases and to prevent their introduction into New Caledonia. All ships entering Nouméa are inspected, and persons suspected of having a communicable disease are sent to a quarantine hospital situated on a small island near the harbor of Nouméa.

A solitary medical post in the Loyalty Islands located at Chépénéhé on Lifou Island is administered by a single medical officer. The island dependencies are visited irregularly by the head of the New Caledonia Health Service. Most of the work of the medical officer has been concerned with control of leprosy. In the Wallis and Hoorn groups of islands the medical officer is assisted to some extent by missionaries and by a specially trained nurse.

Relative Effectiveness. As has been the case in some other French colonies, most public health activities in New Caledonia have not been well organized or very effective, due in part to lack of suitable personnel. Vital statistics are totally lacking except for a few scattered reports concerning some diseases. Some progress has been made in certain public health activities. After the epidemic of typhoid fever in Nouméa in 1927 the sanitary quality of the public water supply was improved by javellization, a French process of chlorination with an aqueous solution of sodium hypochlorite. Wells have been dug in some of the villages in an effort to improve the water supply, but these efforts usually were made at the instigation of missionaries. Until the war interfered, definite progress was being made in the improvement of housing conditions in Nouméa, where insanitary dwellings were being torn down and replaced by more sanitary buildings. Some progress also was being made in the substitution of more suitable homes for natives in the interior. To improve the quality and quantity of fresh cow's milk, government subsidies were granted to the dairy industry in 1938. Most of the milk produced, however, was for the Nouméa market. Attempts to control leprosy by isolation appear to have been successful to a limited degree. Smallpox was being controlled successfully by the vaccination of fairly large numbers of persons each year. Very little has been done to control such widespread infections as tuberculosis, yaws, syphilis and filariasis.

Water Supplies

Nouméa is supplied with water from the Dumbea River. It is impounded before delivery by gravity through 12-inch mains. It is not filtered but has been subjected to javellization since 1927. It is said to contain no suspended matter or sediment. Bacteriologic examination of the water prior to the institution of javellization in 1927 showed the presence of coliform organisms on several occasions. There are no published records available of recent tests. Contamination of water mains is possible through breaks produced by occasional earthquakes. Considering the fact that sewage is carried in open ditches or drains in Nouméa, contamination by means of breaks is likely. In other parts of New Caledonia many villages obtain water for drinking purposes from streams, but do not subject it to any form of treatment. Wells or springs are utilized in some places. In the Wallis and Hoorn groups of islands drinking water is obtained from streams or cisterns. Many of the natives, however, use stagnant water from streams. On the Loyalty Islands there are deep pools in caves from which fairly satisfactory water can be obtained. In recent years wells have been dug by missionaries, but these are stated to be contaminated in most instances.

Sewage Disposal

There are no closed systems for the disposal of sewage in New Caledonia or any of its dependencies. In Nouméa sewage is carried in open ditches or drains in the streets, which creates a nuisance as well as a public health hazard. In some of the towns under the control of the French authorities natives have been taught to use pail privies but these are few in number. On the Hoorn group of islands the beach is the usual latrine and the tides remove the excrement fairly effectively and satisfactorily.

Insects and Animals

Vectors of Disease. Mosquitoes. Although certain observers have recorded the presence of *Anopheles punctulatus moluccensis* and *A. punctulatus punctulatus* here, the accuracy of this observation has been sharply challenged. The prevailing evidence indicates that anophelines, although very common in the near-by New Hebrides Islands, do not exist in either New Caledonia or the Loyalty Islands. If present at all, they must be extremely rare. Seven species of Aedes mosquitoes have been reported in New Caledonia: *A. aegypti, A. alternans, A. vigilax, A. kermorganti, A. notoscriptus, A. vexans,* and *A. pseudoscutellaris. A. aegypti* and *A. pseudoscutellaris* are of medical importance because both can transmit filariasis. The former is also a vector of dengue fever in New Caledonia and a potential vector of yellow fever if the disease should be introduced. Three species of Aedes mosquitoes, *A. vigilax, A. notoscriptus* and *A. vexans,* feed in the daytime.

The only species of Culex mosquitoes definitely recorded in New Caledonia is *Culex fatigans,* which is a vector of filariasis. In the Wallis and Hoorn islands Culex mosquitoes are the predominant species. Other species of mosquitoes reported in New Caledonia are: *Tripteroides caledonica* and *Mansonia crassipes.* None of these is known to be of medical importance.

Lice. *Pediculus corporis* and *P. capitis* both have been reported in New Caledonia.

Flies. Several species of flies have been reported. *Musca domestica, M. sorbens* and *M. vicina* are to be found in or about dwellings. Blood-sucking flies reported are *Corizoneura neocaledonica* and *Stomoxys cal-*

citrans. *Chrysomyia rufifacies,* known as a secondary green blow fly, feeds on human feces and sometimes is the cause of human wound myiasis. *Calliphora augur,* which is primarily a parasite of sheep in Australia, also is found in New Caledonia, where it is a common nuisance in houses.

TICKS. Ticks of medical importance have not been reported from New Caledonia.

MITES. The itch mite, *Sarcoptes scabiei,* is said to be present. *Trombicula deliensis* and *T. hirsti* are said to have been found but positive identification is lacking. *Trombicula deliensis* and *T. hirsti* are the probable vectors of mite typhus in New Guinea.

FLEAS. Four species of fleas have been identified in New Caledonia; namely, *Xenopsylla cheopis, X. brasiliensis, Nosopsyllus fasciatus* and *Pulex irritans*. Since bubonic plague occurs on these islands, the presence of these fleas, and particularly *X. cheopis,* is of considerable medical importance.

RODENTS. Three species of rats commonly associated with the occurrence of bubonic plague are found in New Caledonia; namely, *Rattus rattus, R. alexandrinus* and *R. norvegicus*. *R. jessook* also is described. *Mus musculus canacorum,* a house mouse, is reported. The type of dwelling common on the islands has a thatched roof which offers excellent harborage for rats. Metal roofs have replaced thatched roofs in the construction of new native houses in an attempt to eliminate such harborages.

Snakes and Other Dangerous Animals. There are no poisonous snakes in New Caledonia. Dangerous animals have not been reported.

Pests. Two species of beetles, *Sessinia collaris* and *S. vomitas,* cause blistering when they come in contact with the skin of man. Both have an irritating secretion containing cantharidin. Two species of ants which bite viciously have been reported. They are *Solenopsis geminata,* or fire ant, and the bulldog ant of the genus Myrmecia. Two species of caterpillars (Limacodidae) are found. They have barbed and poisonous spines which cause marked pruritis on contact with the skin. Malayan deer, introduced into the islands, have multiplied to such extent that they are now pests.

POISONOUS FISH

Several species of poisonous fish are to be found in the coastal waters. A species of herring, *Melatta venenosa,* when eaten produces painful cramps, dyspnea, cyanosis and sometimes death. Numerous instances of poisoning have been reported to follow the eating of another herring, *Clupea venenosa,* and the eating of a toadfish, *Tetraodon maculatum*. Another poisonous fish reported is *Galaxias neocaledonicus*.

FOOD AND DAIRY PRODUCTS

The food of the natives in New Caledonia and the other islands has consisted principally of yams, taro, bananas, coconuts, small amounts of meat (mostly pork) and fish. Maize and rice have been introduced and grown in quantities barely sufficient for local consumption. Arrowroot grows wild on some of the islands and is eaten by the natives. Coffee is produced in quantities sufficient for local needs and for export. Green vegetables are grown in some of the missions and on the Loyalty Islands for the Nouméa market. Cattle for a number of years were raised mainly for the purpose of supplying meat. The milk produced had a very low content of fat. Beef cattle are raised in sufficient numbers to supply all local needs and to provide a surplus for export in the form of canned meat. Pigs thrive in all parts of New Caledonia. About 2,000 are slaughtered annually in Nouméa. Sheep and goats likewise furnish some meat. An additional source of meat is found in the large numbers of deer. In spite of the large numbers of Malayan deer shot each year for meat, it is estimated that no less than 60,000 are to be found in New Caledonia at present. Poultry also is produced, but eggs are scarce.

The local government in 1938 began to subsidize the dairy industry. This was done to increase the quantity and improve the quality of milk for the Nouméa market. Approximately 1,000 liters of fluid milk were made available. In other parts of the island and the dependencies any milk used by the white population has had to be imported in the form of powdered or evaporated milk.

MEDICAL FACILITIES

Hospitals

Number of Beds. In Nouméa the principal institution is the Nouméa Hospital, which has a capacity of 125 beds. It is under the direction of the Director of the Health Service, and has a resident medical officer. In 1936 a maternity pavilion was added to the hospital. Consultations in this clinic were offered free to all native women. Recently, a pediatric clinic and a clinic for the treatment of venereal diseases were established.

The Orphelinat Infirmary at Nouméa is under the direction of a civilian physician who has a European nurse and several trained attendants. Native and Asiatic laborers are treated at this hospital. There are special wards for the insane, indigent and aged.

Two small private hospitals are maintained by nickel-mining companies in the southern part of New Caledonia: one at Port Yaté and one at Thio. Three chrome-mining companies provide medical care for their employees at Pagumène. At Kuto village on the Isle of Pines there is a hospital. A hospital with a capacity of 25 beds is situated at Falaleu in the Wallis Islands. A dental clinic is maintained in this hospital. In 1938 the building was enlarged to provide for surgical operations, obstetric care and the storage of medical and chemical supplies. A dispensary was added for the treatment of outpatients, and an isolation building was provided for the care of patients with communicable diseases.

In the Hoorn group a hospital and dispensary were built at Naku in 1927. A specially trained French nun was placed in charge of these two units. A second dispensary was planned in 1939. There are no hospitals in the Loyalty Islands excepting those provided for lepers. In New Caledonia and its dependencies there are seven settlements or stations for lepers, the largest being the Ducos Sanatorium on Ducos Peninsula near Nouméa.

Equipment. The Nouméa Hospital is not well equipped. In 1931 roentgenologic apparatus was installed, but other types of equipment are lacking.

Supplies. All medical and surgical supplies must be imported.

Medical Personnel

Physicians. There are nine French military or government physicians and three civilian physicians in New Caledonia. The former, who have been trained in France, are charged with the medical treatment of all natives and government officials and their families. They make routine visits about every six months.

Nurses. An unspecified number of trained nurses, all nuns, are employed in the hospitals of Nouméa. One nurse and six nurse-aids are attached to the Falaleu hospital in the Wallis Islands.

Dentists. The number of dentists is not known.

Others. Four chemists, 16 hospital assistants, three native laboratory assistants, and 13 native sanitary police are listed among the employees of the hospitals in Nouméa and in government service. Six midwives are said to have been trained for service in the Wallis Islands.

Medical Institutions

The only laboratory is the Bourret Institute in Nouméa, which was organized in 1913 to make medical analyses, smallpox vaccine and plague serum. It was also charged with the responsibility of supervising leper hospitals until a separate post for leprosy control was established in 1936, under the supervision of a medical officer.

The institute has been the center for all research in leprosy on the islands.

Social Services. No organized social service activities are reported to exist in New Caledonia or its dependencies. The American Red Cross maintains a professional staff of workers. The Roman Catholic Church has been firmly established in this French colony since the middle of the nineteenth century. The Marist fathers have established schools as well as churches on all the islands. They also have endeavored to improve sanitary conditions, to introduce animal husbandry, and to improve agriculture. Nuns have been active in caring for the sick and in public health activities. Protestant missionaries also have contributed to the improvement of health and welfare of the New Caledonian natives.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. Both amebic and bacillary dysentery have been prevalent throughout New Caledonia and the other islands. The relative proportion of amebic and bacillary types cannot be judged. Typhoid fever is endemic in New Caledonia and its dependencies, and occasionally is epidemic. Accurate reports of the incidence are lacking, probably because the various types of enteric infections are poorly differentiated and laboratory facilities are not available. In Nouméa the disease was prevalent from December, 1926, until the early part of 1928. During this period 206 cases with 23 deaths were reported. After this epidemic steps were taken to treat the public water supply by javellization.

Cholera. Cholera has not been reported.

Intestinal Parasitism. Intestinal parasitism, and especially infection with hookworm, is very common on all the islands. It is said that in some sections almost every native is infected. It is especially prevalent among miners and Asiatics. Infection with *Necator americanus* is said to be more common than infection with *Ancylostoma duodenale.* In one survey it was found that 40 per cent of a native military group had some type of intestinal parasite; 30 to 50 per cent of children in an orphanage were infected.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis is said to be prevalent in all the islands. Eighteen nonnatives and 298 natives with the disease were observed in 1937. Pulmonary tuberculosis was present in 218 of these persons. It was said in 1929 that in the Wallis and Hoorn groups the incidence of pulmonary tuberculosis was 3 cases per 1,000 persons. Other forms of the disease included tuberculosis of the bones, joints and glands.

Meningococcic Meningitis. An outbreak of meningococcic meningitis occurred in Nouméa and neighboring villages during the latter half of 1942. Twenty-seven cases with six deaths were reported. All patients were from the local population. An unspecified number of cases occurred on the Loyalty Islands.

Miscellaneous. Diphtheria, scarlet fever and poliomyelitis occur sporadically from year to year. Epidemics of whooping cough and measles are reported at intervals. Mild epidemics of chickenpox have been reported. There have been no cases of smallpox in recent years, presumably because of the fairly large numbers of persons vaccinated each year.

Diseases Spread Chiefly by Contact

Venereal Diseases. Various forms of venereal infection are encountered on the several islands. Syphilis is common; 892 Wassermann tests were performed at the Bourret Institute in 1937, and the results of 416, or almost 47 per cent, were positive. In the Wallis and Hoorn islands about 5 per cent of the population is said to have syphilis. Congenital syphilis frequently is encountered. Lymphogranuloma venereum and gonorrhea also are prevalent in New Caledonia. Prostitutes are registered in Nouméa, but little more than this is done to control them. Arabs are reported to be clandestine keepers of houses of prostitution in this city.

Yaws. Yaws is very prevalent among natives. It is said that the native who escapes yaws is rare in the Wallis Islands. In many cases the infection occurs before the patient has reached the age of one year. Seven non-natives and 592 natives were treated in hospital or treatment stations in New Caledonia in 1936. In the same year 494 cases of yaws were reported from the Wallis Islands, in a population of about 4,700. Most persons with yaws in New Caledonia have been natives living along the eastern coast.

Leprosy. It is usually stated that leprosy was brought in from China about 1860, and that it spread widely after an uprising of the natives against the French in 1878. It is also said that the date, 1860, does not represent the time of introduction of leprosy, but only the date it was recognized by Europeans. It has also been said that leprosy is as old in the Pacific Islands as the races that live there. The disease was first observed on the Isle of Pines after the insurrection in 1878, and in the Loyalty Islands in 1880. The disease is said to be rare in the Wallis and Hoorn groups of islands. The number of cases of true leprosy appeared to increase until about 1900, after which time it became more or less stationary for a number of years. The number of patients under treatment in recent years has varied from 1,000 to 1,400 in New Caledonia, and is about 300 in the Loyalty Islands. The apparent increase in the number of patients under treatment may be an indication of improvement in case-finding.

Attention to the problem of leprosy has included both case-finding and segregation. Medical officers have made periodic inspections of the tribes, labor groups, school children and others. Preliminary inspections also have been made by the sanitary police. Compulsory isolation was instituted by decree in 1893; some patients are hospitalized, others are sent to leper settlements or villages. In recent years some of the smaller hospitals and settlements have been abandoned, the lepers being concentrated in larger institutions or colonies. At present there are only seven such institutions in New Caledonia and the Loyalty Islands.

Tetanus. Six cases of tetanus, in all of which the patients died, were reported in 1937.

Diseases Spread by Arthropods

Malaria. Malaria is not present in New Caledonia although it is common in the near-by New Hebrides.

Filariasis. Infection with *Wuchereria bancrofti* is very common in New Caledonia and the other islands. About 20 to 25 per cent of the natives are infected. Elephantiasis also is of relatively common occurrence. Only a comparatively small percentage of patients with filariasis are reported as receiving treatment. There have been reported four different species of mosquitoes in New Caledonia which are known to transmit the disease; namely, *Aedes aegypti, A. pseudoscutellaris, Anopheles punctulatus punctulatus* and *Culex fatigans.*

Dengue Fever. Dengue fever is said to occur in New Caledonia, but no information as to numbers of cases is available. The mosquito vector, *Aedes aegypti,* is found on all parts of the island.

Yellow Fever. Yellow fever never has been reported to occur in any part of New Caledonia or its dependencies or in near-by areas from which it could be transported readily. Consequently, the danger of introduction of this disease is remote. The common mosquito vector, *Aedes aegypti,* is present in sufficient numbers to transmit the disease widely if it should be imported.

Typhus Fever. Typhus fever is not known to exist in any of its forms. The various vectors are, however, present.

Plague. Bubonic plague in New Caledonia was first reported in 1899, when the disease broke out in Nouméa. Presumably it had been imported from the Asiatic mainland. The fatality rate was fairly high. In 1901 another group of cases was reported from the interior of the island. Another outbreak occurred in 1905 and 1906. Late in 1912 dead rats were reported on vessels entering Nouméa harbor. Soon afterward an outbreak of plague occurred among inhabitants of the city. This was followed in the next year by an outbreak in the interior. No more cases were reported in New Caledonia until 1941, when eight cases broke out in the village of Touaourou, about 31 miles east of Nouméa. The first cases were reported in February, 1941; the disease occurred among girls in a native school. Prior to the outbreak, natives living in the Goro region were reported to have found dead rats as well as others apparently sick. In addition to the cases reported from the school, one other was reported early in the year. Two more were reported in November, 1941. In 1942 two cases of pneumonic plague were reported from a mining district in the northern part of the island. One of the patients died. After the 1941 outbreak a campaign was instituted to eradicate rats in Nouméa. None of approximately 2,000 rats caught exhibited any evidence of infection with plague. Plague among human beings was confirmed bacteriologically; but there is no record that similar results had been obtained in tests for the disease among ill or dead rats found in the same areas.

Miscellaneous

Phagedenic ulcers are common; 390 patients were under treatment for them in New Caledonia in 1936. One hundred cases were reported from the Wallis and Futuna groups in 1935. Beriberi has been reported to occur frequently among Asiatic laborers working in the mines.

SUMMARY

Public health activities in New Caledonia and its dependent islands are carried out under the direction of a Director of Health who is also the inspector of native relief services. A total of nine physicians are engaged in public health work and governmental services in New Caledonia; one does such work in the Loyalty Islands. In the Wallis Islands a physician is both medical officer and administrator. Other islands are visited irregularly by the Director of the Health Service.

Water in Nouméa is obtained from the Dumbea River. It is not filtered, but is subject to javellization. Elsewhere water is taken from rivers, wells or springs. Rain water is used on some of the smaller islands. All water excepting that in Nouméa probably is unsafe. There are no systems in which sewage is water-borne.

Only two anopheline mosquitoes are found. Seven species of Aedes and one species of Culex mosquitoes are reported. Two other genera occur, but have no medical importance. Lice, flies, ticks, mites, fleas, rats, blister beetles and poisonous caterpillars are present. Certain species of fish are poisonous if eaten.

Foods, such as yams, taro, maize, rice, bananas, coconuts, and some meat, are produced locally. Fresh milk is available in Nouméa; elsewhere powdered or evaporated milk must be used.

A hospital of 125 beds is located in Nouméa; others of smaller size are maintained elsewhere. There are nine government physicians and three civilian physicians in the islands.

The important problems of disease in New Caledonia are enteric infections, intestinal parasitism, plague, leprosy, filariasis, yaws and venereal diseases. Infections of the skin and nutritional disturbances are common.

BIBLIOGRAPHY

Barbier, M.: L'assistance médicale aux îles Wallis et Futuna. Ann. méd. pharm. col., Par. **27**: 441-453, 1929.

Collin, L.: Épidémie de peste en Nouvelle-Calédonie. Ann. d'hyg. et de méd. colon., Par., **16**: 910-927, 1913.

Compton, R. H.: New Caledonia and the Isle of Pines. Geographical Journal, **49**:81-106 (Feb.) 1917.

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 2d ed., Philadelphia, Lea & Febiger, 1940.

Grosfillez: Les principales maladies observées dans les colonies françaises et territoires sous mandat en 1932. Ann. méd. pharm. col., Par. **32**:153-268, 1934.

Lambert, S. M.: Medical Conditions in the South Pacific. M. J. Australia, **2**:362-378 (Sept. 22) 1928.

League of Nations. Health Organisation: Public Health Services in the French Colonies, by S. Abbatucci. Liége, Imp. G. Thone, 1926.

Ledentu, G.: Les maladies transmissibles observées dans les colonies françaises et territoires sous mandat pendant l'année 1933. Ann. méd. pharm. col., Par. **33**:552-816, 1935. Ibid., **34**:474-749, 1936; **35**:748-928, 1937.

Mumford, E. P.: Mosquitoes, Malaria and the War in the Pacific. Science, **96**:191-194 (Aug. 28) 1942.

Musgrave, A.: Some Caterpillars Injurious to Man. Australian Museum Magazine, **2**:34-36 (Jan.) 1924.

Revilliod, R.: Les mammifères de la Nouvelle-Calédonie et des îles Loyalty. *In* F. Sarasin et J. Roux: "Nova Caledonia Zoologie." Wiesbaden, **1**:342-365, 1914.

Riley, W. A., and Johannsen, O. A.: Medical Entomology. 2d ed. New York, McGraw-Hill Book Co., 1938.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed., by R. P. Strong, Philadelphia, The Blakiston Co., 1942. 2 vols.

Tisseuil, J.: Prophylaxie de la lèpre en 1927. Bull. Soc. path. exot., **21**:288-293, 1928.

——: Sur l'origine de la lèpre en Nouvelle-Calédonie. Ibid., **23**:357-363, 1930.

——: Index du parasitisme intestinal à Nouméa. Ibid., **22**:334-336, 1929.

——: Les parasites intestinaux en Nouvelle-Calédonie. Ibid., **21**:211-214, 1928.

Vogel, E., and Rouzic, J.: Les maladies transmissible observées dans les colonies françaises et territoires sous mandat pendant l'année 1936. Ann. méd. pharm. col., Par. **36**:633-725, 1938.

——, and Riou: Les maladies épidémiques, endémiques et sociales dans les colonies françaises pendant l'année 1937. Ann. méd. pharm. col., Par. **37**:257-551, 1939.

24

New Hebrides

GEOGRAPHY AND CLIMATE

The Condominium of New Hebrides was established at the Anglo-French convention of 1906. A second protocol, ratified in 1922, guaranteed British, French and native interests. The Condominium (a government administered jointly by two or more powers) is governed by high commissioners of both Great Britain and France. It consists of 30 to 40 inhabited islands and 10 to 20 islets situated within the area described by 12 and 21° of south latitude and 165 and 170° of east longitude. The islands parallel the eastern coast of Australia in a northwest-to-southeast direction in an axis about 500 miles long. The most important islands are Espíritu Santo, Malekula, Malo, Efate, Eromanga, Tana, Ambrim, Epi, Pentecost, Maewo, the 17 Banks Islands and the Torres Islands. The total area of the archipelago is 5,700 square miles, or somewhat larger than the state of Connecticut (4,965 square miles).

In this area there were, according to the census of 1936, about 750 French and 180 English. There are some 60,000 other persons including 45,000 Melanesians, a considerable number of Tonkinese, and a smaller group of Polynesians and Papuans. Almost all the white population is concentrated at Vila, the capital, on Efate Island. Languages employed are French, English and a variety of native dialects.

Almost all the islands but those in the low-lying coralline Torres group are of volcanic origin. On Tana and Ambrim islands volcanoes are constantly active. Most of the peaks are of considerable elevation; the greatest occurs on Espíritu Santo and is more than 6,000 feet high. The soil in the valleys is said to be exceptionally fertile. Vegetation is luxuriant and nearly all the islands are heavily forested.

Rivers and smaller streams provide excellent drainage on nearly every island. Lakes are numerous; a lake on Gaua or Santa Maria Island has a circumference of 4 miles. Four harbors—Port Aneityum at Aneityum Island, Port Vila and Port Havannah at Efate Island, and Port Sandwich at Malekula Island—are said to be among the finest in the Pacific Ocean.

The climate is said to be enervating, particularly from November to April. The temperature in general ranges from about 75 to 95° F. (23.8 to 35° C.), with a mean of 82° F. (27.7° C.). Islands to the south, such as Efate, Eromanga, Tana and Aneityum, are cooler than the northern groups. At Aneityum, for instance, the range is from 58 to 79° F. (14.4 to 26.1° C.), with a mean of 76° F. (24.4° C.). Rainfall is said to vary from 50 inches in the extreme south to more than 200 inches (5.1 meters) in the extreme north. Relative humidity is excessive during the hot and wet season, which extends from November to April. The dry and cool season persists from May to October.

PUBLIC HEALTH

Health Services

Organization. Supervision of the public health is the responsibility of (1) the Condominium Medical Service, (2) the French National Medical Service, and (3) the British Mission Medical Service.

The Condominium Medical Service consists of members of the French National

Medical Service and British mission physicians. One physician, who may belong to either group, is appointed Chief Medical Officer of the Condominium. As such he is responsible to the government of the Condominium. Physicians of the Condominium Medical Service receive a small subsidy from the government. A native medical practitioner, trained at the native medical school at Suva in the Fiji Islands, is paid wholly by the government. A British and a French Condominium medical officer act as port health officers, and as meat inspectors at Vila.

The French National Medical Service is financed and controlled by the French government. It maintains a hospital at Vila on Efate Island, another on Espíritu Santo Island, a third on Malekula Island, one on Tana Island, and a dispensary at Port Sandwich on Malekula Island. The French National Medical Service is especially concerned with the health of the laborers, such as the indentured Tonkinese, on French plantations. Its facilities, however, are available to all peoples. The Chief Medical Officer resides at Vila; he is assisted by a medical officer and eight religious sisters. Three other French medical officers are located on the island of Espíritu Santo, Norsup on Malekula Island, and on Tana Island. On Espíritu Santo the officer is assisted by four religious sisters; at Norsup the medical officer has a Tonkinese male nurse as an aid.

The British Mission Medical Service is composed of (1) the Presbyterian Mission Medical Service and (2) the Melanesian Mission Medical Service. The first group is subsidized by the British government. It is interested primarily in the health of natives, but also will care for non-natives. At Vila on Efate Island it maintains one British physician who is assisted by three qualified nurses; at Lenakel on Tana Island it maintains one British physician. These physicians visit the outlying villages and advise the natives in medical and sanitary problems. The Melanesian Mission Medical Service likewise is subsidized by the British government. It is interested chiefly in natives, but will extend medical care to anyone needing immediate attention. The service has three or four qualified nurses, but no physicians. A nurse is situated at Lolowai on Aoba Island; other nurses are stationed at various places.

Relative Effectiveness. There is no satisfactory health organization in the New Hebrides. There are no general health laws, no central control of the water supply, no supervised disposal of sewage, no adequate inspection of food, no programs for maternal or child welfare. At Vila on Efate Island there are periodic inspections of meat and daily collections of garbage. Some of the water used in Vila is chlorinated and filtered. Elsewhere even these measures are lacking. The division of authority between the French and British is largely responsible for this inefficient and inadequate health program. In addition, the primitive state of the natives makes health education almost impossible. Many ancient fears, tribal customs and tabus contribute to the maintenance of poor sanitary conditions. Although the hospitals do their best to render good medical service to all groups, they are handicapped by lack of funds and modern equipment, and reluctance of many of the natives to use the facilities offered. Moreover, the hospitals cannot reach a large percentage of the rural population. Although competent practitioners and missionaries occasionally visit the remote communities, there is no sustained rural health program. Recently the Condominium has trained one native student a year at the medical school at Suva in the Fiji Islands. This student returns to the Condominium to practice when his education is complete.

Water Supplies

Water is plentiful on most of the islands. On the atolls, where it is not plentiful, natives often cut vertical furrows in the trunks of coconut palms; rain water runs down these furrows and collects in a cavity cut out of the trunk of the tree. When this supply fails they may resort to the use of water from swamps. In Vila on Efate Island rain water is collected from the roofs and stored in tanks. In addition to this type of supply, Vila has a supply that is piped from two rivers; it is filtered and chlorinated. Purification plants are located in a few other areas of Efate Island and Espíritu Santo Island. Wells are used in many places, but they are not constructed in such a manner as to exclude contamination. Excepting on the islands of Efate and Espíritu Santo, water in the Condominium cannot be considered safe.

Sewage Disposal

There are no public sewerage systems on the islands. Government houses and the homes of many non-natives are provided with water-flush systems with treatment of the sewage in septic tanks and disposal to cesspools. The porous soil absorbs the liquid readily; usually no difficulty is experienced with these systems. Formerly there were many bored-hole latrines, but the number of such latrines on Efate Island has been considerably reduced. In the past bucket latrines were used to some extent. These were not properly cared for, and as a result the surrounding soil was contaminated during the emptying process. It is said that before the New Hebrides Islands were penetrated by white people the natives were exceedingly careful, for reasons associated with superstitions, to bury such dejecta as feces, nail parings and hair. Partially civilized natives and imported laborers are less careful; pollution of soil is now widespread.

Insects and Animals

Vectors of Disease. Mosquitoes. The only vectors of malaria in the New Hebrides are: *Anopheles punctulatus moluccensis* and *A. punctulatus punctulatus*. These mosquitoes also are believed to be carriers of periodic filariasis. *Anopheles bancroftii* also is reported, but is not thought to be either an actual or potential vector of disease. *Anopheles punctulatus moluccensis,* the principal vector of malaria, lays its eggs in swamps and ditches, in clean or contaminated running or stagnant water, and in artificial as well as natural pools. It is found near the surfaces of wells, in depressions which tap subsurface soil, and in the grass beside rivers. The adult frequents houses, and will bite either at night or in daytime shade. *Anopheles punctulatus punctulatus* breeds in shallow pools of rain water and in small artificial puddles, such as may collect in hoof prints. Larvae are not found in running water. This mosquito frequents houses and bites at night. Both species select sunny areas for laying of their eggs.

Aedes scutellaris and *A. aegypti* are the only species of this genus definitely reported from the Condominium which are capable of carrying infection. Both carry filariasis; *A. aegypti* may carry yellow fever and dengue fever. *Aedes albopictus*, a vector of dengue fever, filariasis, and a potential vector of yellow fever, probably is present. *Aedes pseudoscutellaris,* vector of a non-periodic type of filariasis in the Gilbert Islands and other neighboring areas, probably is not present, but could easily be imported. The larvae of *Aedes scutellaris* are deposited in tree holes, empty domestic utensils and coconut husks.

Aedes aegypti is seldom found far from inhabited buildings. The younger mosquitoes feed in the daytime, but after about a week they become nocturnal. Larvae are deposited in collections of rain water such as occur in barrels, tin cans and cisterns. The larvae of *A. albopictus* are deposited in holes in trees and rocks, axils of leaves and occasionally in empty domestic containers.

Species of Culex which transmit disease are not definitely reported from the New Hebrides Islands. There is disagreement as to whether *Culex fatigans* is or is not present. This mosquito transmits filariasis on the Ocean and Nauru islands and other areas. It is therefore a potential danger. Other mosquitoes present in the New Hebrides but not reported to be actual or potential vectors of disease are *Culex femineus, C. hilli buxtoni, C. pacificus* and *Triperoides caledonica*. The larvae of *Culex fatigans* are deposited in domestic utensils and other containers. This mosquito also breeds in permanent ground water which has little vegetable content. It feeds almost exclusively at night.

LICE. No louse-borne diseases are reported. It seems likely that very few lice are present. The natives are careless in their habits, but are not closely crowded together. They live in small, scattered, rural communities, a fact which would discourage the spread of infestation with lice. The head louse, *Pediculus capitis,* has been reported in Samoa, and could be transported to the New Hebrides Islands, if it does not already exist there.

FLIES. Flies are very numerous. Members of the families Muscidae, Calliphoridae and Sarcophagidae are the chief vectors of disease. They can be mechanical carriers of the organisms of enteric diseases, and especially those of bacillary and amebic dysentery. They may play a part in the spread of yaws among the natives, and their part in the causation of myiasis is well known. The lack of systems in which sewage is waterborne, of effective means of disposal of garbage, and of screening are some of the factors responsible for the prevalence of flies.

Lucilia papuensis and *Chrysomia megacephala* are found. These flies often are involved in myiasis of wounds, and sometimes may be mechanical transmitters of the causative organisms of enteric diseases. They breed in carrion and feed on human feces and sores.

Musca sorbens is an extremely annoying fly which commonly feeds on ulcers, sores and the lesions of yaws, and breeds in human feces. It is one of the most important mechanical transmitters of both bacillary and amebic dysentery, and has been suspected to be an agent in the transmission of yaws and leprosy. *Musca vicina* breeds less commonly in human feces, and is not so likely to feed on sores. It is, therefore, a slightly less important vector of disease than *M. sorbens.*

Sarcophaga chalcura, S. impatiens and *S. orchidea* are present. Flies of this genus deposit their larvae on decaying flesh, human excrement and ulcerated human tissues. They are, therefore, responsible for the secondary infection of many small traumatic lesions. They also breed in food and become temporary parasites in the human bowel. They are mechanical vectors of the organisms of enteric diseases.

Two other flies are reported to be common pests in the New Hebrides Islands, but probably are not important in the transfer of disease. *Simulium jolyi* breeds in running water, depositing its larvae on vegetable matter by the sides of streams. *Tabanus fijianus,* a horse fly, frequently bites man. Its immature stages are passed in mud or water.

TICKS. Tick-borne diseases are not reported, but ticks are said to be present.

FLEAS. Plague never has been reported from the New Hebrides Islands. Two species of fleas potentially able to transmit the disease are found. They are the flea of cats, *Ctenocephalus felis,* and the flea of human beings, *Pulex irritans.* Neither is thought to be a frequent vector of the disease in endemic areas, however. The flea of human beings is very common. It is found on swine as well as on man. Since swine are cherished by the natives, and often are reared in native houses, the propagation of this particular flea is greatly facilitated.

RODENTS. Two species of rat are reported: the black rat, *Rattus rattus,* and *R. exulans.* The former is found in and around buildings, and is potentially capable of serving as a reservoir of plague, should it be introduced. The latter is not known to be a reservoir of disease.

Snakes and Other Dangerous Animals. There are no poisonous land snakes. Poisonous sea snakes are present, but they do not attack bathers and are not dangerous unless caught by mistake. Robber crabs, such as

Birgus latro and other genera, are not uncommon. If heavy shoes are not worn by persons walking along native paths at night, these crabs can be dangerous. *Crocodilus porosus* occasionally is found in the rivers, and will attack swimmers. Wild pigs are numerous. They have long tusks with which they may attack man.

Pests. Flies are the chief pests. Red ants also are found. The cockroach, *Periplaneta brunnea,* and the bedbug, *Cimex rotundatus,* are reported. One common pest is the lizard known as gecko, fourteen species of which are present. Attracted by light, it crawls over ceilings and walls at night, and makes a peculiarly irritating, hissing noise. Popularly believed to be poisonous, these lizards are completely innocuous.

Dangerous Marine Life

Coral. Bathers should avoid regions where coral ledges or projections are known to exist, because cuts or abrasions caused by coral are notoriously slow to heal.

Catfish. The stinging catfish has long spines on the dorsal and pectoral fins. It is not a deadly fish, but inflicts painful wounds which are subject to secondary infection. On some species poison glands are attached to the spines.

Eels. Eels lie on the coral bottoms. They have sharp teeth capable of inflicting troublesome wounds.

Jellyfish. The sting of a jellyfish causes severe reactions and occasionally may be fatal.

Scorpion Fish. The scorpion fish, a member of the family Scorpaenidae, has dorsal and head spines capable of injecting a deadly poison. This fish will attack at the slightest touch. The venom produces acute pain which becomes rapidly generalized. Localized gangrene may ensue. In severe cases death may occur within an hour.

Sharks. Man-eating sharks and barracudas often are found just outside the reefs.

Sting Ray. This dangerous fish lies concealed in the sand or mud of lagoons and estuaries. It has a wide, flat body and an extremely long tail, tipped with hard, sharp barbs. If stepped on, the fish drives the barbed tail repeatedly into the victim, producing severe lacerations and sometimes penetrating bone. The ray varies from 1 foot to 10 feet in width.

Poisonous Plants and Allergens

The *goudron* tree has black sap which is usually found running down the trunk, and which contains an unspecified toxic principle said to be capable of causing severe and prolonged headache in anyone who sleeps under the tree or remains near it for long. It is reported that if the trunk is cut into, the sap will cause severe swelling and dermatitis to develop in any sensitized individual who may come within 50 feet of this tree. Two species of Laportea, or tree nettle, are reported. This nettle attains a height of 15 to 40 feet. Its leaves are oval, with prominent veins on the under surfaces and glossy upper surfaces. Both leaves and flowers have stinging hairs filled with sap containing formic acid. The sap of one species produces ulcers of the skin which occasionally may prove fatal. When the hand is even brushed against this nettle, burning followed by itching results and may last a week. If the leaves are grasped firmly, however, little or no sting is received.

The ragweeds are not reported between 20° of north latitude and 20° of south latitude, and are not, therefore, a problem in the New Hebrides Islands. Copra dust may be the cause of certain allergic reactions. No other plant allergens are listed from this area.

Food and Dairy Products

The soil of the New Hebrides is fertile; vegetables as well as all types of tropical fruits grow well. Each native family has a garden, and the Tonkinese supply produce for the markets. Yams, manioc, taro, coconuts, bananas and papayas are produced throughout the year. Breadfruit is obtained in February and March, and citrous fruits are gathered from May to July.

The native diet is deficient in protein. There are a few cattle, but the beef obtained is of poor quality. On Eromanga Island there is a station at which about 3,000 sheep are raised. There are many pigs, but they are poorly nourished. Because of the cult of veneration of pigs which prevails among the natives, most of the animals are not marketed. A few rabbits are available. Fish are numerous, but there is no well-organized fishing industry. Poultry is scarce. The supply of dairy products is small, and the native diet is deficient in fats. The small amount of milk available is unsafe for consumption.

Because of deficient methods of disposal of excreta, flies and insanitary methods of handling and marketing of foods, uncooked native produce is a potential source of enteric disease. At Vila on Efate Island meat is inspected; elsewhere it is not. There is no inspection of milk. Foods spoil rapidly in this climate and facilities for refrigeration are not available.

MEDICAL FACILITIES

Hospitals

Number of Beds. The French hospital at Vila on Efate Island has 110 beds; the French hospital on Espíritu Santo Island, 110 beds; the Presbyterian hospital at Vila on Efate Island, about 35 beds; and the Presbyterian hospital at Lenakel on Tana Island, some 20 beds. The hospital of the Melanesian Mission Medical Service at Lolowai on Aoba Island has 25 beds. At Norsup on Malekula Island the French Cotton Company has a hospital of 50 beds which is intended for employees of the company. It is financed by the French National Medical Service.

An aid post at Rago on Pentecost Island and another at Tavolavola on Aoba Island are maintained by the Melanesian Mission Medical Service. Infirmary-dispensaries are operated by the French government at Port Sandwich and Norsup on Malekula Island and on Tana Island. These are intended chiefly for the treatment of natives and Tonkinese, but others are accepted. Two leper colonies exist in the islands; the largest is situated on Tana Island. Generally, the French hospitals are open to all persons; the larger ones have wards for both natives and non-natives. Missionary hospitals are operated primarily for natives, but other persons are admitted. Indigent persons are accepted without charge at all hospitals in the region.

Equipment. The French hospital at Vila is inadequately equipped. Laboratory facilities are limited; only the more simple types of examination of blood and urine can be made. The roentgenologic apparatus is not modern. There is an operating room. The French hospital on Espíritu Santo is equipped like the French hospital at Vila. The Presbyterian hospital at Vila has poor equipment, but roentgenologic apparatus is present. The Presbyterian hospital at Lenakel on Tana Island has good equipment, including a satisfactory operating room, but no roentgenologic apparatus. The hospital of the French Cotton Company at Norsup on Malekula Island does not have roentgenologic apparatus; other equipment is limited.

Supplies. All medical supplies and drugs must be imported.

Medical Personnel

Physicians. In 1942 there were three British and five or possibly six French physicians; in 1943 there were apparently five British and fifteen French practitioners. Two of these are the Chief Medical Officer of the Condominium and his assistant, stationed at Vila. The others are located in the various hospitals. One native practitioner, employed by the Condominium Medical Service, is stationed at Vila on Efate Island; another practices on Malekula Island.

Dentists. There are apparently no dentists in the New Hebrides Islands.

Nurses. In 1937 the French National Medical Service employed eight religious sisters at Vila on Efate Island, of whom seven probably were nurses. The service also had four sisters on Espíritu Santo Island, and one Tonkinese male nurse at Norsup on Malekula Island. The Presbyterian Mission Medical Service maintained three qualified nurses at Vila; and the Melanesian Mission Medical Service maintained two at Rago on Pentecost Island, and one at Lolowai and one at Tavolavola on Aoba Island.

Others. Most of the missionaries in the region are able to practice simple medicine. They travel into rural districts and are responsible for much of the health work done in those areas. One medically qualified missionary is located at the aid station at Tavolavola on Aoba Island. Owners of large plantations assist the health authorities by supplying certain medicines to their employees.

Medical Institutions

The only laboratories are in the French hospitals at Vila and on Espíritu Santo. These carry out only the simplest types of examinations. There are no medical schools or societies. A few native students are sent to the native medical school at Suva in the Fiji Islands.

Social Services. There are no social services other than the mission services. These provide hospitals and physicians, and carry on simple health work in some of the rural areas.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysentery. The improper disposal of feces and garbage, the prevalence of flies and the general uncleanliness of the natives are factors in the spread of dysentery. Amebic dysentery was introduced by the Tonkinese, and bacillary dysentery probably was brought to the islands by white settlers. Both are now endemic. The amebic form is recognized more frequently than the bacillary form. During the rainy season both become epidemic. When natives have dysentery in the early stages they tend to conceal the fact, believing that magic can be worked against them if their feces are examined. This increases the difficulties of eradicating the disease.

Typhoid Fever. Typhoid fever was not reported from New Hebrides until 1928. Since then a few cases have been recorded. In view of the extremely insanitary conditions, it is surprising that the disease is not more widespread. Paratyphoid fever is not reported.

Intestinal Helminthiasis. Ascariasis is frequent among the Tonkinese. Trichuriasis seems to affect chiefly the Polynesians. A study in 1929 showed that the approximate percentage of natives infected with intestinal parasites, according to the genus of the helminth involved, was: Necator, 94; Ascaris, 17; Trichuris, 25; Strongyloides, 2; Enterobius, 1; and Hymenolepis, 1. Approximately 58 per cent of the white population were infected with *Necator americanus*. The incidence is essentially the same at present.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Pneumonia is a common cause of both illness and death among the natives.

Influenza. Epidemics of influenza have occurred periodically in the region for many years.

Tuberculosis. Tuberculosis probably was brought to the New Hebrides by white settlers. No native name exists for it, and the natives have almost no acquired resistance. The disease has an acute course and is fatal in almost 100 per cent of cases. Pulmonary tuberculosis is the form most frequently reported, but both the glandular and peritoneal types are common. Tuberculous meningitis is less frequent. Tuberculosis of bone is rare.

Smallpox. Smallpox was introduced by white settlers in 1888. It is now extremely rare, or perhaps absent.

Meningococcic Meningitis. "Cerebrospinal fever" is reported occasionally.

Measles. Measles is endemic and at times epidemic.

Whooping Cough. Whooping cough appears sporadically. The last epidemic occurred on Malekula Island in 1938.

Diseases Spread Chiefly through Contact

Venereal Diseases. The most important venereal disease is gonorrhea, which apparently is increasing, especially around Vila and Segond Channel. The frequency of such serious consequences as stricture, salpingitis and ophthalmia neonatorum is not known. Lymphogranuloma venereum is also common. Chancroid and granuloma inguinale are not reported. It is said that syphilis does not occur among the natives, except in a few persons returning from abroad. Recently syphilis has been observed among the Tonkinese; it is therefore likely to become more frequent.

Yaws. This disease, caused by *Treponema pertenue,* is extremely widespread. In a series of 14,886 natives examined in 1931 it was found that 77 per cent were infected. Of these, 89 per cent had tertiary yaws and 11 per cent had the primary or secondary forms. In two thirds of all cases the disease is acquired before puberty. It is an important cause of infant mortality. It is more common among males than among females, and colored persons are much more susceptible to it than are white ones. It is most prevalent in the lowest and wettest parts of the islands. Infection usually is acquired by means of direct contact with a lesion or its discharges, or through the agency of flies that feed on the lesions. Attempts at abolition of the disease have been made from time to time. The injection of arsphenamine was one form of attack, but measures such as this have not been employed extensively. Mass treatment of persons infected with yaws apparently has not been carried out.

Leprosy. Leprosy has been recognized in the New Hebrides for many years. In 1925 it was said that leprosy was common and spreading. On old charts Pentecost Island was known as "leper's island," but use of this name probably was due to confusion of yaws with leprosy. Up to 1935 government control of leprosy was not attempted. At that time two small leper colonies were started.

Tetanus. A few cases of tetanus are reported.

Diseases of the Skin. Tropical ulcers, particularly of the phagedenic type, are common. Factors predisposing to them are traumatic injuries, such as cuts and abrasions; debilitation arising from chronic diseases, such as filariasis and malaria; heat; and possibly diets low in protein and vitamins. The incidence of the ulcers tends to increase during the rainy season, when heat is greatest. Ulcers seldom develop from traumatic injuries which are promptly cleaned and disinfected. Scabies, produced by the mite *Sarcoptes scabiei,* is frequent.

Tinea imbricata, one form of ringworm, is prevalent. It is called *tokelau* by the natives, and is caused by *Endodermophyton concentricum. Endodermophyton indicum* also has been recovered from the scales caused by tinea imbricata. These fungi produce rosette-like lesions composed of concentric circles of thin scales which are fixed peripherally, and free toward the center.

Diseases Spread by Arthropods

Malaria. The New Hebrides Islands mark the limit of extension of autochthonous malaria in the Pacific Ocean to the south and east. The disease occurs on all the islands excepting those in the Torres and Banks group. The incidence is slight on Tana, Paama and Pentecost islands. On most of these islands the population is predominantly Polynesian. It has been said that malaria is responsible for three fourths of all illnesses on the islands, although the disease is seldom fatal. Studies carried out on Efate Island in 1939 showed that of 3,102 patients treated at the French hospital, 604 had malaria. Parasites were recovered in 307 cases. *Plasmodium falciparum* was present in 242, *P. vivax* in 61, and both in four cases. *Plasmodium malariae* was not recovered. At the same time results of studies disclosed that of 129 school children between five and 12 years old, 47 had palpable spleens, producing a splenic index of 36. The splenic index among 156 Tonkinese on Efate Island was 69.

The only known vectors of malaria in this area are *Anopheles punctulatus moluccensis* and *A. punctulatus punctulatus.* These two species are especially abundant on Espíritu Santo Island near the mouth of the Yoro River and at Turtle Bay. They almost never occur at Hog Harbor. Malaria is more prevalent in the northern islands because of the large swamps and much greater annual rainfall than that of the southern islands. From November to May the disease becomes almost universal in the northern group.

Blackwater Fever. Blackwater fever is reported to occur among the white population. Overexertion and chilling may precipitate the disease, which is said not to occur in the southernmost islands.

Measures of Control. No systematic measures have been taken to combat malaria, although those who have clinical forms of malaria and are seen by physicians, missionaries and planters are given quinine. On some of the plantations quinine is administered prophylactically. There is little or no screening, and clearing, draining, and filling of breeding places have not been undertaken.

Typhus Fever. Typhus fever does not occur in the New Hebrides, but scrub typhus (mite-borne) has been reported in New Guinea. Fleas, ticks and mites capable of carrying typhus fever may already be present, although they have not been reported.

Plague. Plague is not reported, but two occasional vectors, *Ctenocephalus felis,* the flea of cats, and *Pulex irritans,* the flea of human beings, are found in the Condominium. The black rat, *Rattus rattus,* can be a reservoir of the disease. The flea of rats, *Xenopsylla cheopis,* is not reported, but might easily reach the region from areas in India and the Netherlands East Indies in which plague is endemic. Thirteen cases of plague (11 bubonic and two pneumonic) were reported from near-by New Caledonia in 1941 and 1942.

Filariasis. Filariasis is endemic throughout the islands, and affects white persons as well as natives. It is more prevalent in the northern islands than in the southern ones. It is estimated that approximately 31 per cent of all groups of natives that have been studied are infected. The etiologic agent is *Wuchereria bancrofti,* the microfilariae of which may be found in the blood at night. It is transmitted principally by *Anopheles punctulatus punctulatus.* Elephantiasis is observed only rarely among white inhabitants.

Dengue Fever. Dengue fever occurs sporadically. It is carried by *Aedes aegypti,* and, less frequently, by *A. albopictus.*

Yellow Fever. Yellow fever has not been reported in the islands, although its vector, *Aedes aegypti,* is found in the New Hebrides.

Schistosomiasis. This disease is not reported from the New Hebrides. Mollusks proved to be intermediate hosts are not known to be present.

Miscellaneous

Beriberi. Beriberi is moderately prevalent among the natives.

Injuries Caused by Heat. Heat cramps, prickly heat, heat stroke and heat exhaustion seldom occur among the native population. They are most likely to result from injudicious exercise and exposure to the sun between noon and 3 P.M.

Alcoholism. Alcoholism is a serious problem among the natives, who obtain liquor illegally from white persons.

SUMMARY

Public health administration in the New Hebrides is a function of the Condominium Medical Service. This service is supervised by a Chief Medical Officer and is composed of members of the British Mission Medical Service, French National Medical Service, and one native practitioner or more. Its activities include port sanitation, disposal of garbage, and inspection of meat at Vila on Efate Island. Because of the low cultural standards of the natives, adequate health education is impossible. Medical care of the indigent is the responsibility of the French National Medical Service and the Presbyterian and Melanesian missions. The latter two are subsidized by the British government.

Water is plentiful on all but the coral atolls. On these atolls rain water is used; in times of drought swamp water is used. In Vila the water is chlorinated and filtered. Purification units also are found elsewhere on Efate Island. Water in most instances must be considered to be contaminated. There are no public sewerage systems; the soil near native and Tonkinese dwellings is polluted. Insects constitute a major problem. Mosquitoes capable of carrying malaria, filariasis, dengue fever and yellow fever breed in profusion. Many types of flies breed throughout the year. Fleas are numerous; but lice are not reported. Ticks and mites probably are present. Red ants and lizards are pests. There are no poisonous snakes on the islands; but dangerous fish are found near the beaches.

Tropical fruits and vegetables grow readily, but not in surplus quantities. Meat is scarce and poor in quality. Although fish are abundant there is no organized fishing industry. Almost no dairy products are available. Fresh native produce must be considered to be contaminated. Spoilage of food is a major problem because of the lack of refrigeration.

Diseases of major importance are malaria, amebic dysentery, bacillary dysentery, dengue fever, venereal diseases, yaws and tuberculosis. Filariasis and ancylostomiasis are endemic and infect a high proportion of the natives. Typhus fever, yellow fever, plague and possibly schistosomiasis, though not present, might be introduced. Other diseases of the area include influenza, pneumonia, tropical ulcers, scabies, tinea imbricata, helminthiasis, leprosy, beriberi, myiasis, tetanus and injuries caused by heat.

BIBLIOGRAPHY

Allard, H. A.: The North American Ragweeds and Their Occurrence in Other Parts of the World. Science, **98**:292-294 (Oct. 1) 1943.

Baker, J. R.: Man and Animals in the New Hebrides. London, G. Routledge and Sons, Ltd., 1929.

——: The Northern New Hebrides. Geographical Journal, **73**:305-325 (Apr.) 1929.

Bartsch, P.: Molluscan Intermediate Hosts of the Asiatic Blood Fluke, *Schistosoma japonicum*, and Species Confused with Them. Washington, Smithsonian Institution, 1936. (Smithsonian Miscellaneous Collections, Vol. 95, No. 5.)

Bellamy, R. R.: The Real South Seas. London, J. Long, Ltd., 1933.

Buxton, P. A.: The Depopulation of the New Hebrides and Other Parts of Melanesia. Tr. Roy. Soc. Trop. Med. and Hyg., **19**:420-458, 1925-26.

Buxton, P. A.: Researches in Polynesia and Melanesia, Parts V-VII (Relating to Human Diseases and Welfare). London, The London School of Hygiene and Tropical Medicine, 1928. (Memoir Series, No. 2.)

Campbell, F. A.: A Year in the New Hebrides, Loyalty Islands and New Caledonia. Geelong, G. Mercer, 1873.

Cheesman, L. E.: Hunting Insects in the South Seas. London, P. Allen and Co., Ltd., 1932.

Clench, W. J., and Kondo, Y.: The Poison Cone Shell. Am. J. Trop. Med., **23**:105-120 (Jan.) 1943.

Cochran, D. M.: Poisonous Reptiles of the World; A Wartime Handbook. Washington,

Smithsonian Institution, 1943. (Smithsonian Institution, War Background Studies, No. 10.)
Coffee, F.: Forty Years on the Pacific. 2d ed. San Francisco, Oceanic Publishing Co., 1925.
Comstock, J. H.: The Spider Book. New York, Doubleday, Page and Co., 1913.
Craig, C. F., and Faust, E. C.: Clinical Parasitology. 3d ed. Philadelphia, Lea & Febiger, 1943.
Darling, S. T.: Geographical and Ethnological Distribution of Hookworm. Parasitology, **12**: 217-233 (Sept.) 1920.
Ditmars, R. L.: Reptiles of the World. New York, The Macmillan Co., 1931.
Ellerman, J. R.: The Families and Genera of Living Rodents. London, The British Museum, 1941.
Emory, K.: South Sea Lore. Honolulu, Hawaii, The Museum, 1943. (Bernice P. Bishop Museum, Special Publ. 36.)
Fowler, H. W.: Fishes of Oceania. Honolulu, Hawaii, The Museum, 1929. (Bernice P. Bishop Museum, Memoirs No. 10.)
Gr. Brit. Colonial Office: Annual Report on the Social and Economic Progress of the People of New Hebrides. London, H. M. Stationery Off., 1940. (Colonial Reports, Annual No. 1928.)
Grimshaw, B. E.: Fiji and Its Possibilities. New York, Doubleday, Page and Co., 1907.
Hamlin, H.: The Geography of Treponematosis. Yale J. Biol. and Med., **12**:29-50 (Oct.) 1939.
Harrison, T.: Living with the People of Malekula. Geographical Journal, **88**:97-127 (Aug.) 1936.
Herivaux, A., Roncin, P., and Dao, Van Thai: Contribution à l'étude du paludisme des Nouvelles Hébrides. Ann. méd. pharm. col. Par., **1**:40-62 (Jan.-March) 1939.
Herms, W. B.: Medical Entomology. 3d ed. New York, The Macmillan Co., 1939.
Keesing, F. M.: The South Seas in the Modern World. New York, The John Day Co., 1941.
Krieger, H. W.: Island Peoples of the Western Pacific: Micronesia and Melanesia. Washington, Smithsonian Institution, 1943. (Smithsonian Institution, War Background Studies No. 16.)
Kumm, H. W.: The Geographical Distribution of the Yellow Fever Vectors. Baltimore, The American Journal of Hygiene, 1939. (Am. J. Hyg. Monographic Ser., No. 12.)
Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, Hawaii, The Museum, 1934. (Bernice P. Bishop Museum, Special Publ. No. 23.)
——: Health Survey of the New Hebrides. Suva, Fiji, 1924.
——: Medical Conditions in the South Pacific. Med. J. Australia, **2**:362-380 (Sept. 22) 1928.
Lambert, S. M.: A Yankee Doctor in Paradise. Boston, Little, Brown and Co., 1941.
——: Yaws in the South Pacific. Am. J. Trop. Med., **9**:429-437 (Nov.) 1929.
——: Yaws Incidence in the South Pacific. J. Trop. Med. and Hyg., **34**:7-122 (May) 1931.
League of Nations, Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene, Preparatory Papers: VII, Report for the New Hebrides Condominium. Geneva, 1937, pp. 103-114.
——: Public Health Services in the French Colonies, by S. Abbatucci. Liége, G. Thone, 1926.
Lever, R. J. A. W.: The Bed Bug in Melanesia. Agr. J. Fiji, **13** (1), p. 26, Suva, 1942. Abst. in Rev. Appl. Entom., **31** (Series B): 18 (Feb.) 1943.
Mayer, A. G.: The Islands of the Mid-Pacific. Scient. Monthly, **2**:125-148 (Feb.) 1916.
McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.
Mumford, E. P.: Mosquitoes, Malaria and the War in the Pacific. J. Trop. Med. & Hyg., **45**:74-75 (May 15) 1942.
Pacific Islands Year Book. Sydney, Australia, Pacific Publications, 1939.
Placidi, T.: La médicine et l'hygiene aux Nouvelles Hébrides. Rev. de méd. et d'hyg. trop., **24**:113-132, 1932.
Rivers, W. H. R.: Essays on the Depopulation of Melanesia. Cambridge, Cambridge University Press, 1922.
Russell, P. F., Rozeboom, L. E., and Stone, A.: Keys to the Anopheline Mosquitoes of the World. Philadelphia, The American Entomological Society-Philadelphia Academy of Natural Sciences, 1943.
Sapero, J. J.: Observations upon the Transmission of Amebiasis. Proc. Pacific Sc. Congr., 1939, 6th Congr., **5**:1-5, 1942.
Seale, A.: Fishes of the South Pacific. Honolulu, Hawaii, The Museum, 1906. (Bernice P. Bishop Museum, Occasional Papers, vol. 4, no. 1.)
Shurcliff, S. N.: Jungle Islands: The Illyria in the South Seas. New York, G. P. Putnam's Sons, 1930.
Simmons, J. S.: Dengue Fever. Med. Clin. North America, **27**:808-821 (May) 1943.
Smith, W. R.: In Southern Seas. London, J. Murray, 1924.
Sollini, A.: Pian e sifilide unicismo o dualismo. Arch. ital. di sc. med. colon., **16**:616-625 (Aug.) 1935.
Speiser, F.: Two Years with the Natives in the Western Pacific. London, Mills & Boon, Ltd., 1913.

The Statesman's Year Book. London, Macmillan Co., Ltd., 1943.

Stephens, J. W.: Blackwater Fever: A Historical Survey and Summary of Observations Made Over a Century. Liverpool, University Press of Liverpool, London, Hodder & Stoughton, Ltd., 1937.

Stewart's Handbook of the Pacific Islands. Sydney, N. S. W., McCarron, Stewart & Co., Ltd., 1921.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed., by R. P. Strong. Philadelphia, The Blakiston Co., 1942, 2 vols.

Stuart, M. A., and Slagle, T. D.: Jellyfish Stings, Suggested Treatment and Report on Two Cases. U. S. Nav. Med. Bull., **41**:497-501 (March) 1943.

Tate, G. H. H.: Rodents of the Genera Rattus and Mus from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. Bull. Am. Mus. Nat. Hist., **68**:145-178 (Feb. 11) 1935.

U. S. Hydrographic Office: Sailing Directions for the Pacific Islands. 5th ed., 1940. Washington, U. S. Govt. Print. Off. (Publication No. 166.)

U. S. War Dept.: Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. Washington, U. S. Govt. Print. Off., 1943. (Technical Manual TM 10-420.)

Vogel, E., and Riou: Les maladies épidémiques, endémiques et sociales dans les colonies françaises pendant l'année 1937, Ann. méd. pharm. col. Par., **37**:257-551, 1939.

25

New Zealand

GEOGRAPHY AND CLIMATE

New Zealand, a British crown colony from 1840 to 1907, and since the latter year a Dominion within the British Empire, is situated within the area described by 166 and 179° of east longitude, and 34 and 48° of south latitude. It is about 1,200 miles southeast of Australia and 6,000 miles west of South America. It is bounded on the west by the Tasman Sea, and on the east, north and south by the Pacific Ocean. The geographic divisions are (1) North Island, with an area of some 44,000 square miles; (2) South Island, with an area of 58,000 square miles; (3) Stewart Island, of about 670 square miles; (4) the Chatham Islands, of 370 square miles; and (5) various outlying islands, not regularly inhabited, of about 300 square miles. The total area of the Dominion is approximately 103,340 square miles, or about that of the state of Colorado (103,948 square miles). The Cook Islands, Kermadec Islands, Ross Dependency, Union or Tokelau Islands, Western Samoa and certain other islands are administered by New Zealand. Nauru Island is administered jointly by Great Britain, Australia and New Zealand.

In New Zealand proper in 1941 there were approximately 1,630,000 people. This population included about 91,000 Maoris, who are the aborigines of New Zealand; the rest are immigrants or descendants of earlier immigrants from Great Britain, Australia and various other lands. The chief centers of population, with estimates of population made in 1941, were: Auckland, 223,700; Wellington, 160,500; Christchurch, 135,500; and Dunedin, 82,000.

The two principal land masses, North Island and South Island, are divided by Cook Strait, which is from 16 to 90 miles wide. North Island, about 500 miles long and 200 miles wide at the greatest breadth, is notable for an unbroken chain of mountains which runs northeast from Cook Strait to East Cape on the Bay of Plenty. These mountains range from 3,000 to 9,000 feet, and include four volcanoes, three of which are active. The western part of the island, the eastern coast near Hawke Bay, and the south-central portion are fertile plains. The extreme southern part is rough and hilly. South Island is about 500 miles long and 180 miles wide at the greatest breadth. A continuous chain of mountains runs the entire length of the island. One peak, Mount Cook, is more than 12,000 feet high. Seventeen other peaks are more than 10,000 feet high. The agricultural region of South Island is a strip about 30 miles wide, extending from the southeastern part of the province of Marlborough on the eastern coast to the province of Southland at the southern end of the island.

The hydrographic features of New Zealand are notable. Lake Taupo in North Island has an area of 230 square miles. Thermal springs, geysers and waterfalls abound. Manawatu River, 100 miles long, the Waikato River, 200 miles long, and Wanganui River, 140 miles long, are important streams on North Island. The most important river in South Island is the Wairau River. On the same island the Buller River, 105 miles long, empties into the Tasman Sea; and the Clutha, 210 miles long, discharges into the Pacific Ocean. Lake Wakatipu, 54 miles long, is situated in the central part of Otago on South Island.

New Zealand lies wholly within the temperate zone. The prevailing winds in all seasons are westerly. The climate is cool and without much variation excepting in the interior of South Island. The average mean temperature in Auckland is between 51° F. (10.5° C.) in July and 66 (18.8° C.) in January. In the extreme southern portion, such as at Invercargill on South Island, the mean temperature is between 41° F. (5° C.) in July and 57° F. (13.8° C.) in January. Rainfall is abundant, but varied in distribution. It is heaviest in the southern portions and along the western coast, where an annual fall of 200 inches (5.1 meters) is common. Heavy local showers and cloudbursts occur in the interior of both islands, especially in summer. Rainfall is least along the southeastern coast of South Island, where the annual figure ranges between 10 and 26 inches (0.25 and 0.66 meter). Fogs occur chiefly in the harbors of Auckland province; they are widespread only during periods of cyclonic depression. Winds are strongest in Cook Strait, between North and South Islands. Earthquakes are fairly common.

PUBLIC HEALTH

Health Services

Organization. The Director General of Health, distinct from the Minister of Health, is the chief administrative officer of the Department of Health of New Zealand. The Department of Health is the administrative body, and is appointed by the Minister of Health, who serves as its chairman. A Board of Health, associated with the department, is comprised of representatives from the Department of Health, the medical profession, the Faculty of Medicine of Otago University, the municipal association, the county association, hospital boards, civil engineers and groups interested in maternal and infant welfare. Generally speaking, the board functions in an advisory capacity, but under certain circumstances may exercise mandatory powers. The department comprises divisions concerned with public hygiene, hospitals, nursing, school hygiene, maternal and infant welfare, Maori hygiene, dental hygiene, tuberculosis and clinical services.

For the purposes of local health administration, the country is divided into 13 health districts; each district is under the charge of a medical officer of health, who is a medical practitioner with special qualifications in the field of public health. These officers are entrusted with wide administrative powers; they act as advisers to the local governing bodies in matters pertaining to the public health. In this capacity they are charged with the responsibility for securing compliance with the public health laws and regulations.

The Department of Health controls the registration of medical practitioners, dentists, nurses, midwives, opticians, masseurs and plumbers. It supervises the sale of foods and drugs, and protects the public against fraud in connection with alleged remedies. It administers the provisions of the Health Act of 1920, and all other public acts concerned with the promotion of public health; advises local authorities in matters relating to public health; acts to prevent, limit and suppress infectious and other diseases; promotes and carries out researches and investigations in the prevention or treatment of diseases; and takes such other measures as are necessary to promote the public health. The Director General of Health is chairman of the Medical Research Council, which council is responsible for the investigation of special medical problems in New Zealand. Recently the department has been entrusted with the administration of the Social Security Act of 1939 (revised in 1941) dealing with medical, hospital and other related benefits. This act is a broad socialized medical scheme which brings certain general medical services within the scope of benefits covered by the act and provides that a fixed fee be paid by the government for all general and certain special medical services. It does not prohibit the private practice of medicine. Medical and dental inspections and treatment of school children are carried out by special divisions of the department.

Relative Effectiveness. New Zealand has always had one of the lowest death rates in the world; namely, 9 per 1,000 or less. In this instance the death rate is not a good index of the effectiveness of the public health system, for although the death rate is one of the lowest in the world, it has had a definite upward trend during recent years. During the period of colonization and immigration, the majority of people were members of the younger age group and the death rate was therefore low. Now that the average age of the population has advanced several decades, further increases in death rates are to be expected. Although communicable diseases cause only a small proportion of the deaths, they are responsible for considerable morbidity. This is especially true among the Maoris, who have only recently become aware of the advantages of modern sanitary facilities. At present, however, such facilities are found only in the larger towns and cities.

Water Supplies

Except for a few small areas in the eastern part of South Island, water is found in abundant quantities throughout New Zealand. It is taken from deep wells, streams, and in some instances from collections of surface water. Although the potential water supply to New Zealand cities is more than adequate, shortages of water soon develop during periods of dryness. In most instances uncontaminated watersheds are depended upon to insure a supply of safe water. Except in the Wellington, Auckland, New Plymouth and Gisborne areas in North Island, water is not subjected to any form of treatment. In these cities, however, there are facilities for filtration and chlorination. Local authorities, with the cooperation and assistance of the Department of Health, make chemical and bacteriologic analyses of the various water supplies. Although most water is considered to be potable without treatment, available data are not sufficient to prove this. In both North Island and South Island most of the water is soft and has a low temporary hardness and no permanent hardness. Some of the large artesian sources, however, deliver water that is moderately hard although the hardness is not permanent. In some localities the content of fluorine is relatively high and fluorosis is not uncommon. In other respects the mineral content of New Zealand waters is not remarkable.

In those areas in which there is insufficient water (parts of the provinces of Otago, Canterbury and Marlborough), large irrigation projects have been, or are being, developed. In Otago 236,000 acres of land require irrigation; 315,000 acres of land in Canterbury also require irrigation. More than 800 miles of pipe has been laid to supply water for domestic purposes as well as for irrigation in the counties of Levels, Waimate, Mackenzie and Geraldine.

Sewage Disposal

There is no town with a population of 2,000 or more which does not have a system in which sewage is water-borne. This practice is facilitated by the proximity of the cities to the sea or large rivers. In none of these cities, however, is sewage subjected to any form of treatment prior to disposal. In the rural areas and the smaller towns pit privies and the pan system of collection of night soil are the usual methods of disposal of human wastes. Among the Maoris, however, the situation is less favorable. Surveys have indicated that about a third of the more progressive Maoris of the eastern coast are without privies, whereas about two thirds of the more backward natives of the south Auckland area are without privies. In 1939 the government started special sanitation campaigns designed to rectify this situation; until the outbreak of the war in the Pacific considerable progress had been made. In the areas in which privies are not used by the Maoris, pollution of the soil is common. Human excrement, however, is not used as a fertilizer for crops.

Insects and Animals

Vectors of Disease. Mosquitoes. There are no anopheline mosquitoes in New Zealand. Four species of Aedes have been identified, but none of them is a vector of disease. Dengue fever has been reported in North Island, and although there are no reports of the presence of *Aedes aegypti* or *A. albopictus,* it is believed that at least one or possibly both of them may be present. *Culex fatigans* is found in and about Auckland and Whangarei. It is one of the most troublesome of domestic mosquitoes and is capable of transmitting filariasis.

Lice. The head louse, *Pediculus capitis,* and the body louse, *P. corporis,* are fairly common throughout New Zealand, especially among the lower classes. These lice, and particularly the body louse, are capable of serving as the vectors of *Rickettsia prowazeki* and *R. quintana,* the etiologic agents of typhus fever and trench fever, respectively. They also are capable of transmitting the spirochetes (genus Borrelia) of relapsing fever. The pubic louse, *Phthirus pubis,* is encountered much less frequently than are the other types of lice.

Flies. Many varieties of flies have been identified in New Zealand. Among the family Muscidae are the common housefly, *Musca domestica;* the lesser housefly, *Fannia canicularis;* the stable fly, *Stomoxys calcitrans,* and the false stable fly, *Muscina stabulans.* Whereas there is considerable variation in the breeding habits of these flies, it is considered that in the presence of suitable conditions they can all serve as mechanical vectors of various intestinal diseases. The lesser housefly and the false stable fly are capable of causing intestinal myiasis in man. Blow flies, belonging to the family Calliphoridae, are well represented in New Zealand in the form of three species of the genus Chrysomyia and nine species of the genus Calliphora. Virtually all these flies are of economic importance because of their relationship to the development of maggots in sheep. From the medical entomologic standpoint, the flies *Chrysomyia megacephala* and *Lucilia sericata* are important to man in that they are capable of causing myiasis, myiasis of wounds in the case of the former and intestinal myiasis in the case of the latter. Many of these flies also are important in that they breed in carrion and feed on human excrement and thus may transmit the organisms of disease by mechanical means.

There are approximately six native species of Simuliidae (sand flies) in New Zealand, some of which are known to attack man. It is not known whether any of these species are capable of serving as vectors of disease.

Ticks. It has been suggested that the castor-bean tick, *Ixodes ricinus,* which is capable of causing tick paralysis, was introduced into New Zealand. *Haemaphysalis humerosa,* the tick which is a vector of Q fever in Australia, does not occur in New Zealand.

Fleas. The flea of human beings, *Pulex irritans,* is reported to be extremely common in New Zealand. The Oriental rat flea, *Xenopsylla cheopis;* the dog flea, *Ctenocephalus canis;* the cat flea, *C. felis;* and the European and North American rat flea, *Nosopsyllus fasciatus,* are widely distributed throughout the country.

Cockroaches. Four species of cockroaches have been identified: they are the Australian cockroach, *Periplaneta australasiae;* the American cockroach, *P. americana;* the Oriental cockroach, *Blatta orientalis;* and the German cockroach, *Blatella germanica.* Under suitable conditions these cockroaches can act as mechanical carriers of enteric diseases and occasionally contaminate food.

RODENTS. Rats constitute one of the great public health problems in New Zealand; the measures that have been employed have not as yet succeeded in controlling them. It is estimated that in Wellington alone the rat population is double that of the human population. The more common species are the black rat, *Rattus rattus;* and the brown rat, *Rattus norvegicus.*

Snakes and Other Dangerous Animals. There are no poisonous snakes in New Zealand. A poisonous spider, *Latrodectus hasselti,* known as the "red-backed spider," is closely related to the black widow spider. Its bite produces general symptoms of toxemia, which at times may be severe. It is found principally on sand dunes near sea beaches. Reports of injuries caused by its bite are very infrequent.

Pests. The house ant, *Pheidole megacephala,* is capable of inflicting a severe bite and sting. The common tree weta, *Hemideina crassidens,* a large cricket-like insect with formidable mandibles, is common all over New Zealand; it bites severely. The common honeybee, *Apis mellifera,* and the bumblebees, *Bombus hortorum* and *B. terrestris,* are capable of inflicting painful wounds. The cattle tick, *Haemaphysalis dispinosa,* is fairly common in the northern part of the province of Auckland on North Island. This tick will feed on the blood of man; although it is not a serious pest in this respect, it may be troublesome. It has not been proved to be a vector of disease for man or animals. Mosquitoes, which are merely pests, such as *Aedes notoscriptus, A. antipodeus,* and *A. vexans,* have been recorded. *Culex pervigilans* is especially abundant in New Zealand. It can be found in practically any collection of water, and is capable of hibernating as an adult or in larval form, under the ice. Its bite is not particularly severe. *Culex annulirostris* was introduced into New Zealand, but probably has been eradicated. It bred in a wide variety of pools, usually in those with filamentous algae, and was important because it would bite extremely viciously by day or night. Other common mosquitoes include *Opifex fuscus, Tripteroides argyropus, Mansonia iracunda* and *M. tenuipalpis.* All these mosquitoes are reported to be persistent and annoying biters.

DANGEROUS MARINE LIFE

The gray nurse or sand shark, *Carcharias taurus* or *Odontaspis littoralis,* and the sting ray, of the family Trygonidae, are the chief dangerous fish in the waters about New Zealand.

POISONOUS OR IRRITATING PLANTS

The poisonous flora of New Zealand is not large.The following plants, seeds, fruits or berries, however, are present and are poisonous when eaten: castor beans, *Ricinus communis;* raw fruit of the karaka tree, *Corynocarpus laevigata;* foliage of the black nightshade, *Solanum nigrum,* and the deadly nightshade, *Atropa belladonna;* and two species of mushroom-like fungi, *Amanita muscaria* and *A. caesaria.* Several species of stinging nettles and poison ivy, *Rhus toxicodendron,* are present and are poisonous if touched. Wait-a-bit or the bush lawyer, *Rubus australis,* is a leafless, prickly bramble which forms almost impenetrable thickets and is an annoying pest in this respect.

FOOD AND DAIRY PRODUCTS

New Zealand is primarily an agricultural country. It is one of the world's great exporters of foodstuffs, the principal items being butter, cheese and frozen meats. Considerable quantities of the following foods also are exported: poultry; eggs; fresh, dried and preserved fruit; honey; dairy products; small amounts of wheat, oats and barley; and vegetables such as potatoes, peas, onions, beans.

Animals are slaughtered at the licensed export freezing works or at local abattoirs under the supervision and inspection of the Department of Agriculture. Because of the limited number of personnel qualified in the inspection of meat, it is not considered practicable to require the presence of a veterinary officer in each meat plant. Inspection frequently is made by lay inspectors who are under the supervision of the veterinary officer in charge of the given area. After slaughter and inspection of the animals, the grading of meat is carried out under the supervision of the New Zealand Meat Producers' Board. Under the Meat-Grading Standards Regulation of July, 1943, a system for the grading of meat was introduced into the Wellington area. The system will be extended to other metropolitan areas and the remaining districts as trained graders become available. This system does not apply to poultry, fish and specially prepared meats, such as ham and bacon. New Zealand specifications in respect to meat differ in some cases from United States specifications, both as to cuts or as to the conditions under which the meat is processed.

The control of the dairy products industry also is under the jurisdiction of the Department of Agriculture. This department regulates the inspection of dairy stock and the manufacture of dairy products. The general aim of legislation for control of the dairy industry is to make certain that pure milk and cream are produced in reasonably good surroundings, to provide for efficient packaging and honest branding and grading, and generally to safeguard the buyer and consumer. Before a dairy may be registered, the owners must comply with the regulations of the Dairy Industry Act, which requires the maintenance of certain standards in respect to cleanliness, equipment and methods of operation. All registered dairies are under the supervision of district inspectors who serve as local officers of the Department of Agriculture. The processing of dairy products is strictly supervised, and the maintenance of minimal standards of quality and purity is enforced. All cream which is manufactured into butter and most milk which is manufactured into cheese are pasteurized. Butter and cheese are graded by trained graders of dairy produce, and all samples taken by these graders are subjected to chemical and bacteriologic analysis. The sale and distribution of raw milk are largely under the control of local authorities. In many of the smaller centers pasteurized milk is not available. It is estimated that there are approximately 45 pasteurization plants in New Zealand. In most instances the milk, whether it is bottled or poured into cans, raw or pasteurized, is distributed without refrigeration.

Dairy herds are inspected with a view to limitation of the number of diseased animals, but testing of herds with tuberculin is not required. The fact that raw milk from untested herds is sold, even in metropolitan areas, constitutes a potential menace to the public health. Although the dairy herds in some districts are believed to be entirely free from tuberculosis, evidence from abattoirs indicates that in other areas as many as 10 per cent of the animals that are inspected are diseased. Contagious abortion in cattle is reported to be widespread; the average percentage of infection of dairy herds during the past few years has been about 30. The low incidence of undulant fever in man would suggest, however, that massive infection of milk is not common. The high incidence of contagious abortion among cattle constitutes, however, a potential danger to the public health. Reports of epidemics of other milk-borne diseases, and especially scarlet fever, typhoid fever and diphtheria, are common.

The sale and inspection of beverages are covered by the Food and Drugs Act. This act is designed to protect the consumer against adulterated or impure beverages, and provides for the inspection of premises where such beverages are bottled. The water used in the preparation of these beverages is taken from the same supply as ordinary drinking water. The sale of food, the inspection of food handlers, and the control of shops, markets, restaurants and other eating establishments are under the control of the Department of Health, which is responsible for administration of the Food and Drugs Act. In practice, however, authority is relegated to the local governments, which in many instances are lax in the administration and enforcement of the provisions of the act. It is reported that in some localities there is no effective inspection. There is a growing demand for the more strict control of food handlers, food dispensers and eating establishments.

MEDICAL FACILITIES

Hospitals

Number of Beds. In accordance with the provisions of the Social Security Act, New Zealand is divided into 45 hospital districts. In each district a board is elected which provides certain types of institutional and extra-institutional medical and nursing service. Under the jurisdiction of each board there is at least one public hospital. These hospitals vary in size and the nature of the facilities afforded according to the density and composition of the population served. There are approximately 160 public hospitals, with a combined capacity of approximately 12,200 beds. Included in this number are the general hospitals, hospitals for the treatment of infectious diseases, tuberculosis institutes, homes for convalescents, charitable institutions, and homes for the aged. In addition to these public hospitals, there are 332 private hospitals with a combined capacity of approximately 3,000 beds. On the basis of these figures, it is estimated that there are 97 beds per 10,000 of population, which figure is identical to the number of beds available in the United States.

Equipment. All the hospitals supported by the Dominion, as well as those subsidized jointly by the Dominion and the local district, are well equipped. The majority of the public hospitals have pathological, bacteriologic and chemical laboratories. In addition to these laboratories, special laboratories are operated by the Department of Scientific and Industrial Research and the Department of Agriculture. The New Zealand Medical Research Council operates a laboratory in connection with the Medical School of Otago University.

Supplies. The production of medical, dental and surgical goods in New Zealand is limited to a few items, notably, hospital beds, sterilizers and autoclaves; virtually all other supplies and equipment are imported. Before the onset of the war Great Britain was the principal supplier of dental and surgical instruments. Surgical sutures and ligatures were obtained almost exclusively from Scotland. About 90 per cent of the rubber goods used were imported from the United Kingdom. Great Britain and the United States each furnished approximately 50 per cent of the operating-room, blood-pressure, electromedical, electrotherapeutic and orthopedic equipment. The United States furnished roughly 90 per cent of the anesthesia and oxygen-therapy equipment and artificial dentures. Materials used in the filling of teeth were obtained primarily from Switzerland and the United States.

Medical Personnel

Physicians. All physicians are required by law to be registered before they are allowed to practice. The Medical Council of New Zealand, constituted under the Medical Practitioners' Act of 1914 as amended, receives and acts upon applications for registration and licensure. The qualifications for licensure compare favorably with those of other countries. In 1943 there were 1,804 qualified medical practitioners in the New Zealand medical register. Most of them were graduates of the Medical School of Otago University. On the basis of this figure it is estimated that there is one physician for each 900 of population. It should be noted, however, that approximately 12 per cent of physicians registered in New Zealand actually do not live there, but practice medicine abroad.

Nurses. In 1943 there were 3,818 registered nurses in New Zealand. It is believed that this number represents those in active practice and that it does not include nurses serving with the armed forces. In addition to these nurses, there were, in the same year, 920 registered maternity nurses and 1,000 midwives.

Dentists. The number of registered dentists in 1943 was 822. It is not known whether this number includes dental surgeons and those dentists who have the degree of doctor of medicine. A dentist is not permitted to use the title "doctor" in New Zealand; but dental surgeons and dentists who have a medical degree may use the title. In general, the regulations concerning the registration of dentists are the same as those pertaining to the registration of physicians.

Medical Institutions

The following boards, councils and committees are administered through the Department of Health: the Board of Health, Medical Council, Medical Advertisement Board, Opticians' Board, Masseurs' Registration Board, Nurses' and Midwives' Registration Board, Medical Research Council, Dental Council, Plumbers' Board and the National Medical Committee. The majority of the work of the New Zealand Medical Research Council is carried out in its laboratory at the Medical School of Otago University. The Medical Research Council is primarily a research organization which functions through the activities of specially appointed committees. In 1942 the following committees were functioning under the auspices of this council: committee on nutrition, committee for the study of the physiology and pathology of the thyroid gland, committee on hydatid disease, committee on tuberculosis and the committee on obstetric research. The Department of Scientific and Industrial Research maintains the Dominion Laboratory, which is a service laboratory for governmental departments. The Department of Agriculture maintains laboratories designed to meet the requirements of the several branches of this department. A medical school and a dental school are maintained at the University of Otago. Most nurses receive their training in the large government hospitals.

Social Services. The Saint John's Ambulance Brigade Within the Dominion of New Zealand is a branch of the Grand Priory in the British Realm of the Venerable Order of the Hospital of Saint John of Jerusalem. It has many divisions throughout New Zealand. The particular functions and commitments of the Venerable Order of the Hospital of Saint John of Jerusalem are instruction of the public in first aid, home nursing and ambulance work.

The Wellington Free Ambulance is a government service, financed with government funds, which provides free ambulance service within the Wellington Hospital District. It is the only governmental free ambulance service in New Zealand. The only other free ambulance service is that maintained by the Venerable Order of the Hospital of Saint John of Jerusalem.

The New Zealand Red Cross Society, Inc., organized by the International Red Cross Committee, has 32 centers and 700 subcenters throughout the Dominion. The active membership is said to include 100,000 persons. This society functions as an auxiliary to the state health services. Its objects are the promotion of health, the prevention of disease, and the mitigation of suffering. Under the auspices of this society training is given by qualified members of the medical and nursing profession in first aid, home nursing, hygiene, sanitation, air-raid precautions and emergency transportation of the injured. Graduates of these classes form the voluntary aid detachments and, after being certified, may be recruited for service overseas or at home.

The Royal New Zealand Society for Health of Women and Children, also known as the "Plunket Society," is concerned primarily with the dissemination of information concerning health and welfare, particularly as this information pertains to women and children.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysentery. Both bacillary and amebic dysentery are encountered. The morbidity rate for bacillary dysentery in the white population has been about 6 per 100,000. So-called summer complaint is reported to be common throughout New Zealand. Investigation of outbreaks of this condition has proved that it is actually caused by the organisms of bacillary dysentery. The organisms most often recovered are the Sonne and Flexner types of *Shigella paradysenteriae.*

Amebiasis once occurred among as much as 11 per cent of the population; but in recent reports the incidence is not high. Amebiasis attacks the white and Maori population with approximately equal frequency.

Typhoid Fever and Paratyphoid Fevers. These diseases occur sporadically throughout New Zealand. Outbreaks in areas in which population is congested have been traced to contamination of milk and water supplies. Water-borne epidemics have occurred most often in the low-lying areas along the eastern coast, especially in the vicinity of Hawke Bay, where overcrowding and pollution of the soil and water are common. In 1941 the mortality rate for typhoid fever and paratyphoid fevers in the white population was 0.5 per 100,000. This rate is about the average rate for the past eight years. In the white population the morbidity rate for these two diseases has varied between 3 and 5 per 100,000. Morbidity and mortality rates for typhoid fever and paratyphoid fevers—as well as bacillary dysentery—are higher among the Maoris than among the white people.

Cholera. This disease has not been reported from New Zealand.

Helminthiasis. Hydatid disease, caused by the cestode, *Echinococcus granulosus,* is a very real problem in New Zealand. Cattle, sheep and hogs are the usual intermediate hosts of this parasite; it is reported that approximately 44 per cent of the large sheep population is infected. The percentage of cattle similarly infected is thought to be almost as great. This tapeworm may be transmitted to man through the ingestion of food or water contaminated by fecal material from dogs that have become infected as the result of eating offal. Because of the large dog population, at least 200,000 in New Zealand, this disease constitutes a grave menace to the public health. The Department of Health has conducted intensive campaigns against this disease, consisting of compulsory anthelmintic measures for dogs and the proper disposal of diseased animals. It is illegal for the owner of a dog to feed or permit his dog to be fed on offal. Intensive publicity and propaganda have been devoted to the subject, and much work has been done in education of the owners of stock with regard to the best methods of reducing the incidence of this disease among animals and man. On the basis of hospital statistics it would appear that the incidence of hydatid disease is about 7.5 cases per 100,000 population. Infections with other types of intestinal parasites are encountered, but their prevalence is about the same as in other temperate climates. Infections with the following intestinal parasites have been reported but do not constitute serious public health problems: the pork tapeworm (*Taenia solium*); the beef tapeworm (*Taenia saginata*); the roundworm (*Ascaris lumbricoides*); the pinworm (*Enterobius vermicularis*); the whipworm (*Trichuris trichiura*); and the hookworms (*Ancylostoma duodenale* and *Necator americanus*).

Diseases Spread Chiefly through Respiratory Tract

Diphtheria, influenza, scarlet fever, whooping cough, measles, rubella, chickenpox, mumps, encephalitis lethargica, poliomyelitis and rheumatic fever are reported each year. The incidence of these diseases in New Zealand is usually lower than that in the United States. Between 1940 and 1943, however, there was a notable increase in the morbidity and mortality rates from pneumonia of all types, influenza, whooping cough, measles, diphtheria and poliomyelitis. The morbidity rates from respiratory diseases in general are much higher among the Maoris than among the white people. In some cases morbidity rates among Maoris may be seven times greater than among the white population.

Tuberculosis. During the period 1937 to 1942, the mortality rate from tuberculosis remained at about 35 per 100,000 of population. In spite of the fact that this is one of the lowest rates in the world for tuberculosis, the disease is one of the most common causes of death in New Zealand. Tuberculosis is far more prevalent among the Maoris than among the white people.

Meningococcic Meningitis. In 1942, New Zealand experienced the worst epidemic of meningococcic meningitis in its history. The morbidity rate was 56.8 per 100,000 of population and the case fatality rate was 12.6 per cent. The fatality rate among the Maoris was 13 times greater than the rate among white patients.

Smallpox. This disease has not been reported since 1920.

Diseases Spread Chiefly through Contact

Venereal Diseases. Syphilis, gonorrhea and chancroid are the most common venereal diseases. During recent years the increased incidence of venereal diseases, particularly syphilis, has constituted a grave problem of public health. Syphilis, which until recently was comparatively rare in New Zealand, first began to increase in Wellington at about the time of the Centennial Exhibition (1940). Since that time the increase has been maintained and, in addition, the same tendency toward increase has been manifest in Auckland and Christchurch. This increase in the prevalence of syphilis has not, however, materially affected the incidence of the disease in the smaller towns or country districts. As judged on the basis of the number of persons seen for the first time at the venereal disease clinics in the four large metropolitan areas, there is evidence that the disease has about doubled in prevalence. To combat the situation amendments to the Health Act were passed in 1941 which enabled district health officials to control syphilitic persons more readily. This regulation empowers the medical officer of health to order any person suffering, or suspected to be suffering, from syphilis to be detained in any public hospital in which diagnostic and therapeutic procedures can be carried out. Formerly, this power rested with the Director General of Health. The regulation thus makes for the decentralization of control, with a consequent saving of time in the bringing of patients under treatment. An effort is made to trace contacts in order that they also may be brought under treatment. Clinics for the treatment of venereal disease are maintained in Auckland, Wellington, Christchurch and Dunedin; treatment is free at each of these centers. The medical officers in charge of these clinics are also appointed assistant inspectors of hospitals; they make inspections of the smaller hospitals in New Zealand with a view to ascertaining whether the facilities for treatment in these institutions are adequate.

On the basis of available information, it would not appear that an increase in the prevalence of gonorrhea has paralleled that of syphilis. In 1941 the reported incidence of gonorrhea was one case per 100 of the total population. It is recognized, however, that this figure does not disclose all the facts, and that undoubtedly many patients are unreported.

Leprosy. A few cases of leprosy are reported annually from among the Maoris.

Leptospirosis. Weil's disease and other forms of leptospirosis have been reported in New Zealand. In most cases the disease occurs among dock hands, butchers, men working in sewers or other persons who come into contact with water or food contaminated by the excrement of rats infected with the causative spirochetes.

Undulant Fever. This disease is reported, but is not common. Some of the health authorities in New Zealand believe that many instances of brucellosis are undiagnosed and that the actual incidence of the disease is higher than the reported incidence. The fact that approximately 30 per cent of the dairy herds are infected with *Brucella abortus* creates a potential menace to the public health.

Trachoma. Trachoma is reported from among the Maoris, but is not common.

Diseases of the Skin. There is no undue prevalence of diseases of the skin. The infections that are encountered are the same as those that are commonly observed in all temperate climates. They consist primarily of staphylococcic and streptococcic infections of the skin and areolar tissues, and the common types of epidermomycosis.

Other Diseases. A few cases of tetanus, anthrax and actinomycosis are reported annually.

Diseases Spread by Arthropods

Dengue Fever. A few cases of this disease are reported annually from North Island in the Auckland and Wellington-Hawke Bay areas. During recent years there have been no reports that this disease has assumed epidemic proportions in New Zealand. It is of interest to note that although dengue fever is reported, there is no definite indication that the vectors of this disease, *Aedes aegypti* and *A. albopictus*, have been identified.

Malaria. A few cases of malaria are reported each year, but in these cases the disease unquestionably is of extraneous origin, because no anopheline mosquitoes are known to occur in New Zealand.

Typhus Fever. Neither louse-borne epidemic typhus fever nor flea-borne endemic typhus fever has occurred in New Zealand for many years. The vectors of both these diseases, however, are known to be present.

Other Diseases. Indigenous sandfly fever, trypanosomiasis, relapsing fever, filariasis, yellow fever, leishmaniasis, mite-borne typhus fever, tick paralysis, Q fever and plague have not been reported from New Zealand.

Nutritional Diseases

The clinical manifestations of diseases caused by vitamin deficiencies are not commonly observed in New Zealand, even though it is a well-recognized fact that the diet of the average New Zealander is deficient in milk, fresh fruits and green vegetables. The Department of Health is of the opinion that this latter situation is largely responsible for the very poor dental health of the population. In an effort to educate the public with regard to the necessity for an adequate diet the Minister of Health inaugurated an educational campaign in 1943, and special emphasis was placed on the subject of nutrition. A nutrition committee of the Medical Research Council was actively engaged in the study and investigation of problems relating to nutrition. Endemic goiter is comparatively common among both children and adults. During the first World War 1.2 per cent of all men examined for military service were rejected because of goiter. Although this disease is still prevalent among all elements of the population, reduction in incidence has been effected by regulations which provide that iodized salt be used for table and culinary purposes.

Miscellaneous

In some localities the fluorine content of the drinking water is high, with the result that chronic endemic fluorosis is common.

SUMMARY

Public health in New Zealand is under the jurisdiction of the Department of Health, the chief administrative official of which is the Director General of Health, distinct from the Minister of Health. The advisory body is the Board of Health, members of which are appointed by the Minister of Health, who serves as chairman of this board. The board is composed of physicians, municipal and county officials, engineers and others interested in public health. The country itself is divided into 13 health districts, each of which has a medical officer of health with wide administrative powers. The effectiveness of the system as a whole is reflected by the fact that New Zealand always has had one of the lowest death rates in the world.

Water is abundant in most places, excluding certain areas in South Island. It is taken from deep wells, streams and collections of surface water. Reserve supplies are inadequate, and in periods of drought shortages of water develop quickly. Facilities for treatment exist in only a few places. It is said that every town of 2,000 population or more has a system in which sewage is water-borne. Pit privies and the pan system of collection are employed in the smaller places. When the Maoris do not use privies they are likely to resort to pollution of the soil.

There are no anopheline mosquitoes in New Zealand; but four species of Aedes and a species of Culex have been identified. Lice of human beings, many species of flies, ticks, fleas of man and animals, cockroaches, rats and other rodents are found. Poisonous snakes do not occur, but a poisonous spider does. Ants, bees, and certain ticks and mosquitoes are pests. Sharks and sting rays inhabit the waters about New Zealand, and a few poisonous or irritating plants are identified.

The country is one of the world's great exporters of foodstuffs. Meat, dairy products, poultry, eggs, fruit and vegetables are plentiful. Certain sections of a Food and Drugs Act control the sale and inspection of foods and beverages.

Hospital facilities are adequate and hospitals are well equipped. On the basis of registration the ratio of physicians-to-population is satisfactory. The number of dentists is thought to be sufficient; the supply of nurses is excellent. The people as a whole are keenly interested in organizations devoted to social service.

The chief diseases are bacillary dysentery, typhoid and paratyphoid fevers, endemic goiter, helminthiasis, pneumonia, influenza, whooping cough, measles, diphtheria, poliomyelitis and meningitis. Tubculosis still is a leading cause of death. Venereal diseases have become more prevalent in recent years. Leptospirosis is reported; undulant fever occurs but is not common. Trachoma afflicts some of the Maoris. Cholera and typhus fever apparently do not occur nor does locally acquired malaria. Avitaminoses are not observed commonly, although the diet of most New Zealanders is said to be deficient in milk, fresh fruits and green vegetables.

BIBLIOGRAPHY

Barnett, L.: Deaths from Hydatid Disease. Australian & New Zealand J. Surg., **5**:205-211 (Jan.) 1936.

——: Gaps in Our Knowledge of Hydatid Disease. Australian & New Zealand J. Surg., **4**: 211-218 (Jan.) 1935.

——: Hydatid Disease: Errors in Teaching and Practice. Brit. M. J., **2**:593-599 (Sept. 16) 1939.

——: Incidence of Hydatid Disease in New Zealand and Elsewhere. New Zealand M. J., **39**: 330-338 (Dec.) 1940.

——: Incidence and Prevention of Hydatid Disease. New Zealand M. J., **41**:258-259 (Dec.) 1942.

The Commandery in New Zealand of the Grand Priory in the British Realm of the Venerable Order of the Hospital of St. John of Jerusalem: Report of the Commandery Chapter for the Year 1942. Wellington, N. Z., 1943.

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 2d ed. Philadelphia, Lea & Febiger, 1940.

Ditmars, R. L.: Snakes of the World. New York, The Macmillan Co., 1931.

Epidemiological Record of the Austral-Pacific

Zone for the Year 1939. Health, Canberra, **18**: 25-31 (Apr.) 1940.
Lane, C.: Points in Diagnosis and Prevention of Ascaris Infection. New Zealand M. J., **38**: 23-26 (Feb.) 1939.
Manson, P.: Manson's Tropical Diseases. Ed. by P. H. Manson-Bahr. 11th ed. Baltimore, Williams and Wilkins Co., 1941.
Miller, D.: Report on the Mosquito Investigation Carried Out in the North Auckland Peninsula of New Zealand during the Summer of 1918-1919 (Pt. 1). Wellington, N. Z., 1920. (Dept. of Health. Publ. No. 3.)
——: Termites or "White-ants." Wellington, N. Z., Govt. Print., 1939. (New Zealand Dept. of Scientific and Industrial Research. Entomology Division. Bull. No. 6.)
National Blood Transfusion Service of New Zealand: Annual Report of the Wellington Branch for the Year Ending 31 March 1942. Wellington, 1942.
New Zealand. Census and Statistics Office: Monthly Abstract of Statistics. May, 1940: Jan.-Aug., 1941.
——. ——: The New Zealand Official Year Book, 1941. Wellington, N. Z., 1941.
——. ——: Report on the Vital Statistics of the Dominion of New Zealand for the Years 1939-1942. Wellington, N. Z., Govt. Print.
New Zealand. Dept. of Agriculture. Prevention of Hydatid Diseases in Man and Animals. Eradication of Hydatids (Instructions for the Use of Arecoline Tablets). Wellington, N. Z., Govt. Print., 1930. (Bull. No. 147.)
——. Dept. of Health: Reports of the Director-General of Health, New Zealand, for the Years Ended 31st March, 1938-1942. Wellington, N. Z., Govt. Print., 1939-1943.
New Zealand. Dept. of Health: Appendix to the Annual Report for the Year Ended March 1942, Containing Hospital and Charitable Aid Statistics. Wellington, N. Z., Govt. Print., 1943.
——. ——: Regulations Under the Sale of Food and Drugs Act, 1908. Wellington, N. Z.
——. ——: The New Zealand School Dental Service. Wellington, N. Z., Govt. Print., 1943.
——. ——: Dept. of Scientific and Industrial Research: The Dominion Laboratory; Extract from the Annual Report of the Department. Wellington, N. Z., Govt. Print., 1942.
The New Zealand Red Cross Society, Inc.: Annual Report for the Year Ended March 31, 1942. Wellington, N. Z.
Robb, D.: Medicine and Health in New Zealand, a Retrospect and a Prospect. Christchurch, Whitcombe & Tombs, 1940.
Shore, R. A., and Andrew, R. L.: Goitre in School Children. Wellington, N. Z., Govt. Print., 1934. (New Zealand Dept. of Scientific and Industrial Research. Bull. No. 45.)
Statesman's Year-Book. London, The Macmillan Co., Ltd., 1939.
Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed. by R. P. Strong. Philadelphia, The Blakiston Co., 1942. 2 vols.
Turbott, H. B.: Tuberculosis in the Maori. Dept. of Health Reports, New Zealand, 1935.
U. S. Bureau of Foreign and Domestic Commerce (Dept. of Commerce): World Trade in Dental and Surgical Goods. Washington, U. S. Govt. Print. Off., 1939.
Whitley, G. P.: Poisonous and Harmful Fishes. Melbourne, Australia, 1943. (Council for Scientific and Industrial Research. Bull. No. 159.)

26

North Borneo, Sarawak and Brunei

GEOGRAPHY AND CLIMATE

The great island of Borneo, situated between 108 and 119° of east longitude and 4° of south latitude and 7° of north latitude, was divided into four chief parts. Three of these—the state of British North Borneo, the protectorate of Sarawak and the sultanate of Brunei—were either in British possession or were dominated by the British. The fourth part is a province of the Netherlands East Indies, and as such is treated in the chapter devoted to those islands.

British North Borneo. The northernmost portion of the island of Borneo was officially known as "British North Borneo." It was administered by the British North Borneo Company under the terms of a royal charter granted in 1881, and was regarded as a British-protected state. The Governor was responsible to the directors of the company in London, and his appointment was subject to approval of the Secretary of State for Colonies of the British government.

The area of British North Borneo is approximately 29,500 square miles, or about that of the state of South Carolina (30,989 square miles). In this area, according to the census of 1931, were some 270,000 people, most of whom, along the coast line, were Mohammedan settlers from Asia, and in the interior, aboriginal tribes. About 205,000 persons were natives; of these, Dusuns numbered 97,000, Bajaus 31,000 and Muruts 14,000. There were almost 48,000 Chinese. Occidentals did not exceed 500.

British North Borneo is characterized by mountains heavily covered with dense forests. Steep hills range down to the swamplands of the coast line; back of the hills are numerous mountains, one peak, Mount Kinibalu, rising to 13,455 feet. Since the entire island of Borneo has been known as one of the best-watered countries in the world, it is not surprising that British North Borneo should have many streams. None of them, however, is of economic importance. The coast line of 900 miles provides excellent access to the South China Sea on the northwest, the Sulu Sea on the northeast and the Celebes Sea on the east.

Sarawak. The protectorate of Sarawak was purchased in 1842 from the sultan of Brunei. A constitution was provided in 1941, and the rajah, a descendant of the English purchaser of 1841, ruled the country by means of this constitution. The country had been regarded since 1888 as an independent state under British protection. It has an area of about 50,000 square miles, or about that of the state of New York (49,204 square miles). In this country, it was estimated, lived some 490,000 persons. The population was composed of Malays, Dyaks, Kayans, Muruts and other minor tribes. The number of Chinese in Sarawak was considerable.

What has been said of the physiography of British North Borneo applies likewise to Sarawak. With a coast line of only 450 miles, Sarawak has notable inland hydrographic features. The Sarawak River, for instance, is the stream on which the capital, Kuching, is situated. The Rejang River is

300 miles long and can be navigated by steamships. Other streams, marshes and lakes occur in profusion. Mount Kalulong, in the northeastern part of Sarawak, is 7,000 feet high.

Brunei. The Sultanate of Brunei, which had been under the protection of Great Britain since 1888, is bounded on all sides by Sarawak territory. The area of Brunei is only 2,226 miles, or about that of the state of Delaware (2,370 square miles). The population in 1931 was about 30,000. Malays and natives of Borneo numbered some 27,000 and there were 2,600 Chinese. Occidentals did not exceed 100. The state since 1906 had been administered by a British resident who was an officer of the Malayan Civil Service, but the supreme authority was the Sultan. The physical features of Brunei need not be given here, since the country itself is surrounded by Sarawak, which has been described.

The climate of British North Borneo, Sarawak and Brunei is mild. Along the coast the atmosphere is oppressive and humid. Northwestern and southwestern winds are frequent. Rainfall is abundant throughout the year, but especially so from October to November. Torrential rains are common. The maximal annual rainfall is recorded as 225 inches (5.7 meters), and the minimal annual rainfall has been 102 inches (2.6 meters). The average annual rainfall is about 160 inches (4.1 meters).

The temperature has ranged, normally, between 72 and 93° F. (22.2 and 33.9° C.). It has been as high as 100° F. (37.7° C.) and as low, along the coast, as 64° F. (17.7° C.). It is probable that in the hills the minimal temperature is lower than the latter figure. As a general rule, the minimal temperature is not often lower than 70° F. (21.1° C.). The heat, said to have an enervating effect on Europeans, is tempered somewhat by sea breezes. It is said that nights in Brunei are cool.

PUBLIC HEALTH *

Health Services

The health services of North Borneo, Sarawak and Brunei were maintained along similar lines. Public health personnel were supposed to be responsible for the medical care of the people as well as for the carrying out of public health measures.

North Borneo. The health service of North Borneo in 1937 consisted of six Occidental medical officers. One of these was the principal medical officer; the other five were district surgeons. An auxiliary staff consisted of two Occidental nursing sisters, seven locally trained nurses, two village nurses who were certified midwives and 45 male dressers.

Sarawak. In 1936 the personnel of the health service consisted of four Occidental medical officers and an auxiliary staff of 53 dressers and 14 sanitary inspectors.

Brunei. A medical officer of the Malayan Medical Service supervised a staff of 11 dressers, two sanitary inspectors, five nurses and four midwives. All but the medical officer were natives.

Actually, the primary function of the health services was to staff and operate the hospitals and conduct medical tours among the tribes of the hinterlands. In theory, in all the larger towns, there were health boards that were supposed to be responsible for local sanitation and housing.

Relative Effectiveness. Because of the small number of men engaged in this work, the limited means at the disposal of these organizations, the difficult problems of transportation, the apathetic attitude of the native people toward sanitation and European medicine in general, together with the consequent lack of co-operation, and the great numbers of sanitary and medical problems, few public health meas-

* Unless otherwise indicated, governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

ures were carried out. These few included a small amount of antimalarial work about the larger towns, together with attempts to institute the use of sanitary methods of disposal of wastes and to conduct a general educational campaign in public health among the people. The health boards in the larger towns never were able to operate as effective organizations.

Water Supplies

Water for domestic purposes was obtained from rivers, springs, shallow wells and small basins for the collection of rain water. In 1937 there were no facilities for purification of water in any of these countries. Water was commonly collected from a stream each morning in a bamboo vessel or was occasionally piped to the house from the nearest spring by means of a split-bamboo aqueduct. The coastal villages usually obtained water from unprotected surface wells.

Sewage Disposal

In recent years efforts were made throughout all three of these countries to teach the natives to build and use pit privies; however, contamination of the soil remained the common method of disposal. Brunei Town, the capital of Brunei, had several public latrines that were connected to systems in which sewage was water-borne. These systems dumped raw sewage into the sea.

Insects and Animals

Vectors of Disease. Mosquitoes. The most commonly occurring mosquitoes capable of transmitting malaria in this area include *Anopheles sundaicus* (the most important vector), *A. kochi*, *A. barbirostris barbirostris* and *A. leucosphyrus hackeri*. Occasionally, *Anopheles maculatus maculatus*, *A. separatus*, *A. umbrosus*, *A. tessellatus*, *A. karwari*, *A. baezai*, *A. hyrcanus sinensis*, *A. novumbrosus*, *A. albotaeniatus*, *A. brevipalpis*, *A. subpictus subpictus* and *A. aconitus* have been found. The majority of these anophelines breed in rice paddies, swamps, wells, ponds and drains. *Aedes aegypti*, one of the carriers of dengue fever in this area, is also known as the vector of the urban type of yellow fever in other parts of the world. *Aedes albopictus*, which has been reported from this area, is capable of carrying dengue fever. Although *Culex fatigans* is the most important vector of the filarial worm, *Wuchereria bancrofti*, such mosquitoes as *Anopheles barbirostris barbirostris*, *A. sundaicus* and *C. fuscocephalus* also have been incriminated. *Mansonia longipalpis*, which is present, and *A. barbirostris barbirostris* can carry *Wuchereria malayi*.

Flies. The common flies, *Musca domestica* and *M. sorbens*, constitute an important problem throughout this area, especially in villages along the seacoast.

It is probable that the sand fly is found in this area, but specific information is lacking. The sand fly has been found in the Netherlands East Indies, but is very rare there.

Rats. The towns and villages of this region all were infested with rats. *Rattus rattus* and *R. norvegicus* are the usual species. These rats frequently live in the walls and thatched roofs of the native homes, where they constitute a menace because they frequently are carriers of plague-infected fleas.

Other Vectors. There is no mention in available literature of the presence of mites; however, an occasional case of scrub typhus fever, a mite-borne disease, has been reported. The most common mite in near-by areas is *Trombicula akamushi*, and it is assumed that it is also the vector of the disease in this region.

Fish, crabs, crayfish and other seafoods frequently are the carriers of parasites such as tapeworms and flukes. Several poisonous fish, species of Tetraodon, found in waters off Borneo are capable of causing severe toxemia when eaten, and the *sanbilang* and the *raii* are also capable of causing toxemia by stinging.

Snakes and Other Dangerous Animals. The cobra and the adder are the most important poisonous snakes found in this region. There are said to be more than 50 indigenous species of various snakes. The great python also is found in the area and, although it is not poisonous, it is said to attack man occasionally. The rhinoceros, elephant, orangutan and a small cat, called the "tiger" cat, are found throughout this part of Borneo. The rivers abound with crocodiles.

Pests. There are many pestilential insects throughout northern Borneo, including hornets, bees, wasps, ticks, fire ants and mosquitoes. There are several different kinds of blood-sucking leeches in Borneo that are obnoxious and also dangerous because the site of the bite frequently becomes infected, especially when the proboscis is broken off in the skin.

Food and Dairy Products

Rice, sago and tapioca were the staples of the native diet, supplemented by such vegetables or fruits as maize, sweet potatoes, marrows, gourds, cucumbers, eggplants, bananas, limes, oranges, pineapples and coconuts. Salt fish, pork and deer meat (*jaruk*) were eaten occasionally. Small quantities of beef or buffalo meat were obtainable throughout the area. North Borneo had a small beef industry. There were few areas in which agriculture had been developed to provide for more than the needs of the native people. Small quantities of dairy products were marketed, but they were all subject to contamination and there were no methods, such as pasteurization, of insuring their safety.

Miscellaneous Problems of Sanitation

Throughout the three countries living conditions were primitive. The majority of the people lived along the seacoasts or on the river banks, and small nomadic tribes lived in the interior. In the larger cities there was an occasional "modern" dwelling, but town planning was poorly carried out. In the smaller villages houses were crowded together and conditions were insanitary. The houses were of wood, frequently built on piles over streams, were poorly ventilated, and were roofed with leaves. In some villages as many as 20 families lived in one long house, with common living quarters and individual family sleeping rooms. Garbage was dumped on the ground immediately beneath the house. If the house was built over the water, human wastes were disposed of in the same manner. Pigs, chickens, dogs and other animals lived in the filth beneath the houses.

MEDICAL FACILITIES

Hospitals

North Borneo. In 1936 there were 10 government hospitals. The number of beds in the various hospitals is not known. It was not large, however, for the yearly hospital population of the entire group was only 3,472. Nothing is known about the equipment or the supplies available in these hospitals. The health service maintained a system of dispensaries operated by native dressers, scattered throughout the rural areas. In 1937 there were 12 dispensaries, seven of which had small "sick rest houses" for the treatment of natives who could not be cared for in their homes. District surgeons toured their districts each year, treatment centers having been arranged in advance, so that during the tour, a trip of three months' duration, the majority of sick natives were seen.

Sarawak. In 1937 the health service maintained a General Hospital located one mile from the center of Kuching. This had 300 beds, two modern operating theaters, an up-to-date x-ray plant, a pathology laboratory and a dispensary. Other hospitals were located at Sibu and at Miri and were well equipped. A system of dressing posts and dispensaries was operated by native dressers in various villages scattered throughout the country.

Brunei. The General Hospital of 48 beds at Brunei was fairly well equipped in 1939. It had a new operating theater and a system in which sewage was water-borne. A British petroleum company operated a hospital at Kuala Belait, supervised by a company medical officer. Two small dispensaries were maintained in outlying parts of the state at Tutong and Temburong, each in charge of a native dresser. Three native dressers traveled throughout the country, attending to the needs of the population located in remote areas.

Medical Personnel

Nearly every practitioner of medicine in these countries was an employee of the departments of health. A white medical officer, employed by an oil company, was stationed at Miri in Sarawak. Eleven nurses were stationed in the General Hospital at Kuching in the same country.

DISEASES

General Considerations. Accurate, specific information concerning disease is unobtainable. Reports of health officers state that statistical tables are not reliable, for less than 10 per cent of deaths were certified by physicians. There are also conflicting reports in various governmental papers dealing with the same areas during the same periods.

In medical reports it was stated that there had been no instances of cholera, smallpox, epidemic (louse-borne) typhus fever, relapsing fever or undulant fever in many years. It was also stated that plague had not occurred after 1920. Yellow fever never has been reported in this part of the Orient, although *Aedes aegypti,* capable of transmitting the disease in other parts of the world, is commonly encountered.

There is no available information concerning the presence or absence of Weil's disease, Oriental sore, kala-azar, hydatid disease, sand-fly fever and rabies.

Diseases Spread Chiefly through Intestinal Tract

Both amebic dysentery and bacillary dysentery were reported as being common in all parts of North Borneo. The use of human excrement to fertilize soil in which vegetables are grown, the insanitary methods of disposal of sewage, the lack of safe water and the unhygienic customs of the people were responsible for the spread of these diseases.

There were few reported cases of typhoid fever or paratyphoid fever from this area. Many deaths, however, were recorded in available statistical charts as having been caused by diarrhea or enteritis, and it is possible that a large proportion of these deaths actually were caused by typhoid fever or paratyphoid fever.

Cholera had not been reported from this area in more than ten years. The lack of supplies of safe water and the extremely insanitary disposal of human wastes, however, suggest that severe epidemic outbreaks might occur should the disease be reintroduced.

Infection with various worms was extremely common in this area. In several coastal villages 100 per cent of the children were found to be infected. Members of the genus Ascaris, the most prevalent, accounted for more than 80 per cent of the cases. Infection with *Enterobius incognita, Ancylostoma duodenale* or *Hymenolepis nana* was fairly common. The custom of the natives' going barefoot, the extremely insanitary disposal of human wastes, the unhygienic preparation of foods and the custom of eating with the hands from a common dish all were responsible for the spread of infection with worms.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis was said to be of common occurrence among the Chinese. It was also stated, however, that because the people were reluctant to seek medical attention they usually were moribund when first seen, thus accounting for a disproportion between cases reported and deaths.

Other Respiratory Infections. The respiratory and other infectious diseases were responsible for much morbidity and many of the reported deaths. The diseases of this category included in available records were pneumonia, influenza, diphtheria, measles, mumps, whooping cough, chickenpox and cerebrospinal meningitis. Vaccination against smallpox was said to have been well received by the natives, and had been carried out effectively, so that instances of the disease had not been reported in many years. Diphtheria occurred in several severe epidemics in the past six years.

Diseases Spread Chiefly by Contact

Venereal Diseases. Gonorrhea was the most frequently occurring venereal disease, and in some areas as much as 80 per cent of the people were affected with it. Syphilis was said to be a new disease in this area, brought there recently by Chinese coolies. The frequency of this disease has increased during the last 10 years so that it was considered to be endemic. Occasionally, instances of chancroid and lymphogranuloma venereum were encountered. Although prostitution as such existed on a very limited scale in the larger towns, the people were extremely promiscuous and clandestine contacts were frequent.

Yaws. The majority of cases of yaws were reported from the hinterlands; few instances of the disease were found along the seacoast. Brunei had instituted a campaign against this disease, but there were no records that similar measures had been taken in the neighboring countries.

Trachoma. Trachoma and other ophthalmic diseases constituted a serious problem, especially among the hill tribes.

Leprosy. A few new instances of leprosy were encountered each year. The disease was of little significance in this area.

Diseases of the Skin. Various mycotic diseases of the skin, including epidermophytosis, tinea imbricata and Madura foot, were of common occurrence, especially among Occidentals. Scabies frequently was found.

Tetanus. Cases of tetanus occasionally were reported. The incidence and distribution of this disease were unknown.

Diseases Spread by Arthropods

Malaria. Malaria constituted the most important problem of disease in Borneo. Available information indicates that it was found in all parts of North Borneo, Sarawak and Brunei, but was of most common occurrence along the seacoast. Swamps, small streams, wells, rice fields, cisterns and natural collections of rain water were breeding places for mosquitoes. Around the larger towns and villages, and especially in the capital cities, attempts were made to drain and oil near-by swamps and streams. Because of these antimosquito measures, it is said that malaria was less prevalent in the larger towns. Blackwater fever was of common occurrence. Splenic indices in the few areas studied disclosed that the incidence of so-called malarial spleens varied from 2 to 70 per cent.

Filariasis. Filariasis and elephantiasis were commonly seen along the coastal plains and in the river bottoms. *Wuchereria bancrofti* was the parasite most often encountered in this part of the world, although *W. malayi* was reported occasionally.

Dengue Fever. Dengue fever, or breakbone fever, was a common disease among new arrivals, and sporadic epidemics among the native people were reported. Both *Aedes aegypti* and *A. albopictus,* carriers of dengue fever, were found in North Borneo.

Typhus Fever. It is reported that tropical scrub typhus fever, a mite-borne disease, occurred occasionally in the state of Brunei. There were no reports from North Borneo or Sarawak. It is probable, however, that the disease did occur in these regions but that it had not been recognized. Mites were most frequently encountered on land along river banks that were subject to flood and in recently cutover jungle.

It is said that epidemic (louse-borne) typhus fever was not found in this area. Endemic typhus fever and relapsing fever also were absent from this area.

Plague. Plague was last reported from this region in 1920, in which year there was a small epidemic in Sandakan in North Borneo. Rats were found throughout the houses and buildings, so that the danger of this disease existed constantly. Plague-infected fleas (*Xenopsylla cheopis*) of rats were found in varying numbers each year.

Nutritional Diseases

Beriberi. Beriberi was responsible for many deaths, especially during periods of famine. Rice was the staple food; despite active governmental educational programs, the polished type of rice was still the one most frequently used.

Endemic Goiter. The northern part of Borneo was one of the largest centers of endemic goiter in the world.

Miscellaneous Conditions

Injuries from animals were often reported in the medical literature from this part of the world. They included stings by poisonous fish, crocodile bites, shark bites and centipede bites. The smoking of opium was very common among the Chinese, and to a lesser extent among the native people. Governmental control consisted only of levying of a tariff on imports of opium.

SUMMARY

In North Borneo, Sarawak and Brunei public health, hospital and medical facilities under British control, although well organized and maintained, were inadequate for the health and medical problems of the area. Locally produced foods were scarcely sufficient for local needs, except for small amounts of fruits and vegetables in some areas. Food and dairy products were not subjected to qualified inspection or pasteurization, and refrigeration and other health safeguards were inadequate. Water was plentiful but, regardless of its source, probably was unsafe for human consumption until it had been adequately treated. Only one system in which sewage was water-borne is recorded. Although the construction and use of pit latrines had been encouraged, promiscuous defecation was the usual means of disposal and resulted in widespread pollution of the soil. The area abounded with insects and animals that are dangerous to man, including mosquitoes which carried the organisms of malaria, dengue fever and filariasis, and which were capable also of carrying yellow fever. There were various types of rats, fleas, mites, lice, ants, centipedes, spiders, poisonous snakes, crocodiles, elephants, rhinoceroses and orangutans.

Diseases of greatest importance in this area were malaria; the enteric diseases (typhoid fever, paratyphoid fever, amebic dysentery, bacillary dysentery and common diarrheas); venereal diseases (gonorrhea, syphilis, chancroid, lymphogranuloma venereum); dengue; typhus fever; diseases of the skin; and pneumonia. Other serious diseases were tuberculosis, helminthiasis, filariasis, yaws, leprosy, trachoma, other ocular diseases and nutritional disturbances.

BIBLIOGRAPHY

British North Borneo. Governor: Administration Report, 1913-1939. Jesselton, Sandakan, 1915-1940. 25 vols.

——. Medical Dept.: Annual Report, 1928. Jesselton, 1929.

British North Borneo Company: Handbook of the State of North Borneo, with a Supplement of Statistical and other Useful Information. London, The British North Borneo Co., 1934.

Brunei. Medical Dept.: Annual Report, 1933-1936, 1939. Singapore, 1934-1940.

Cator, G. E.: Brunei. Asiatic Review [London] **35**:736-744 (Oct.) 1939.

Copeland, A. J.: The Muruts of North Borneo: Malaria and Racial Extinction. Lancet (London) **228**:1233-1239 (May 25) 1935.

Dingle, P. A.: Memorandum on Conditions Prevailing in North Borneo. (*In* League of Nations. Health Organisation. Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers. Geneva, 1937.)

Gt. Brit. Colonial Office: Annual Report on the Social and Economic Progress of the State of Brunei, 1938. London, H. M. Stationery Off., 1940. Colonial Reports. (Annual No., 1930.)

Harnack, W.: Geography of Sarawak. Empire Survey Review, **5**:266-267 (Oct.) 1939.

Harrison, T. H., ed.: Borneo Jungle: An Account of the Oxford Expedition to Sarawak. London, L. Drummond, 1938.

——: The Oxford University Expedition to Sarawak, 1932. Geographical Journal [London] **82**:385-410 (Nov.) 1933.

Hose, C.: Natural Man; A Record from Borneo. London, The Macmillan Co., 1926.

Hutchinson, W.: Note on the Medical and Health Services in Sarawak. (*In* League of Nations. Health Organisation. Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers. Geneva, 1937.)

Krolm, W. O.: In Borneo Jungles, among Dyak Headhunters. Indianapolis, The Bobbs-Merrill Co., 1927.

Merrill, E. D.: A Bibliographic Enumeration of Bornean Plants. Singapore, Fraser and Neave, 1921. (Journal of the Straits Branch of the Royal Asiatic Society. Special No. Sept., 1921.)

Ride, L. T.: The Problem of Depopulation with Special Reference to British North Borneo. Population [London] **1**:36-48 (Nov.) 1934.

Rutter, O.: British North Borneo; An Account of Its History, Resources and Native Tribes. London, Constable & Co., 1922.

Sarawak. Govt. Medical Dept.: Annual Report, 1925-1935. Kuching, 1926-1936. 8 vols.

Smart, J.: A Handbook for the Identification of Insects of Medical Importance. London, British Museum, 1943.

State of North Borneo, 1939. Administration Report; Survey Department Report. Empire Survey Review, **6**:117-121 (Apr.) 1941.

Statesman's Year-Book, 1943. London, The Macmillan Co., Ltd., 1943.

Torrance, O.: Junglemania. New York, The Macaulay Co., 1933.

27

Papua and New Guinea and the Bismarck Archipelago

GEOGRAPHY AND CLIMATE

New Guinea, the second-largest island in the world, is situated, roughly, within the area enclosed by 129 and 152° of east longitude and 1 and 11° of south latitude.* Approximately half of New Guinea is part of the Netherlands East Indies; this portion has been discussed in the chapter devoted to those possessions. The other half of New Guinea—the eastern half—is divided into two parts: the Territory of Papua and the Territory of New Guinea. Both were administered by the Commonwealth of Australia.

The Territory of Papua, an area of about 90,000 square miles, including all possessions, consists of Papua proper, and the D'Entrecasteaux, Trobriand, Murua and Louisiade islands. The Territory of New Guinea, an area of about 93,000 square miles, including all possessions, is composed of the territory proper, the Admiralty Islands, the Bismarck Archipelago, and Buka and Bougainville.

The population of both territories and their possessions is thought to be about 900,000. Approximately 300,000 live in the Territory of Papua and 600,000 in the Territory of New Guinea. Almost all the people are Papuans, Negritos or Melanesians, although there are a few Polynesians and Micronesians. Papuans carry on agriculture to a limited degree and fishing and coastwise trade to a considerable degree. Negritos are the pygmy Negroid peoples, about 3 to 5 feet tall, who dwell chiefly in the mountains, throughout New Guinea. Melanesians are tall, round-headed people who inhabit chiefly the northern and northeastern coasts of New Guinea; a few inhabit the southeastern coast. They are the most recent arrivals in the region.

The island of New Guinea is traversed for its entire length by a great mountain range which constitutes a natural and effective barrier between the northern and southern divisions. Part of this range is occupied by the Bismarck Mountains, which in some places are more than 15,000 feet high. To the southeast of these mountains is the Owen Stanley range, in which Mount Victoria is more than 13,000 feet high. Along the northern coast of the Territory of New Guinea are the Torricelli and Finisterre ranges. A coastal plain extends from the northern coast of the Territory of New Guinea southward to the base of the Bismarck Mountains. A similar plain, but much larger, continues from the other side of these mountains southward to the southern coast of the Territory of Papua. This plain occupies by far most of Papua itself, and is more than half the width of the entire island of New Guinea.

The largest river in either Papua or Australian New Guinea is the Fly, some 800 miles long, which originates in the Bismarck Mountains and flows southward into the Gulf of Papua. The Fly River is navigable by seagoing ships for a considerable distance. The Strickland River is a large tributary of the Fly. The Sepik River, some 400 miles long, flows toward the northeast

* This is the mainland only; not the several contiguous island groups that were attached politically to New Guinea.

TABLE 29

Salient Climatic Data, Annual Figures, Certain Places in Papua and New Guinea

Place	Temperature, ° F. Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Port Moresby (Papua)	98	68	81	40	74	SE, 50	126
Madang (New Guinea)	98	62	81	137	84	W, 27	20
Daru (Papua)	..	..	80	84	84	......	26
Samarai (Papua)	..	..	80	106	79	......	20

in the Territory of New Guinea. The Sepik is navigable by seagoing vessels for approximately 180 miles. The only other stream of importance is the Ramu River, about 300 miles long, which empties into the Pacific Ocean near the mouth of the Sepik. Other important hydrographic features are the excellent harbors, such as Port Moresby, Daru, Kerema, Gona, Buna and Kikori in the Territory of Papua, and Aitape, Madang, Lae, Salamaua, and Morobe in the Territory of New Guinea.

The island of New Guinea lies below the equator, but at sea level or moderate altitudes it is not subject to extremes of temperature. Generally, the temperature in the early morning is about 72° F. (22.2° C.) and at noon about 92° F. (33.3° C.). The climate along the coast line is said to be enervating to persons from more temperate regions, because a relative humidity of more than 75 per cent is usual. The hot season extends from December to March, but there is no definite dry season. From July to September it is cooler than during the rest of the year. Precipitation occurs at any time of the year; on the northeastern coast and the eastern islands the annual rainfall varies from 100 to 250 inches (2.5 to 6.4 meters). The salient climatic data are seen in Table 29.

PUBLIC HEALTH *

Health Services

Organization. New Guinea. In the Territory of New Guinea the public health organization was administered by the Commonwealth of Australia under mandate from the League of Nations. The territory includes northeastern New Guinea, the Bismarck group and some of the Solomon Islands. For purposes of administration, the territory was divided into seven districts, three of which are on the mainland of New Guinea. These are the Morobe, Madang and Sepik districts. In each district there was a district medical officer, who, assisted by a small staff, administered the services of the health department. Headquarters of this service were at Rabaul. Facilities consisted of: (1) a staff of medical officers, traveling physicians, and medical orderlies; (2) native hospitals at government stations and substations (the staff also supervised hospitals on plantations and at missions); (3) a laboratory; (4) a training system for native inhabitants as medical *tul-tuls;* (5) agencies for the distribution of medical necessities; and (6) two leper stations. The department also undertook the supervision of sanitary conditions. In the more remote localities, health and sanitary measures were largely governed through the medium of medical patrols, medical base posts staffed with trained medical orderlies, and missionary groups. Public health activities included quarantine services, sanitary inspections and control, health surveys, epidemiologic surveys, the operation of native hospitals and clinics, field patrols and a central laboratory service. The public health department conducted campaigns against

* Unless otherwise indicated, governmental organization, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

specific diseases, notably malaria, infection with hookworm, yaws, tropical ulcers and leprosy. To a large degree, these measures were effected through the medium of medical patrols. In localities that were not under direct supervision of a regular medical officer, simple medical treatment was administered by trained and indentured medical orderlies who were placed in charge of a supply of basic medicaments for use among the native inhabitants.

PAPUA. Papua was a territory of and was administered by the Commonwealth of Australia. It includes southeastern New Guinea and the islands of the Trobriand, Murua (Woodlark), D'Entrecasteaux, and the Louisiade groups. For the purpose of administration, this territory was divided into eleven districts. Headquarters were at Port Moresby, where there was located the central agency for the administration of public health and sanitary programs. This agency was headed by a Chief Medical Officer. The method of administration, the operation, and the services rendered were similar to those of the Territory of New Guinea.

Relative Effectiveness. The administration of health and sanitary measures among the Papuan and Melanesian natives is a problem of enormous proportions. Much of both territories is unexplored. Because of the numerically inadequate staff, the great distances involved, and the obstacles encountered in travel by land, sea, and rivers, some of the population groups have rarely been seen by white men. Some of these groups are composed of fierce savages whose culture resembles that of the "Stone Age." A large proportion of the natives have been brought under varying degrees of governmental influence, but their ignorance, indifference, and backwardness contribute to the difficulties in the administration of any health program. For the most part they require constant supervision in all matters pertaining to their health and welfare, and do not readily adapt themselves to the modern concepts of sanitation. In the cities and other localities that are centers of the Occidental population and influence, the administration of the public health program has been carried out with varying degrees of success.

The sanitary conditions in both New Guinea and Papua were comparable. Both had detailed ordinances, regulations, and proclamations relating to matters of public health. The respective territorial governments administered these measures through the medium of specially qualified white officials or native representatives. Strict compliance with all public health legislation was required in areas that were under complete governmental surveillance and control. For the most part, these localities include cities, towns, plantations, missions and mining districts, all of which had a small but influential Occidental population before the war. In the outlying districts, and in areas not under governmental control, the enforcement of sanitary measures was lax or wanting. Among some of the natives it was impossible to institute or enforce any sort of sanitary program, because of their tribal customs, religious beliefs, primitive social structure, belief in magic, native mythology and warlike habits.

WATER SUPPLIES

There are abundant supplies of surface water throughout both territories. The rainfall is heavy, and the majority of the Occidental population depended upon rain water collected from roof tops for their supply. Water collected in this manner was stored in small tanks in houses. Large reservoirs are impracticable, because of the frequency of shocks caused by earthquakes. During the periods of average rainfall the supply is adequate for all needs, but in the event of prolonged dry weather, and in certain areas in which the rainfall is light, there is danger of a shortage of water. The numerous lakes, rivers, streams, and wells are the sources of water for the majority of the native population. Generally speaking, the water taken from rivers in New Guinea is not highly contaminated, since the watercourses arise in mountainous regions and highlands which are sparsely populated. None of the water from either the streams or rivers, however, should be considered to be free from pollution. Lakes and springs are numerous, but the water obtained from them is of doubtful safety. Springs are particularly dangerous, since they frequently represent nothing more than the reappearance of surface water that has temporarily passed underground; this is particularly true of intermittent springs. The danger of pollution of springs is especially great during the rainy season and in areas in which the surface soil is sandy. Lakes, generally, are less contaminated than springs, but are likely to be polluted, particularly by cattle. Shallow, poorly constructed, uncovered wells are found in abundance. Very often they are contaminated. In the mining districts and particularly in the northeastern part of New Guinea the water supplies frequently are polluted.

Sewage Disposal

Flyproof tanks or pit latrines were in general use in the larger towns, governmental headquarters of the various districts, missions, plantations, and other centers of Occidental population. At these points night soil was collected nightly. This material was then emptied into the sea, treated by the "Indore process" or disposed of by shallow burial. In some of the newer buildings and homes septic tanks were in use. Recent sanitary regulations passed in some districts directed the screening of rooms and the installation of septic tanks on government-licensed premises. In districts that were under complete government control and influence sanitary regulations were strictly enforced; in other districts they were lax or wanting. The government encouraged the construction and use of bored-hole latrines, but had very limited success in persuading the native groups to adopt this sanitary measure. In general the native customs of disposal of sewage had not been materially altered. The inhabitants of the coastal areas used the sea, whereas natives of the interior usually set apart certain areas for this purpose. Some of the island natives, however, were indiscriminate with regard to pollution of soil.

Insects and Animals

Vectors of Disease. Mosquitoes. *Anopheles punctulatus punctulatus, A. punctulatus moluccensis, A. bancroftii,* and *A. subpictus subpictus* are the anophelines of medical importance in this area. *Anopheles punctulatus punctulatus* and *A. punctulatus moluccensis* are known to be highly efficient vectors of malaria throughout this area. *Anopheles punctulatus punctulatus* breeds chiefly in shallow pools of rain water, temporary puddles, swamps, and water in local depressions in the ground such as those created by hoof marks, automobile ruts, and cart tracks. It breeds exclusively in fresh water, and prefers open and sunny places. It frequents human habitations, bites at night, and prefers human blood. *Anopheles punctulatus moluccensis* breeds in more nearly permanent bodies of water, such as pools, brackish drains or open wells. It is able to tolerate water less pure than that utilized by *A. punctulatus punctulatus,* and often is found in pools and swamps close to the sea, where levels vary with the tides. It also breeds in moving water and in the grass along the banks of rivers. Its breeding spots usually are sunny. It frequents houses and feeds at night. *Anopheles bancroftii,* a minor vector, breeds in shady stagnant or slightly running water. Ordinarily, it feeds at night, but has been known to bite during the daytime when or where the light is subdued. Although some authorities doubt that *A. subpictus subpictus* is a vector of malaria in this general area, other competent observers believe that in Papua this mosquito is a vector of malaria. It breeds in fresh or brackish water, often in collections of muddy rain water or pools of water contaminated with sewage.

Aedes (*Finlaya*) *kochi*, *A. aegypti*, and *A.* (*Ochlerotatus*) *vigilax* are found in this area. *Aedes kochi* and *A. vigilax* are vectors of filariasis. The former breeds in swamps which vary from fresh to brackish; the latter breeds in water collected in the axils of the leaves of large trees or plants such as the pandanus, banana and taro. *Aedes aegypti* and *A. albopictus* are the vectors of dengue fever in this region. *Aedes aegypti* is the vector of yellow fever in other parts of the world. Both of these are domestic mosquitoes, and breed in any collection of clean water, such as those found in roof gutters, tin cans, house tanks, barrels, bottles, tire casings, and the like.

Culex fatigans, *C. annulirostris* and *C. sitiens* are widely distributed throughout New Guinea and Papua. All three are known to be vectors of filariasis. *Culex fatigans*, a domestic mosquito, breeds in dirty and contaminated water such as household water and water in septic tanks, street gutters, and the like. The other two culicines breed in swamps.

LICE. Pubic lice (*Phthirus pubis*), head lice (*Pediculus capitis*), and body lice (*Pediculus corporis*) are common. They are pestilential and are not known to transmit any specific diseases in these territories. The body louse is a potential carrier of epidemic typhus fever and relapsing fever.

FLIES. The common housefly, *Musca domestica*, is common; it breeds in practically all decaying nitrogenous matter.

TICKS. Ticks are said to abound, and it is probable that *Ixodes holocyclus* (the scrub tick) is present in New Guinea and Papua. The eggs of these ticks are laid on the ground. After the larvae have been hatched they mount stems of grass and shrubs, and there await a suitable host. In eastern Australia this tick is the cause of human tick paralysis. Unconfirmed reports indicate that patients with tick paralysis are seen occasionally in Papua and New Guinea.

FLEAS. The Oriental rat flea (*Xenopsylla cheopis*) and the cat flea (*Ctenocephalus felis*) are common. Although no flea-borne diseases such as plague and endemic typhus fever have been reported, the rat flea is capable of transmitting these diseases.

RODENTS. Rats and mice are common throughout this region, particularly in and about the towns and villages and in areas under cultivation. The more common rats are the black rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), Brown's rat (*Rattus exulans browni*), brown bush rat (*Rattus leucopus ringens*), and the naked-tailed rats (*Melomys* sp.). They are dangerous because the parasites they harbor are capable of transmitting diseases to man. Moreover, the excreta from infected rats may harbor organisms pathogenic to man.

MITES. Mites belonging to the genus Trombicula are vectors of tropical typhus fever (scrub typhus, mite typhus, tsutsugamushi disease) and are distributed throughout New Guinea and Papua. *Trombicula hirsti* is considered the principal vector of tropical typhus fever in this area. *Trombicula deliensis*, the vector in Malaya and Sumatra, has also been incriminated as the vector of the disease in New Guinea and Papua, but evidence to this effect is not conclusive. The principal hosts of *T. hirsti* are bandicoots (*Echymipera cockerelli*); the bush pig (*Sus papuensis*); bush fowl (*Megapodius reinwardt*); bush turkey (*Talegallus jobiensis*); cassowary (*Casuarius casuarius*); and the ground pigeon (*Gallicolumba jobiensis*). Casual hosts are a type of rail (*Amaurornis frankii*); the swamp hen (*Porphyrio melanotus*); and man. According to Gunther, these mites are definitely regional in their habitat. The grassed hills and the drier, less dense bush on the mountain slopes are practically free of them, whereas the dense, damp jungle of the river basins and smaller valleys is very heavily infested. Sago-palm and water-bamboo swamps and cleared areas covered with kunai grass are reputed to be the most heavily infested. Felling and clearing the bush in infested areas brings out the mites in enormous numbers. In

Papua a mite resembling *T. hirsti* is the cause of an extremely annoying dermatitis. Thirteen other mites of the family Trombidiidae have been identified, but are not believed to be vectors of tropical typhus fever.

Snakes and Other Dangerous Animals. The territories of New Guinea and Papua are known to have many poisonous land snakes belonging to the family Elapidae. At least seven genera are known to be present, but the death adder (*Acanthophis antarcticus*), the brown snake (*Demansia textilis*) and the black snake (*Pseudechis porphyriacus*) are the most dangerous. There are undoubtedly several genera of poisonous sea snakes of the family Hydrophidae. Crocodiles and lizards are common in some regions. In some regions there are wild pigs and dogs that on rare occasions have been known to attack man.

Pests. The "red-back" spider, *Latrodectus hasseltii,* is the only poisonous spider known to be present. Its potent venom may cause severe sickness, occasionally prolonged illness and, at times, death.

Three species of land leeches are known to occur in Papua and New Guinea: they are *Haemadipsa papuensis, H. noxia* and *Geobhella tristriata.* These leeches commonly lie near pathways in damp areas or regions next to water. When a victim approaches, such a leech can affix itself to an extremity with great facility; it sometimes succeeds in getting beneath the tightest clothing or through the eyelets of shoes. Although the bite of a land leech is not dangerous so far as loss of blood is concerned, the wounds heal very slowly and seem peculiarly susceptible to secondary infection.

Food and Dairy Products

Neither New Guinea nor Papua was an agricultural, livestock, or poultry-producing country. With the exception of native fruits, vegetables and fish, foodstuffs and dairy products were for the most part imported. The native dietary was quantitatively adequate but qualitatively inadequate. Almost all of the milk, dairy products and meat were consumed by the small white population. Pigs were raised by the natives, but their number was limited and their use was restricted to purposes of barter and ceremonial occasions.

Miscellaneous Problems of Sanitation

Measures of rat control were effectively administered in areas that were under complete governmental control, but in other areas measures of control could not be exercised or enforced because of limited facilities or personnel. Control of malaria was confined to the more densely populated areas, particularly those in which there was an appreciable white population. Screening for the most part was limited to government buildings. The flyproofing of human habitations and latrines was by no means universal. No measures were employed to control the mites that carry scrub typhus fever.

MEDICAL FACILITIES

Hospitals

Number of Beds. There were 31 hospitals in New Guinea and nine hospitals in Papua, but many of the institutions referred to as "hospitals" were nothing more than treatment stations and possessed only a few beds. The existing hospitals and their facilities and equipment were in fact extremely limited. The health departments of both territories operated and maintained hospitals and clinics at the government stations and substations. Their staffs also supervised plantation and mission hospitals.

Equipment. The Administration Hospitals at Rabaul on New Britain and at Port Moresby in Papua were well equipped. They had operating rooms, and facilities for roentgenologic, clinical and pathological examinations. No medical, surgical or dental supplies or equipment were manufactured in either territory. Information based on reports of importations indicates that the territories were entirely dependent upon outside sources, principally Australia, for all medical and surgical supplies.

Medical Personnel

Physicians. In June, 1940, there were 22 practitioners of medicine in the Territory of New Guinea (administrative, 13; missions, five; physicians in private practice [Rabaul], two; physicians employed by gold-mining companies, two). The medical personnel of Papua was probably even smaller than that of New Guinea.

Nurses. The number of competently trained nurses was very small. For the most part, these nurses were stationed at the larger hospitals, plantation hospitals and missions. Some of the missions selected suitably qualified native girls who were accepted as nurse trainees. If they proved to be of sufficient intelligence they were given at least two years' teaching and training. The number of these trained native nurses was small.

Others. For several years past, certain natives in the Territory of Papua were sent to the School of Public Health and Tropical Medicine at the University of Sydney, Australia, for a six months' course of instruction in first aid, elementary physics, chemistry, anatomy, physiology and pathology. Upon the satisfactory completion of this course, they returned to the territory, where they were employed by the administration as native medical assistants. In 1940 a training school for native medical assistants was established at the native hospital at Port Moresby. Trained medical assistants worked at almost every center at which there was a magisterial station; an unofficial estimate placed their number between 90 and 110. These natives were of particular value in that they spoke English and were thoroughly acquainted with the native language and customs.

Such trained and indentured native medical orderlies (literate, if possible) were placed in charge of supplies of basic medicaments for issue to the medical *tul-tuls* whom they advised and controlled. The orderlies in turn were under the supervision of Australian medical assistants.

In June, 1940, there was a total of 4,003 medical *tul-tuls* in the Territory of New Guinea. These were natives brought for a period of three months to a central school where they were taught the use of simple dressings and the most simple types of treatment. They then returned to their villages, where they practiced under the supervision of the trained medical orderlies and Australian medical assistants.

DISEASES

Diseases Spread through Intestinal Tract

Typhoid and Paratyphoid Fevers and the Dysenteries. These diseases (typhoid fever, paratyphoid fevers, bacillary dysentery and amebic dysentery) are endemic throughout all regions. They are most common in the more densely populated areas, particularly in the mining districts of the mainland of New Guinea, where epidemics of these diseases are of relatively frequent occurrence. The danger of typhoid fever is evidenced by the fact that all white persons entering the gold fields are required to be immunized against typhoid fever and paratyphoid fevers. Bacillary dysentery caused by the Flexner strains (types V, W and Z) is much more prevalent than infections caused by the "Rabaul" type of organism. During the past 10 years infection caused by the "Rabaul" type of organism has been responsible for only 22 per cent of all instances of bacillary dysentery. The primitive habits of the natives and the difficulties encountered in the enforcement of sanitary regulations result in contamination of water supplies, thus predisposing to high rates of enteric diseases.

Intestinal Parasitism. The most common intestinal parasites were *Necator americanus, Ascaris lumbricoides, Trichuris trichiura* and *Strongyloides intestinalis.* Infection with hookworm is extremely common throughout the entire area. Figures concerning the number of treatments administered indicate that in some years as much as a fifth of the native population received treatment for this disease. A survey of the incidence of hookworm in 1920 indicated that 74 per cent of the New Guinea natives and 59 per cent of the Papuan natives were infected with hookworm. The prevalence of this disease indicates the wide extent of pollution of the soil.

Diseases Spread through Respiratory Tract

Tuberculosis. Tuberculosis is extremely common; the incidence of the disease among the natives is high. In 1939 and 1940 in Papua 23 per cent of deaths of natives in administration hospitals were caused by tuberculosis.

Influenza and Pneumonia. Influenza and pneumonia periodically assume epidemic proportions. During epidemics the fatality rate among the native population is high.

Other Respiratory Infections. Chickenpox, measles, mumps, German measles, diphtheria, whooping cough, meningococcic meningitis and poliomyelitis occur sporadically among both the non-native and native populations. For the most part, the acute infectious diseases have been introduced by and occurred among recent immigrants. Epidemics, however, occur among the natives, and the effects of the introduction of these diseases have been disastrous. The danger of the development of major epidemics of one or more of these diseases constitutes a serious threat to the health of all inhabitants.

Diseases Spread by Contact

Venereal Diseases. Gonorrhea and lymphogranuloma venereum are common among the indentured laborers and natives of the central, southeastern and eastern districts of Papua. The prevalence of these diseases is greatest among the coastal tribes, particularly those in the vicinity of port towns. Syphilis is said to be rare or nonexistent; in fact, no instances of syphilis among either non-natives or natives had been reported from the Territory of New Guinea for the past ten years, or from Papua in the past seven years. In earlier publications, however, isolated cases were mentioned. Apparently, in those cases, the disease occurred only in districts in which natives had come in close contact with foreigners. Reference has been made to the fact that some of the late effects of various ulcers and the late stages of yaws are similar in appearance to the tertiary lesions of syphilis. Although syphilis is not mentioned in any of the recent statistical reports, the circumstances which perpetuate gonorrhea and lymphogranuloma venereum among the natives are also conducive to the acquisition and spread of syphilis.

Among some native groups premarital intercourse is freely indulged in and is an approved custom. Although promiscuity is common, prostitution as a profession has been almost nonexistent. Intercourse with public prostitutes once was commonly practiced by the natives of the Admiralty group, but this was suppressed.

Yaws. Yaws is very prevalent among all groups of natives, but the incidence of infection among the non-native population is negligible. In New Guinea 6 to 7 per cent of the natives have yaws; a third of all natives admitted to hospitals sought treatment for the disease. The attitude of the natives has been favorably influenced by the dramatic results of the campaigns for the treatment of yaws. These campaigns have served as an effective means of introducing other health measures.

Diseases of the Skin. Pyogenic, parasitic and fungous diseases of the skin are extremely common, particularly among the natives in both territories. In 1939 and 1940 in New Guinea 5 per cent of non-natives admitted to hospitals sought treatment for tropical ulcers; 7 per cent of non-natives admitted to hospitals sought treatment for other types of cutaneous diseases. In the same period in New Guinea 24 per cent of native inhabitants admitted to hospitals had tropical ulcers, 3 per cent had scabies, and 6 per cent had other types of cutaneous diseases.

Mycotic (fungous) infections of the skin are particularly common among the natives. Tinea imbricata is said to be especially prevalent. "Dhobie itch," an itching ringworm-like affection of the skin, and especially tinea cruris, were very troublesome to non-natives. Careful attention to care of the skin is necessary to prevent their occurrence. Pyogenic infections of the skin, including boils and abscesses, accounted for 8 to 10 per cent of all admissions to the hospitals. Scabies is almost universal in its distribution among the native inhabitants. In the Delta District of Papua an extremely annoying dermatitis called "scrub itch" is common. It is caused by the bite of a mite.

The morbidity rate (based on patients admitted to hospitals and number of treatments administered) resulting from tropical ulcers exceeds that of any other disease. In New Guinea in 1939 and 1940 approximately 5 per cent of all non-natives and 24 per cent of natives admitted to hospitals sought treatment of tropical ulcers. The disease may be bacterial in origin, but its exact etiology is unknown. Debilitation caused by chronic diseases and dietary deficiency probably was a factor in the development of tropical ulcers among the natives.

Diseases of the Eyes. Diseases of the eyes are common. Epidemic conjunctivitis caused by the Koch-Weeks bacillus affects large numbers of the native inhabitants. Other forms of epidemic conjunctivitis have been reported from this area, but no reference has been made to their etiology. Trachoma is endemic, but the incidence is not high.

Diseases Spread by Arthropods

Malaria. Malaria is without doubt the main scourge and the most important health problem in this area. The large, heavily infected native population, in association with conditions favoring the breeding of anopheline vectors, constitutes a serious menace, particularly for persons newly arrived from nonmalarious countries. *Anopheles punctulatus punctulatus* is the principal vector of malaria in this region. Benign tertian, malignant tertian and quartan types of malaria all are present, the proportions varying in different areas and in different seasons. The malignant tertian type predominates. High morbidity and mortality rates are encountered among newly arrived persons from temperate countries. The arrival of such persons in a given area usually is followed by an increase in the virulence of the disease. This increased virulence in turn adversely affects the non-immune native population. In 1940 between 14 and 19 per cent of all non-native patients admitted to hospitals had malaria or blackwater fever. The spleen rate among the native inhabitants was between 25 and 30 per cent; but in some regions almost 100 per cent of the natives had malaria. The peaks of the incidence of malaria usually occur in January and February and in May and June. The spleen indices in the various districts of the Territory of New Guinea in 1936 and 1937 were as follows: New Guinea mainland, 26 to 43; New Britain, 23 to 52; New Ireland, 32 to 34; Solomon Islands, 25 to 63; Duke of York group, 56; and Admiralty Islands, 53. Blackwater fever occasionally occurred, particularly among persons from temperate zones.

Malaria also is widely distributed throughout Papua and the adjacent groups of islands. Along the greater part of the coastal region of Papua, as well as in a large part of the smaller islands, malaria is hyperendemic. The incidence of the disease is also high in the central highlands. In the mountainous country at an elevation of more than 2,000 feet it decreases sharply. The problem of malaria in Papua is essentially the same as in the Territory of New Guinea, with the notable exception of Port Moresby. At Port Moresby there is a well-marked dry season from May to January.

The rainfall there is only about 30 inches (0.75 meter) per year. Although the incidence of malaria is high in this region, there is a notable decrease during the latter half of the dry season. Malaria is hyperendemic in the island groups of D'Entrecasteaux and Amphlett. It is highly endemic in the Trobriand Islands, the Louisiade Archipelago, and Murua or Woodlark Island.

Filariasis. Filariasis caused by *Wuchereria bancrofti* is prevalent throughout both territories and the adjacent groups of islands. Several species of Aedes and Culex mosquitoes are known to be vectors of this disease. Although elephantiasis, hydrocele and abscesses are not encountered frequently, filariasis is a common cause of morbidity among the native population.

Dengue Fever. Dengue (breakbone) fever is endemic in both Papua and New Guinea. The majority of the patients have been non-natives in the gold-field (Morobe) district in New Guinea, and in or about Port Moresby in Papua.

Typhus Fever and Typhus-Like Diseases. TROPICAL TYPHUS FEVER (SCRUB TYPHUS, MITE TYPHUS, TSUTSUGAMUSHI DISEASE). In New Guinea tropical typhus fever is almost exclusively a disease of non-natives, although in Papua a few instances have occurred among the natives. From 1930 to 1939 a total of 67 cases was reported, with a case fatality rate of 18 per cent. In the Territory of New Guinea the incidence among the small non-native population has been 7 per 1,000 of population; the disease was responsible for the illness of one out of every 24 patients admitted to the hospital. It is most commonly observed among those engaged in the felling and clearing of brush in these areas. The most heavily infested area is the vicinity of Wau and the Upper Watut in the Morobe district; but the disease also has been encountered in the Bulolo-Bulla area and the Ramu area. In the Madang district the disease has been reported from Karkar Island, and from the Green River, the Maprik, the Aitape and the Wewak areas in the Sepik district. In Papua cases have been reported from areas close to the frontier of Dutch New Guinea. The mite, *Trombicula hirsti*, is considered to be the most likely vector. This mite is transferred to man by contact with vegetation that harbors the larval mite. After being transferred to human beings, the mite is found most frequently about the parts of the body where the clothing exerts pressure: around the waist, beneath the stockings, around the scrotum and penis and in the armpits. The incubation period of the disease is about 10 days. A single, typical eschar at the site of the bite is a constant feature; this eschar, when fully developed, consists of a central, adherent black slough 2 to 8 mm. in diameter. It is not painful or tender and does not itch. The symptomatology and course of the disease are similar to those of endemic typhus fever. Locally, the disease has been called *mokka*.

ENDEMIC OR MURINE TYPHUS FEVER. In this region, as well as in Australia, all typhus fevers, with the exception of old-world epidemic typhus fever, are classified as "endemic typhus." It is considered likely, however, that murine typhus fever does occur, and there are a few isolated reports of its occurrence in the Territory of New Guinea. It is entirely possible that in these few cases the disease was of the mite-borne type.

EPIDEMIC TYPHUS FEVER. Epidemic, or louse-borne typhus fever, has not been reported. The louse vector of this disease is widely distributed throughout the entire region. Many of the native inhabitants are infested with such lice. If epidemic typhus fever should be introduced into this region, major epidemics of it might develop.

OTHER RICKETTSIAL DISEASES. Tick typhus fever, tick-bite fever, Q fever and spotted fever have not been reported from either territory.

NUTRITIONAL DISEASES

Deficiency States. Clinical and subclinical deficiency states are relatively common among all the natives, but particularly so among the indentured laborers in the gold-field areas near Morobe in New Guinea. The most commonly manifested deficiency diseases are beriberi, "New Guinea mouth disease" and nonspecific conjunctivitis. Occasional references are made to "epidemics of beriberi" (wet and dry forms) associated with considerable numbers of deaths. It is not clear whether the cases represented advanced wet forms of beriberi or epidemic dropsy caused by poisoning with contaminated mustard oil. "New Guinea mouth disease" probably was not a contagious or infectious disease, even though it is referred to in some reports as "epidemic mouth disease." It apparently is a form of scurvy. In the mildest forms of the disease there is slight ulceration of the gums about the teeth, which become loose. In the more advanced forms the ulceration extends over the gums to the inner surfaces of the cheeks and to the tongue. In extreme forms ulceration and destruction of the cheeks and face sometimes resulted in death.

Miscellaneous

Cholera, plague, rabies, yellow fever, relapsing fever, echinococcosis (hydatid disease), leptospirosis, schistosomiasis, paragonimiasis, anthrax, undulant fever, glanders, scarlet fever and smallpox have not been reported within the past ten years. It is probable that they were nonexistent in either territory at the outset of the war.

SUMMARY

Public health and sanitary measures for both territories were administered by the Commonwealth of Australia, but each territory had its own staff. Well-organized staffs were small and grossly inadequate for the needs of the native population. The administration of these measures was further complicated by the geographic factors of great distance and poor communication, faunal distribution, and by sociologic and sociomedical factors interjected by the white man's civilization into a primitive native society. There are abundant supplies of water, but facilities for treatment of it were nonexistent. There were no sewerage systems. Although there are flyproof tanks or pit latrines at the non-native centers, the natives resort to pollution of the soil. Insects that are vectors of disease abound throughout this area; especially mosquitoes which transmit malaria, dengue fever and filariasis. Mites are present which are vectors of tropical typhus fever. Flies, lice, fleas and ticks are common. Rats, bandicoots, cassowaries, wallabies and ground birds, all of which are of importance as hosts for the insect vectors of disease, are numerous. Native food supplies are quantitatively adequate but qualitatively inadequate, and deficiency states are common. The primitive, ignorant and indifferent native inhabitants require constant supervision in all matters pertaining to health and welfare. Hospitals, medical personnel, medical facilities and medical and surgical equipment and supplies are extremely limited.

Diseases of special importance are malaria, dengue fever, tropical typhus fever, venereal diseases, enteric diseases (typhoid fever and paratyphoid fevers, bacillary dysentery, amebic dysentery), diseases of the skin and filariasis. Cholera does not exist. Common communicable diseases such as pneumonia, influenza, chickenpox, measles, mumps, German measles, diphtheria, whooping cough, periodically become epidemic and are of unusual importance to the nonimmune native population, in which they are associated with high morbidity and fatality rates. Tuberculosis, yaws, infection with hookworm and diseases of the eyes are frequent among the natives.

BIBLIOGRAPHY

Australia. Bureau of Census and Statistics: Official Year Book of the Commonwealth of Australia, 1925; Ibid., 1939. Melbourne.

Australia. Governor-General: Report to the League of Nations on the Administration of the Territory of New Guinea. Annual Report 1931-1940. Canberra, Govt. Print., 1931-1940.

Breinl, A.: On the Occurrence and Prevalence of Disease in British New Guinea. Ann. Trop. Med. & Parasit., **9**:285-318 (June 30) 1915.

Byam, W., and Archibald, R. G.: The Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1921-23. 3 vols.

Cilento, R. W.: Tropical Diseases in Australasia. Brisbane, Queensland, W. R. Smith & Paterson, Ltd., 1940.

——: The White Man in the Tropics with Special Reference to Australia and Its Dependencies. Melbourne, Govt. Print. (1925).

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 2d ed., Philadelphia, Lea & Febiger, 1940.

Encyclopaedia Britannica, 14th ed. London, Chicago, Encyclopaedia Britannica, Inc., 1939.

Epidemiological Record of the Austral-Pacific Zone for the Year 1939. Health, the Journal of the Commonwealth Dept. of Health, Australia. **18**:25-31 (Apr.) 1940.

Ford, E.: Notes on Pregnancy and Parturition in d'Entrecasteaux Islands. M. J. Australia, **2**:498-501 (Nov. 16) 1940.

Gunther, C. E. M.: Endemic Typhus in New Guinea; Its Occurrence and Probable Vector. Proc. Pacific Sc. Congr. 1939, 6 Congr., **5**: 715-724, 1942.

Herms, W. B.: Medical Entomology. 3d ed., New York, The Macmillan Co., 1939.

Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, Hawaii, The Museum, 1934. (Bernice P. Bishop Museum, Special Publ. 23.)

League of Nations. Permanent Mandates Commission: Minutes, 34th Session. Geneva, 1938.

Manson, P.: Manson's Tropical Diseases, ed. by P. H. Manson-Bahr. 11th ed. Baltimore, Williams and Wilkins Co., 1941.

Papua (Terr.) Annual Report, 1934-1940. Port Moresby, 1934-1940.

Rickettsial Infections in Man. Lancet, **1**:149 (Jan. 31) 1942.

The Statesman's Year-Book. London, The Macmillan Co., Ltd., 1943.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed. by R. P. Strong. Philadelphia, The Blakiston Co., 1942. 2 vols.

Taylor, F. H.: Intermediary Arthropod Hosts and Mechanical Carriers of Human Diseases in the Australian Region. Health, the Journal of the Commonwealth Dept. of Health, Australia, **16**:72-82 (Aug.) 1938.

28

Philippine Islands

GEOGRAPHY AND CLIMATE

The Philippine Islands are situated at the eastern edge of the China Sea, about 500 miles from the southeastern coast of China, in the center of the main ocean lanes which link China and Japan to Australia. On the north and east the islands are surrounded by the Pacific Ocean; on the south by the Celebes Sea and the coastal waters of Borneo; on the west by the South China Sea.

The some 7,000 islands of the Philippine group have a land area of 115,600 square miles, or slightly more than that of the state of Arizona (113,956 square miles). Only 11 islands are considered to be important, and only about 460 have an area of 1 square mile or more. Two of the islands, however —Luzon and Mindanao—have a combined area of more than 76,000 square miles, and rank among the large islands of the world.

The population of the Philippine Islands is about 16,000,000. The greatest concentration is in the northern and central parts of the island of Luzon and in the entire plain country of the island of Cebu, where in some districts the ratio is as high as 150 persons per square mile. The island of Mindanao, on the other hand, is sparsely populated. More than 15,000,000 of the inhabitants of the Philippine Islands are Filipino; the rest constitute a relatively small element of foreign-born residents. The chief languages are Spanish and English, although there are numerous native dialects, such as Tagalog, which is one of the most developed of the Austronesian languages.

Physically, the Philippine Islands are mountainous and heavily wooded. Both active and extinct volcanoes are found, and much of the terrain has an elevation of from 1,000 to 3,000 feet. Some mountain ranges attain an elevation of more than 3,000 feet; on Luzon there is a peak 9,480 feet high, and another peak 9,610 feet high is situated in Mindanao.

The hydrographic features are notable. A few large streams in Mindanao and Luzon, as well as smaller ones which become torrential during the rainy season, provide ample drainage throughout the islands. The most important stream probably is the Pasig River, extending from Laguna de Bay to the city of Manila. There are also underground streams and numerous lakes, the largest of these being situated in Luzon and Mindanao.

The climate of the Philippine Islands is in general warm; in the lowlands it is tropical. At Manila, for instance, the annual mean is 80° F. (26.6° C.); the highest temperature has been 100° F. (37.7° C.), and the lowest, 53° F. (11.6° C.). The winter season extends from December through February; the summer season ranges from March through June. From June through November the rainy season persists, in the course of which the rainfall varies from 40 to 120 inches (roughly, 1 to 3 meters).

The northeastern trade winds prevail from June to November. During this time the eastern coast lines receive much rainfall, whereas the interior and the western coast lines are dry. Actually, however, there are three distinct zones of rainfall in the Philippine Islands: (1) the western coast, in which the rainy season lasts from June 15 to December 1; (2) the eastern coast, which receives rain throughout the year but in which the maximal rainfall occurs in the winter, and (3) certain regions in which there is either a short dry season, in March and April, or no dry season or period of maximal rainfall.

Typhoons are most frequent from July to November, are less frequent in May, June and December, and are rare in other months.

PUBLIC HEALTH *

Health Services

Organization. The organization and administration of public health in the islands were centralized. Although there were insular, provincial and municipal health organizations, the health administration was nevertheless in the hands of a central authority, the Office of the Director of the Bureau of Health. The last Director of the bureau was appointed to this post in 1938. The bureau was composed of five divisions: (1) administration, (2) hospitals, (3) maternal and child hygiene, (4) epidemiology and (5) sanitation. Each had a separate chief. In the provinces, at the head of each health district (usually one province), was a district health officer and under him were "presidents" of sanitary divisions who were regarded as field officers. Under them were sanitary inspectors, disinfectors and vaccinators. A corps of nurses also was assigned to duty in the provinces. In all, in the year 1938, the medical personnel of the Bureau of Health numbered 680 and for the same year there were 5,177 nonmedical employees. The bureau maintained hospitals and public dispensaries. In addition, special clinics were maintained for the treatment of tropical ulcers, scabies, trachoma and yaws. There were 20 special units for the treatment of yaws operating in 18 provinces (areas of highest incidence) in 1938. The bureau was responsible for the maintenance and operation of four traveling roentgen-ray units for use in tuberculosis control work, and there was also a tuberculosis research laboratory and facilities for special training for qualified physicians. A field laboratory for the control of malaria had headquarters in Bulacan province, and malaria control units were situated in the provinces of Laguna, Pangasinan and Isabela. Programs of immunization were constantly in operation; they were directed against smallpox, typhoid fever, paratyphoid fever, dysentery and cholera. Control and inspection of water supplies were most effective in Manila. There were 11 public health laboratories in the provinces, and it was planned to establish an additional 20 during 1939. Rapid strides had been made in industrial hygiene; with the passage of an act requiring employers to furnish free emergency medical treatment to laborers under certain conditions, 172,605 employees were benefited by the provisions of the measure and 453 physicians were furnished full-time and part-time positions. Other activities included a board of food inspection, a biologic products board, and public health nursing and education services. The total expenditure by the Bureau of Health in 1938 was 6,116,639.02 *pesos*, an average of 0.45 *pesos* per capita. The *peso* had a fixed value of $0.50.

Relative Effectiveness. It has been stated that few countries in the Far East could approach the Philippine Islands in their efforts toward advancement of personal and public health. The original stimulus was furnished by the United States at the beginning of the century, with the American occupation of the Philippines. After the formation of the Commonwealth in 1935, the Philippine Government took over all public health activities. The task of the Bureau of Health of the Philippines was made doubly difficult by the physical geography of the islands. There are about 7,000 islands with a total area of 115,600 square miles, and a population of 16,000,000 spread

* Unless otherwise indicated, governmental organizations, medical facilities and other conditions which may have been changed as a result of the war are described in this chapter as they were known to exist at the outset of hostilities.

out over a territory approximately equivalent in size to the eastern third of the United States. The effective application of public health and sanitation measures to all these people was a monumental achievement and one which has not been equaled in that part of the world, except possibly by the Dutch efforts in the Netherlands East Indies.

Miscellaneous Problems of Sanitation

In the provinces, Filipino houses usually are of simple frame construction, covered with thatch. They are well ventilated and are placed on stilts to avoid floods and high water. In contrast, Chinese houses on the islands are usually built on the ground, the only apparent reason being to "prevent devils from coming up through the floor."

In general, health conditions in the Philippines were superior to those in other Far Eastern and Asiatic countries, although there was considerable room for improvement. The greatest strides in sanitation were made in Manila, where an excellent water supply was made available, with the added advantage of a disposal system in which sewage is water-borne. Elsewhere in the islands, the Bureau of Health had succeeded in installing suitable types of sanitary latrines in numerous areas to replace the more primitive methods of disposal of sewage. The artesian well water which supplied the provinces was considered to be potable without treatment, although the high incidence of enteric diseases would not bear this out. On the whole, the Philippines remained remarkably free of most of the tropical scourges, with the exception of leprosy, malaria and enteric infections, whereas the ordinary diseases of temperate climates, especially tuberculosis, were present in abundance.

Water Supplies

Water in the Philippines was obtained from three principal sources: artesian wells, surface wells and rainfall. Water from streams and rivers was principally employed for bathing, laundry and removal of sewage and waste; consequently it was rarely used for drinking. Most of the potable water in the provinces was supplied by artesian wells. These were deep and ordinarily required no pumping. Water obtained from them was believed by the Bureau of Health to be satisfactory for general use without treatment. Such wells, if properly capped and controlled, will last indefinitely, but if they once run dry they seldom can be reclaimed. Surface wells were used to some extent throughout the islands to supplement the artesian supply. They were shallow, usually placed too close to privies or other areas in which wastes were disposed of and were almost universally contaminated. As a rule, the wells were not curbed or covered and heavy rainfall might wash surface soil into the wells. They were likely to be community property, thus increasing the opportunities for contamination of water and dissemination of disease. In a few areas located near suitable natural watersheds, rain water was used as a main source of supply. Since watershed areas were sparsely populated, opportunities for contamination were few; but such water generally was chlorinated before it was used.

The only properly treated water in the islands was found in Manila. The supply of the city was obtained from watersheds located on the plateaux of the eastern portion of the province of Rizal. The city had an excellent water purification plant, complete with reservoirs, sand filters and facilities for chlorination. Bacterial examinations carried out by the Bureau of Health consistently demonstrated a low bacterial count, and no members of the coli-aerogenes group were present. In some areas of the city, where regular city water was not obtainable, artesian wells and surface wells continued to be used.

Sewage Disposal

Facilities for the disposal of sewage, excepting those in the city of Manila, were relatively primitive. Drainage ditches, creeks or other streams could be found in close proximity to *barrios* and towns, and such water was used for bathing, laundering, dumping of wastes and excrement, and for irrigation or watering of crops. In those areas in which pollution of the soil was practiced or the pail system of collection was used, these streams were especially rank. Such practices were common, more so among the Chinese, and were potent factors in the spread of enteric disease. Many Filipino houses were equipped with the so-called bored-hole latrine. This is a pit of narrow diameter (post-hole size) about 18 feet (5.5 meters) deep, dug so that the bottom of the hole is below ground-water level. These latrines are so placed as to be close to the house but some distance from the source of water. Because of the pressure of water in the bottom of this type of latrine, the latrine is a modified septic tank which usually is satisfactory. In places in which the ground-water level is so high that splashing or overflowing is troublesome, the hole is extended above ground by a length of tile pipe which is surrounded by a mound of earth. The public health program was responsible for the establishment of one of these bored-hole latrines for every eight inhabitants, a proportion thought to be sufficient for sanitary needs.

Manila had the only piped collection system in the islands in which sewage was water-borne, but even this did not supply the entire Manila area. Privies and sanitary latrines were in general use and the pail system was employed in some sections of Manila. It was apparently impossible to supply each house with connections to the sewer system, but each new house that was constructed was required to have such a connection. The sewage was disposed of in Manila Bay at a point about 1 mile from shore.

Insects and Animals

Vectors of Disease. Mosquitoes. Twenty-nine species of Anopheles mosquitoes have been recognized in the Philippines but, on the basis of accumulated evidence, only four species have been incriminated in the transmission of malaria. The most active transmitter is *Anopheles minimus flavirostris,* a member of the *funestus-minimus* subgroup. The other two members of this subgroup, *Anopheles mangyanus* and *A. filipinae,* are of secondary importance. *Anopheles maculatus maculatus* is a less-prominent vector of malaria. *Anopheles minimus flavirostris* most often breeds in clean, fresh, flowing and slightly shady streams in which bamboo roots are present but also in rivers, flowing or stagnant irrigation ditches, pools and wells. Consequently, malaria is a disease of the foothills, and is not common in the lowlands or rice fields and does not occur above elevations of 2,000 feet. It was not until this fact was fully appreciated that any progress was made in the control of malaria. These mosquitoes are more prominent in transitional seasons. Where there are pronounced wet and dry seasons, malaria will appear in two waves each year at the change of the seasons. Where such seasons are not pronounced, malaria is perennial. It has been suggested that the prevalence of malaria in the foothills has been partly responsible for the maintenance of ethnologic distinctions between the hill people and those from the plains.

Mosquitoes of the Aedes group are the common household pests of the Philippines. Thirty-five species have been identified. Especially important are *Aedes aegypti* and *A. albopictus,* both active in the transmission of dengue fever and both effective vectors of yellow fever, although this disease is not present.

Twenty species of the genus Culex have been identified in the Philippines. Of these, *C. fatigans* is of medical importance as a vector of infections due to *Wuchereria bancrofti.* It is possible that some species of Anopheles may also aid in the dissemination of this disease.

Rodents. Rats and their parasitic fleas are numerous, but plague has not been reported since 1914.

Snails. Snails of the genus Melania harbor the miracidia of the lung fluke, *Paragonimus westermani,* and are distributed throughout the islands. The miracidia undergo the usual development, eventuating in the formation of cercariae which then inhabit fresh-water crustacea (crabs and crayfish) that constitute the source of the disease that affects human beings. The snails, Schistosomophora sp., the intermediary hosts of *Schistosoma japonicum,* are found in the provinces of Leyte, Samar and the northern part of Mindanao.

Poisonous Snakes. Two species of Indian coral snakes, *Doliophis bilineatus* and *D. philippinus,* are reported to be present in the islands. The *dahon palay* or arrow-headed, rice-leaf snake is reputed to be poisonous. It is reported, however, that snakes are of relatively rare occurrence and danger from them can be minimized. Some species of sea snakes have been reported.

Pests. Flies (*Musca sorbens, M. vicina*) are present and are instrumental in maintaining the high incidence of enteric infections. Itch mites of the genus Trombicula are widespread. *Sarcoptes scabiei* has universal distribution, and scabies has become a distinct problem in the islands. A species of small spider, *Latrodectus hasseltii,* is said to secrete a potent venom which produces profound toxemia that may result in death. Tarantulas also are present, but their appearance is much worse than the effects of their sting. Rats are numerous and, although strict port quarantine has prevented outbreaks of disease, little has been done to eradicate the rat population. A species of terrestrial leech, *Haemadipsa talagalla,* is present.

Measures of Control. The Philippine government carried on some measures of control in the more malarious areas in an effort to eradicate the breeding sites of anophelines. "Naturalistic" methods, such as sluicing and shading, were employed to produce conditions unsuitable for anopheline larvae, and Paris green was used as a larvicide. Extensive treatment of carriers of malaria and patients who had the active form of the disease proved effective in some areas. Educational campaigns as to the proper use of screens and mosquito nettings were carried out at frequent intervals. In the provinces served by the malaria control units, operations yielded encouraging results in reduction of anophelines and in diminution of the actual number of cases of malaria.

Port authorities were active in trying to suppress the rat population, but there was no concerted effort on the part of the provinces to eliminate these pests. The Bureau of Health made sporadic attempts at educational programs and gave bounties for rats brought to health officers. Measures for control of flies were entirely inadequate; until considerable improvement is made in methods of disposal of waste and sewage, flies will continue to be a menace.

Food and Dairy Products

As a rule, Filipino natives were better nourished than natives of other Far Eastern countries, although there is no doubt that they also were suffering from the effects of inadequate nutrition, due either to poverty or to ignorance of the value of nutritive foods. Conditions improved considerably in recent years, largely because the Bureau of Health taught practical nutrition in the public schools. The native diet was made up of fish, rice, leafy vegetables and fruit, together with some meat obtained from such domestic animals as hogs, sheep, cattle and carabaos. In some areas there was also a supply of native corn somewhat similar to that grown in the United States. As a general rule, Americans and Europeans, especially in the area of Manila, used foods obtained from abroad, since facilities for cold storage were adequate in the city. Locally grown vegetables were sometimes used to supplement imported foods but, as a general rule, these had to be considered unsafe if they were not cooked. Fertilization with night soil was a common practice, and ditch or drainage water was used freely to keep vegetables wet and fresh on the way to market. These practices all were much more common among Chinese farmers than among the Filipinos. Attempts were made to encourage the raising of cattle and other domestic livestock suitable for marketing, but progress was negligible.

Supplies of milk were inadequate and, with the exception of milk from one or two dairies in Manila in which pasteurization was carried out, the milk was considered unsafe. Evaporated or dried milk imported from the United States or Australia was in wide use. Butter also was imported.

MEDICAL FACILITIES

Hospitals

Number of Beds. At the end of 1938, there were about 160 hospitals with a total capacity of approximately 0.76 bed per 1,000 of population (U. S. A., 9.7 beds per 1,000 of population). This included hospitals directly under jurisdiction of the Commonwealth Government, general hospitals, university hospitals, leprosariums, penal hospitals, mission hospitals, private hospitals and maternity hospitals. In general, hospitals were fairly well equipped and were able to offer a variety of services. Public health laboratories were maintained in the provinces and their facilities were available free of charge. In addition, there was a large number of public dispensaries and special treatment stations. In every instance, the hospitals and clinics were utilized fully, and increased capacity was a constant need. The outstanding deficiency was a notable lack of isolation facilities for patients with communicable diseases.

In addition to the facilities already mentioned, there were private corporations in the Philippines which maintained dispensaries or more elaborate installations for the medical care of their employees.

Equipment. Adequate medical and surgical laboratory and research facilities were available only in the larger urban centers and at special hospitals and institutions controlled by the government.

Supplies. Almost all medical supplies were imported. The only medicinal product manufactured locally was totaquina, a quinine alkaloid.

Medical Personnel

Physicians. There were 4,909 licensed physicians in the Philippines as of January 1, 1940, or one physician for every 3,216 inhabitants. About 90 per cent of these physicians were Filipinos, and a great majority were graduates of local medical colleges, of which there were four. They were the College of Medicine and Surgery of the University of Santo Tomas, the College of Medicine of the University of the Philippines, the Graduate School of Hygiene and Public Health of the University of the Philippines and the Afable College of Medicine. Examinations were conducted by a board of medical examiners, and successful candidates were licensed to practice. The Philippine Islands Medical Association had 1,127 members and was affiliated with the American Medical Association.

Nurses. As of January 1, 1940, there were 5,030 registered nurses in the islands. With few exceptions, they were trained in the eight nurses' training schools operated by various hospitals. Six of these schools were in Manila, one was in Capiz and one was in Iloilo.

Others. In addition to licensed physicians and nurses, there were, at the same time, 2,699 dentists, 3,920 pharmacists and 234 veterinarians scattered throughout the islands. There were 1,748 licensed midwives, located chiefly in the provinces.

On the whole, Philippine medicine made great strides during the past 40 years under the guidance of some of America's finest physicians.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysentery. Bacillary dysentery was by far the most important enteric infection in the Philippines; the incidence rate was notably greater in the provinces than in Manila. It was said that the disease was largely sporadic, but unsafe water and food supplies enhanced the possibility of epidemics. In 1938 there were 8,867 cases, with 2,836 deaths (Table 30). Amebic dysentery occurred much less commonly than bacillary dysentery, but was a cause of considerable morbidity. Reports indicated that this type was especially troublesome on the island of Negros. Balantidial dysentery was not commonly encountered.

Typhoid fever was prevalent throughout the islands, but about a third of the cases were reported from Manila (Table 30). In 1938 there were 2,236 cases, with 1,040 deaths. Paratyphoid fevers accounted for only six of these fatalities. The number of cases of typhoid fever had decreased from the 1924 figure of 3,162, but the disease remained a public health problem.

Common diarrheas were widespread throughout the islands, and outbreaks of food poisoning of undetermined etiology were frequent.

Cholera. Severe epidemics of cholera have been recorded in the Philippines. However, this disease had not occurred after 1937 and, in spite of subsequent outbreaks in Far Eastern ports, the islands remained free of the disease until the Japanese invasion. Excellent facilities for port quarantine were responsible for this record.

Infection with Worms. Such infection was extremely common throughout the

TABLE 30

Disease Statistics: Philippine Islands

Diseases		Manila 1937	Manila 1938	Provinces 1937	Provinces 1938	Total 1937	Total 1938
Cerebrospinal meningitis..	C *	14	19	8	15	22	34
	D *	11	10	6	14	17	24
Diarrhea and enteritis....	C	2,407	2,657	23,702	26,743	26,109	29,400
	D	858	1,062	10,845	11,096	11,703	12,158
Dysentery...............	C	608	417	11,514	8,450	12,122	8,867
	D	192	174	3,423	2,662	3,615	2,836
Typhoid fever...........	C	570	678	1,572	1,558	2,142	2,236
	D	181	186	985	854	1,166	1,040
Bronchitis...............	C	2,358	2,451	40,833	43,811	43,191	46,262
	D	621	541	26,447	26,526	27,068	27,066
Bronchopneumonia.......	C	2,668	2,890	22,723	23,853	25,391	26,743
	D	1,844	2,306	20,720	21,828	22,564	24,134
Lobar pneumonia........	C	610	1,070	8,149	8,907	8,759	9,977
	D	379	592	7,658	8,166	8,037	8,758
Measles.................	C	904	655	5,675	4,427	6,579	5,082
	D	77	88	1,214	906	1,291	994
Influenza................	C	1,757	2,478	32,195	31,304	33,952	33,782
	D	158	291	9,554	8,994	9,712	9,285
Diphtheria..............	C	297	328	176	140	473	468
	D	54	68	83	89	135	157
Gonorrhea..............	C	2,710	1,779	495	333	3,205	2,112
	D	.....	.....	...	...	......	.....
Syphilis.................	C	208	382	57	159	265	541
	D	.....	.....	...	...	.....	.....
Chancroid..............	C	21	41	24	3	45	44
	D	.....	.....	...	...	.....	.....

* C = cases; D = deaths.

Philippines; ascariasis and trichuriasis were the most prevalent of these. Infection with hookworm was endemic, and all three varieties of hookworm, *Ancylostoma duodenale, A. braziliense* and *Necator americanus*, were present. Four tapeworms were found, *Taenia saginata, T. solium, Sparganum mansoni* and *Hymenolepis nana*, the latter being the least commonly encountered. A few cases of clonorchiasis were encountered among the Chinese; infection with *Fasciolopsis buski* was rare. Infection with *Paragonimus westermani* occurs.

Schistosomiasis. Infection with *Schistosoma japonicum* has been recognized in only three provinces: Samar, Leyte and the northern part of Mindanao. In these areas, swimming in fresh water is never advisable.

Diseases Spread Chiefly through Respiratory Tract

Respiratory infections were sources of trouble throughout the islands. Influenza, bronchitis, bronchopneumonia and lobar pneumonia all were common (Table 30). Influenza was of common occurrence, and many physicians believed that in a number of cases in which dengue fever had been diagnosed, the disease really was influenza.

Tuberculosis. Tuberculosis in all forms was prevalent in the Philippines and ranked as the single greatest cause of death. In 1938 new cases numbered 44,560 and in the total number of cases, new and old, there occurred 34,693 deaths. The death rate in 1938 was given as 2.8 per 1,000 of population. These are incomplete figures. As a rough estimate, almost 1,000,000 people in the islands were afflicted with some form of tuberculosis. Regardless of the relative accuracy of these statements, the importance of the disease to the Philippines cannot be minimized. The Philippine Bureau of Health reported a yearly admission rate of 8.5 per 1,000 of population for tuberculosis in 1940.

Smallpox. In the islands smallpox did not occur after 1922 except for a few instances of it among Moros in the far south. In two cases reported in 1938 both the patients were passengers on ships docked in the islands. The intensive immunization campaigns carried out by the Bureau of Health were responsible for this record.

Diseases Spread Chiefly through Contact

Venereal Diseases. Gonorrhea was the most prevalent of the venereal diseases; 2,112 new cases of it were reported in 1938 (Table 30). There were also 541 new cases of syphilis and 44 cases of chancroid. It is not believed that these figures give anything like a true picture of these diseases in the islands. It has been said that Manila had an especially difficult problem in respect to venereal disease. There were no licensed houses of prostitution, but clandestine contacts were plentiful, especially among the Chinese. Supervision and control of the sources of venereal infections were impossible. Lymphogranuloma venereum and granuloma inguinale were not reported.

Yaws. In 1938 there were 31,647 patients with yaws known to be under treatment, and special clinics had been set up by the government to operate in the more heavily endemic areas.

Trachoma. In 1938, fully 32,695 cases of trachoma were reported, and 15,419 were recorded from the province of Bohol. No explanation of this prevalence was given. Special clinics for the treatment of trachoma were maintained by the Bureau of Health.

Leprosy. In the Philippines, leprosy is a fairly common affliction. At the end of 1938 there were 8,582 lepers, including 920 new patients whose condition had been recognized during the year. The Bureau of Health had excellent facilities for the isolation and treatment of these patients, the largest institution being the Culion Leper Colony on Culion Island. Every province had its temporary detention camp for suspected lepers. Dispensaries and stations for treatment of diseases of the skin were available in Cebu, Iloilo, Manila, Zamboanga and Albay.

Diseases of the Skin. As in the other tropical countries, dermatologic disturbances were a major affliction. Most characteristic were scabies, dhobie itch and common fungous infections. Tropical ulcer also was frequently encountered; 19,431 instances of it were recognized in 1938.

Diseases Spread by Arthropods

Malaria. Four of the twenty-nine species of anopheline mosquitoes in the islands are capable of transmitting malaria. Of these *Anopheles minimus flavirostris* is by far the most important. Breeding habits of this mosquito and its effect on distribution of, and seasonal variation in, malaria were previously explained in the paragraphs on mosquitoes. Malaria was seldom transmitted in Manila; a few cases were occasionally imported. The actual number of cases of malaria in the islands was not known, but it was variously estimated at between 1,000,000 and 2,000,000. Statistics for the year 1938, obviously incomplete, showed an incidence of 76,193 new cases with 9,427 deaths. Blackwater fever was an uncommon complication.

Filariasis. Both filariasis and elephantiasis were seen in the islands. The causative organism was *Wuchereria bancrofti.*

Dengue Fever. Dengue is endemic and periodically assumes epidemic proportions. Two vectors of dengue fever are present in the Philippines: *Aedes albopictus* and *A. aegypti.* Although there was some local controversy concerning the relative prevalence and diagnosis of dengue fever and influenza, there is no doubt that dengue fever is prevalent.

Yellow Fever. Although the common vector of yellow fever, *Aedes aegypti,* abounds, this disease has not been reported.

Plague. This disease was not reported after 1914. However, in view of the large rat and rat-flea population, reintroduction of this disease is a possibility.

Nutritional Diseases

Largely because of poverty and ignorance concerning proper foods, malnutrition was prevalent. Deficiency states, chiefly beriberi, persisted despite all public health efforts of the last few years. Pellagra, scurvy and rickets were of uncommon occurrence.

SUMMARY

The Philippine Islands are generally considered to be one of the more healthful regions of the Far East, although the climate is tropical and the rainfall is heavy. Food supplies in the islands, consisting largely of fish, rice, leafy vegetables, fruits and meats, were sufficient for the normal population. Milk supplies were inadequate and those fresh milk and dairy products which were available were considered unsafe. In general, all surface water supplies should be considered contaminated, but water from deep artesian wells frequently was found to be potable without treatment. Only Manila had a system in which sewage was water-borne; elsewhere the bored-hole latrine was in common use. In rural areas, the pail system of collection of night soil was used, but indiscriminate pollution of the soil was not uncommon.

Medical supplies and hospital facilities were inadequate for the personal needs of the local population.

The most important problems of disease in the Philippine Islands include malaria; enteric infections, especially bacillary dysentery, typhoid fever, paratyphoid fevers and the common diarrheas and, to a less extent, amebic dysentery; venereal diseases; common respiratory diseases; dengue fever; intestinal parasitism; diseases of the skin; and tuberculosis.

BIBLIOGRAPHY

Byam, W., and R. G. Archibald, Editors: Practice of Medicine in the Tropics. London, H. Frowde and Hodder & Stoughton, 1921-23. 3 vols.

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 2d ed. Philadelphia, Lea & Febiger, 1940.

de Jesus, P. I., and Abdon, G.: Chemical Analysis of the Sewage of Manila. Acta Med. Philippina, **1**:315-329 (Jan.-Mar.) 1940.

——, and Ramos, J. M.: Effect of Filtration on the Sanitary Quality of the Water of the Metropolitan Water District. Philippine J. Sc., **59**:455-470 (Apr.) 1936.

Dunham, G. C.: Leprosy in the Philippine Islands. Am. J. Pub. Health, **26**:27-29 (Jan.) 1936.

Encyclopaedia Britannica, 14th ed. London, Chicago, Encyclopaedia Britannica, Inc., 1939.

Garcia, O., and Vazquez-Colet, A.: Bacteriological Examination of Stools of Food Handlers in Manila. Philippine J. Sc., **24**:735-741 (June) 1924.

Greentree, L. B.: Ambulatory Pneumothorax, Its Rôle in a Program of Treatment and Prevention of Tuberculosis. Am. Rev. Tuberc., **45**: 499-503 (May) 1942.

League of Nations. Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Report of the Philippines. Geneva, 1937.

Lull, G. F.: Health Conditions in the Philippine Islands. Mil. Surgeon, **72**:215-224 (Mar.) 1933.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

——: Leptospira Icterohaemorrhagiae in Wild Rats of the Philippine Islands. Proc. Soc. Exp. Biol. & Med., **26**:26-28 (Oct.) 1928.

McMurdo, H. B.: Malaria, 1940 Maneuvers, Luzon, Philippine Islands. Mil. Surgeon, **87**: 252-255 (Sept.) 1940.

Manson, P.: Manson's Tropical Diseases. Edited by P. H. Manson-Bahr. 11th ed. Baltimore, Williams and Wilkins Co., 1941.

Mendoza-Guazon, M. P.: Sanitary Problems in the Philippines. Rev. Filipina de med. y farm., **18**:350-354 (Oct.) 1927.

Month. Bull. Philippine Health Service, **15,** 1935; **18,** 1938; **19,** 1939; **20,** 1940.

Philippine Islands: Bureau of Health. Annual Report for the Fiscal Year Ending December 31, 1936. Manila, Bureau of Printing, 1937. Ibid., 1938, 1939.

Philippines. (Commonwealth) Commission of the Census: Census Atlas of the Philippines. Manila, Bureau of Printing, 1940.

Ramirez, T. R.: Some Observations on the Manila Water Supply. Acta Med. Philippina, **1**: 331-337 (Jan.-Mar.) 1940.

Russell, P. F., and Baisas, F. E.: A Practical Illustrated Key to Adults of Philippine Anopheles. Philippine J. Sc. 1936, **59**:15-64 (Jan.) 1936.

Simmons, J. S., and Aitken, T. H. G.: The Anopheline Mosquitoes of the Northern Half of the Western Hemisphere and of the Philippine Islands. Army M. Bull., 1942 (Special issue), No. 59.

——, St. John, J. H., and Reynolds, F. H. K.: Experimental Studies of Dengue. Philippine J. Sc., **44**:1-251, 1931.

——, ——, ——: Dengue Fever Transmitted by *Aedes albopictus* Skuse. Am. J. Trop. Med. **10**:17-21 (Jan.) 1930.

Simpich, F.: Return to Manila. Nat. Geog. Mag., **78**:409-451 (Oct.) 1940.

Statesman's Year-Book. London, The Macmillan Co., Ltd., 1939.

Taylor, C. N.: Odyssey of the Islands. New York, C. Scribner's Sons, 1936.

Worcester, D. C., and Hayden, J. R.: Philippines, Past and Present. New York, The Macmillan Co., 1930.

World Almanac. New York, New York World-Telegram, 1942.

29

Phoenix Islands

GEOGRAPHY AND CLIMATE

The eight Phoenix Islands are a part of the Gilbert and Ellice Islands Colony, and were acquired by Great Britain between 1889 and 1892. They are situated within the area described by 3 and 5° of south latitude and 170 and 175° of west longitude. The question of title to two of the islands—Canton and Enderbury—is in abeyance. These two islands are claimed by both Great Britain and the United States, but in 1938 an agreement was reached as to use of certain facilities on the islands by the two nations.

The eight islands are Canton, McKean, Birnie, Enderbury, Phoenix, Hull, Sydney and Gardner. The total area of the group is 16 square miles. The population in 1938 was 62, all but a few of whom were colonists from the Gilbert and Ellice groups.

The islands are coralline. Each has a central lagoon, but the lagoons vary in depth. That of Phoenix is only 1 to 2 feet deep; that of Hull and Canton islands is about 80 feet deep. The rims which encircle these lagoons as a rule are less than a quarter of a mile wide. None has an elevation of more than 20 feet. Fringing reefs of coral surround all the islands.

The climate is warm and dry. The east wind blows for about three fourths of the year. The temperature generally ranges between about 75 and 85° F. (23.8 and 29.4° C.), but it has been said that a temperature of 140° F. (60° C.) at midday has been recorded. The average annual rainfall has been between 15 and 25 inches (0.38 and 0.63 meter). Heavy storms are not frequent, but rain falls intermittently from December to May.

PUBLIC HEALTH

Health Services

Organization. There is no public health organization on these islands; such preventive measures as are carried out are the responsibility of the medical services. Medical service on Canton Island is furnished by an airline company, which maintains a small infirmary. Hull, Sydney and Gardner islands each has a small native hospital in charge of a native dresser trained at Tarawa in the Gilbert Islands. Prior to Japanese occupation of the Gilbert and Ellice Islands each hospital was visited once or twice a year by a British colonial medical officer, or by a native practitioner trained at Suva in the Fiji Islands and employed by the colony. The native dressers were responsible to the British Chief Medical Officer at Tarawa in the Gilbert Islands, who in turn was responsible to the British High Commissioner for the Western Pacific in the Fiji Islands.

Water Supplies

There is no fresh water on Canton Island, Enderbury Island, Birnie Island, Phoenix Island or McKean Island. Fresh water in wells on Sydney Island, and more particularly on Hull and Gardner islands, is likely to be brackish after periods of drought. The coral formation of these islands is so permeable that almost all the rain which reaches the surface of the ground is rapidly lost to the lower levels, where there is relatively free communication with the sea water within the coralline rock. Brackish water is found at a depth of several feet practically anywhere on the islands; if water is drawn from one point for a short time it becomes salty. On all the islands most water for drinking is obtained by the collection and storage of rain water in cisterns or special tanks. Such cisterns are provided on the islands of Canton, Sydney, Hull and Gardner. Since such water is always exposed to contamination, it cannot be considered safe for drinking without treatment. Treatment of the water taken from cisterns or from "seeps" or slightly brackish wells is provided only on Canton Island.

Sewage Disposal

Human excreta are disposed of into shallow pit latrines which probably penetrate the water table and for this reason add to the contamination of the slightly brackish underground water. On Canton Island and possibly on Sydney Island there are sewerage systems in which sea water or slightly brackish well or seep water is utilized for operation. Many of the inhabitants, now as previously, deposit excreta on the seashore.

Insects and Animals

Vectors of Disease. Mosquitoes. Neither anopheline nor Aedes mosquitoes are reported from any part of the Phoenix Islands. No species of Culex capable of carrying disease is reported. *Culex annulirostris* is said by some observers to be a common pest on Phoenix Island, and to be present, although less numerous, on Hull and Sydney islands. An unidentified species, possibly this same mosquito, is said to have been brought from Tahiti in the Society Islands to Sydney Island in 1884.

Lice. Lice are not reported, but they probably are present among the natives of Hull, Gardner and Sydney islands.

Flies. Approximately 21 species of flies are reported. All are troublesome pests, and some are potential vectors of disease. It is said that flies do not occur on McKean Island. The most important flies are *Musca domestica, Sarcophaga dux,* and one species or more of the blue or green bottle fly of the family Calliphoridae. These species breed in food, human excrement, carrion, and sometimes in ulcerated human tissues.

Ticks. An undetermined species of the family Argasidae is reported from Canton Island, where it is thought to be parasitic on sea birds. Other ticks are not reported.

Fleas. Flea-borne diseases are not known in the Phoenix, Gilbert or Ellice islands, and fleas are not reported from these areas.

Rodents. Rats are extremely numerous on all the atolls excepting Phoenix, but rat-borne diseases have not as yet been reported. Most of these rats probably belong to the group of which *Rattus concolor* is the type. This rat was brought to many remote islands by early Polynesian voyagers. *Rattus rattus* and *R. norvegicus* also are present, but are not numerous. No adequate measures for the control of rats have been instituted.

Snakes and Other Dangerous Animals. Land snakes are not reported, but flat-tailed sea snakes often may be found swimming in shallow coastal waters. They will not attack bathers, but if caught inadvertently by fishermen will strike readily. They are extremely poisonous. The yellow-bellied sea snake probably is most common. Centipedes and a scorpion, *Isometrus maculatus,* occasionally are found in buildings. Their stings are painful, and are dangerous to children.

Pests. Roaches are extremely common pests; they may possibly be of potential medical importance, since they invade places in which excrement and sputum are found. They likewise feed on food in all stages of preparation. The species known to be present are *Periplaneta americana* and *Supella supellectilium.* Crabs as well as rodents destroy many coconuts. Extremely tame rabbits overrun Phoenix Island, and probably other islands. Insects are constant pests. Moths, spiders, beetles, leaf hoppers, caterpillars and ants are extremely numerous.

Dangerous Marine Life

Stinging fish, including lumpfish, zebra fish and others, are numerous. They have dorsal and head spines communicating with poison glands, and will attack readily. The lumpfish lie on the bottom of reefs, from which they are distinguished only with difficulty, whereas the brightly colored zebra fish swim actively. Their venom produces localized gangrene and rapid, generalized cardiovascular changes which may be fatal. Sting rays are greatly dreaded. These are broad, rounded fish with extremely long, powerful, barbed tails. They lie concealed in shallow water, and if disturbed drive their barbs repeatedly into their foe, causing severe lacerations. Poisonous jellyfish occur; their sting causes severe pain and swelling and occasionally death. Morays are dangerous because of their long teeth, through which is injected a hemolytic toxin capable, in large amounts, of causing almost instantaneous death.

The organs and flesh of certain fish, especially the rock codfish and the red snapper, may be poisonous if eaten at certain times. It is particularly dangerous to eat these fish during the spawning season. Some lagoons are known locally as "poison fish lagoons," and it is believed that fish taken from them are poisonous. Puffer fish and other fish of the genus Tetraodon are reported from the China coast to Hawaii, and probably are present among these atolls. The eggs, testes or ovaries and occasionally the liver, bile and flesh of these fish can cause fatal poisoning.

Persons treading by accident on sharp projections of coral often receive lacerations which heal very slowly. Some species of coral have tentacles which can sting severely.

Poisonous or Irritating Plants

The Phoenix Islands are, for the most part, barren atolls on which are found only a few coconut palms, patches of scrub forest and low herbs and grasses. Poisonous plants are not reported. Two species of nettle are found, but apparently are not dangerous. One, *Pipturus velutinus,* is a low shrub; the other, *Fleurya ruderalis,* is an herb.

Pollen-producing plants are not reported, but allergic rhinitis and asthma occur in the Gilbert Islands, and probably are known in the Phoenix Islands. Copra dust is a possible allergen.

Food and Dairy Products

On Gardner, Hull and Sydney islands enough native foods are produced to supply the prewar population with a meager subsistence. On the other islands nearly all food and dairy supplies must be imported. Prior to the war non-natives on these islands existed almost entirely on canned foods and imported supplies of such staple foods as flour and rice. Fresh fish are plentiful about all the atolls. Turtles are frequently found. Thousands of migratory birds nest in the islands, and their eggs are eaten commonly, although they are said to have a salty flavor. On some of the atolls rabbits are numerous. A few pigs and some poultry are owned by native settlers. Vegetables will not grow well in the coral dust and there are no citrous fruits. Coconuts are produced throughout the year. Taro, bananas, pumpkins and yams are grown in small quantities. The native diet is deficient in protein, fats and vitamins. Facilities for refrigeration do not exist.

MEDICAL FACILITIES

Hospitals

Three hospitals, built and supported by the Gilbert and Ellice Islands Colony, are located on Hull, Sydney and Gardner islands. Each hospital consists of a number of small houses built of native materials and grouped around a central court. Each is in charge of a native dresser, who is capable of treating simple medical conditions and of doing some minor surgery. The Central Hospital at Tarawa in the Gilbert Islands and that at Funafuti in the Ellice Islands provide facilities for the treatment of more complicated conditions, provided transportation to these hospitals is available. On Canton Island an airline company operates an infirmary with eight beds. One physician is in charge. The facilities of the hospital for lepers and of the asylum for persons with nervous or mental diseases, both situated on Tarawa atoll, also were available to patients from the Phoenix Islands.

Equipment. The infirmary on Canton Island has a small operating room, a sterilizer and roentgen-ray equipment. Other equipment at the three hospitals on Hull, Sydney and Gardner islands is adequate for the purposes to which the hospitals are devoted.

Supplies. Formerly, medical supplies were provided from the Central Hospital at Tarawa in the Gilbert Islands.

Medical Personnel

Physicians. The physician in charge of the infirmary on Canton Island is the only graduate practitioner in the Phoenix Islands. Before the war physicians employed by the Gilbert and Ellice Islands Colony carried out periodic tours of inspection to Hull, Gardner and Sydney islands.

Nurses. No qualified nurses are present.

Dentists. There are no dentists.

Others. The native hospitals on Hull, Gardner and Sydney islands are in charge of native dressers, trained in simple medical procedures at Tarawa in the Gilbert Islands. In addition to treating simple conditions at the hospitals, they make periodic visits of inspection to all houses in their villages.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

The common diarrheas and amebic and bacillary dysentery are common. Typhoid fever and paratyphoid fevers apparently do not occur. The prevalence of flies, the insanitary native methods of handling food, the lack of refrigeration and the pollution of beaches and water supplies are factors in the prevalence of these diseases. Both types of dysentery occur throughout the year, the bacillary form being reported most frequently. Cholera has not been reported in the central Pacific islands.

Helminthiasis. Infection with hookworm has not been reported from the Phoenix Islands, but in the Ellice Islands from 50 per cent to 80 per cent of natives who have been examined have been found infected. In the Gilbert Islands, because of more careful disposal of excreta, it is mild and far less frequent, affecting only 9 per cent of natives there. Since most of the Phoenix colonists are Gilbertese, the rate of infection probably parallels that of their home islands. *Necator americanus* is the predominant type of hookworm found there. Although the incidence of trichuriasis and enterobiasis in the Phoenix Islands is not reported, both of the parasites are present in the Gilbert Islands, and may therefore have been brought to the Phoenix.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Pneumonia is moderately frequent, but morbidity and fatality rates have not been reported.

Tuberculosis. Pulmonary tuberculosis occurs frequently. The disease has an acute course and is likely to be fatal.

Scarlet Fever. This disease has occurred in the Phoenix Islands, but details have not been reported.

Measles. In 1936 a severe epidemic of measles, introduced from the Fiji Islands, swept the Gilbert and Ellice Islands, causing many deaths. Since that year sporadic cases have been reported from the Phoenix Islands.

Common Colds. Common colds occur often, particularly following new arrivals.

Diseases Spread Chiefly through Contact

Venereal Diseases. Syphilis is said to be widespread among the native population, but these reports need confirmation. Gonorrhea is present, but is said to be mild and without serious sequelae such as stricture and salpingitis.

Diseases of the Eyes. The incidence of diseases of the eyes is not known, but since conjunctivitis is widespread among the natives of the south and central Pacific islands, it probably occurs in the Phoenix Islands.

Diseases of the Skin. Scabies probably was brought to the Phoenix Islands within the last 10 years by the Gilbertese colonists. Fungous infections are said to be frequent, although the fungi responsible are not specified. Tinea imbricata and tinea circinata probably occur. Small cuts and abrasions are subject to irritation by coral dust and to secondary infection. Unless such lesions are cleaned and bandaged at once, indolent ulcers and abscesses may ensue. Cuts on the feet sustained while bathing may be particularly troublesome.

Diseases Spread by Arthropods

No diseases spread solely by arthropods have been reported from the Phoenix Islands.

Miscellaneous

Dental caries is said to be common among the natives. Copra dust, or certain parasites or fungi which attack copra, may be responsible for some seemingly allergic reactions. Because of the flat and barren character of the atolls, there is little or no protection from the sun. Although there is usually a light breeze, the temperature in the middle of the day may reach 140° F. (60° C.). Unless precautions are taken, prickly heat, heat cramps, heat exhaustion and sunstroke may seriously affect persons from temperate climates.

SUMMARY

Small hospitals are found on Hull, Sydney, Gardner and Canton islands.

A limited amount of drinking water is obtained from rainfall and shallow, brackish wells. The natives use shallow pit latrines, or defecate on the beaches below the high-tide mark. The only foods which can be obtained locally are coconuts, fish, eggs of sea birds, and some taro, yams and bananas.

No mosquitoes capable of carrying diseases are reported, but flies are numerous and play some part in the spread of enteric and other diseases. Rats are extremely numerous, but apparently are not infected. Various types of poisonous fish and sea snakes are potentially dangerous.

Diseases of special importance are the enteric diseases including the common diarrheas, amebic and bacillary dysentery; tuberculosis; diseases of the skin; and venereal diseases such as syphilis and gonorrhea. Injuries caused by heat can be dangerous to unacclimated persons.

BIBLIOGRAPHY

Becke, L.: Wild Life in Southern Seas. London, T. Fisher, 1897.

Bryan, E. H.: American Polynesia; Coral Islands of the Central Pacific. Honolulu, Tongg Publ. Co., 1941.

Buxton, P. A.: Researches in Polynesia and Melanesia. Pts. V-VII (Relating to Human Diseases and Welfare). London, The London School of Hygiene and Tropical Medicine, 1928. (Memoir Ser. No. 2.)

——, and Hopkins, G. H. E.: Researches in Polynesia and Melanesia. Pts. I-IV (Relating Principally to Medical Entomology). London, The London School of Hygiene and Tropical Medicine, 1927. (Memoir Ser. No. 1.)

Castellani, A.: Rhinitis Spastica Tropicalis (Tropical Hay Fever). J. Trop. Med. **41**:98-100 (Mar. 15) 1938.

Christophersen, E.: Vegetation of Pacific Equatorial Islands. Honolulu, Hawaii, The Museum, 1927. (Bernice P. Bishop Museum. Bull. 44.)

Clench, W. J., and Kondo, Y.: The Poison Cone Shell. Am. J. Trop. Med., **23**:105-120 (Jan.) 1943.

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 3d ed., Philadelphia, Lea & Febiger, 1943.

Darling, S. T.: Observations on the Geographical and Ethnological Distribution of Hookworms. Parasitology **12**:217-233 (Sept.) 1920.

Ditmars, R. L.: Reptiles of the World. The Macmillan Co., 1931.

Ellerman, J. R.: The Families and Genera of Living Rodents. London, The British Museum, 1941.

Ellis, A. F.: Adventuring in Coral Seas. 2d ed., Sydney, Australia, Angus & Robertson, 1937.

Flying "Down Under." Canton Island. The New York Times, Sect. 10, **1**:8 (June 23) 1940.

Gilbert and Ellice Islands Colony. Medical Officer: Medical and Sanitary Report for the Year 1938. Suva, Fiji, 1939.

Grant, A. M. B.: A Medical Survey of the Island of Nauru. M. J. Aust., **1**:113-118 (Jan. 28) 1933.

Gt. Brit. Colonial Office: Medical Service List. 4th ed., London, H. M. Stationery Off., 1939.

—— Foreign Office. Historical Section. Former German Possessions in Oceania. London, H. M. Stationery Off., 1920. (Handbooks. No. 146.)

Hamlin, H.: The Geography of Treponematosis. Yale J. Biol. & Med., **12**:29-48 (Oct.) 1939.

Herms, W. B.: Medical Entomology. 3d ed., New York, The Macmillan Co., 1939.

Kumm, H. W.: The Geographical Distribution of the Yellow Fever Vectors. Baltimore, American Journal of Hygiene, 1931. (Am. J. Hyg. Monographic Ser. No. 12.)

Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, Hawaii, The Museum, 1934. (Bernice P. Bishop Museum. Special Publ. 23.)

——: Medical Conditions in the South Pacific. M. J. Australia, **2**:362-378 (Sept. 22) 1928.

——: Yaws in the South Pacific. Am. J. Trop. Med., **9**:429-437 (Nov.) 1929.

Larsen, N. P.: Tetrodon Poisoning in Hawaii. Proc. Pacific Sc. Congr. 1939, 6th Congr., **5**: 417-421, 1942.

League of Nations. Health Organisation: Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Preparatory Papers: V. Memorandum on Public Health Organisation of the Gilbert and Ellice Islands Colony. Geneva, 1937, pp. 75-78.

McKinley, E. B.: A Geography of Disease. Washington, The George Washington University Press, 1935.

Mayer, A. G.: The Islands of the Mid-Pacific. Scient. Monthly, **2**:125-148 (Feb.) 1916.

Pacific Islands Year Book, 1942. Sydney, Australia, Pacific Publications, 1942.

Schultz, L. P.: Fishes of the Phoenix and Samoan Islands Collected in 1939 During the Expedition of the U.S.S. "Bushnell." Washington, U. S. Govt. Print. Off., 1943. (U. S. National Museum Bull. 180.)

Simmons, J. S.: Dengue Fever. M. Clin. North America. **27**:808-821 (May) 1943.

The Statesman's Year-Book 1943. New York, The Macmillan Co., 1943.

Stewart's Handbook of the Pacific Islands. Sydney, N. S. W., McCarron, Stewart & Co., Ltd., 1923.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed. by R. P. Strong. Philadelphia, The Blakiston Co., 1942. 2 vols.

Tate, G. H. H.: Rodents of the Genera Rattus and Mus from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. Bull. Am. Mus. Nat. Hist., **68**:145-178 (Feb. 11) 1935.

U. S. Hydrographic Office: Sailing Directions for the Pacific Islands. 5th ed., 1940, Washington, U. S. Govt. Print. Off., 1940. (Publication No. 166.)

U. S. War Dept.: Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. U. S. Govt. Print. Off., 1943. (Technical Manual TM 10-420.)

Usinger, R. L.: Distribution of Heteroptera of Oceania. Proc. Pacific Sc. Congr. 1939, 6th Congr., **4**:311-315, 1940.

30

Pitcairn Island

GEOGRAPHY AND CLIMATE

Pitcairn Island is a British colony which was annexed in 1839. It was settled in 1790 by mutineers from H.M.S. *Bounty*. The island lies at approximately 130° of west longitude and 25° of south latitude. The adjacent islands of Henderson, Ducie and Oeno were annexed to the British Empire in 1902. They are not inhabited. Pitcairn Island, as well as the aforementioned three islands, is under the jurisdiction of the Governor of the Fiji Islands.

The island has an area of about 2 square miles. It is only 1½ miles long in the longest axis, and has a circumference of not more than 5 miles. The only village, Adamstown, has a population of approximately 200, all descendants of the mutineers of 1790 and all related to one another. A Tahitian strain is noticeable among the islanders, who now speak a dialect incomprehensible to either an Englishman or a Tahitian.

The island is volcanic in origin. At certain points an elevation of 1,000 feet is attained. Generally, the land slopes to the sea, and is remarkably fertile. Rivers and streams are lacking. In some places a wild luxuriance of vegetation is seen, and trees are numerous.

The climate is equable and warm. The temperature is not characterized by extremes; in the summer the maximal temperature is 87° F. (30.6° C.) with an average of 82° F. (27.7° C.). In the winter the minimal temperature is 59° F. (15° C.) and the average is 65° F. (18.3° C.). Rainfall is said to be heavy. For about a fourth of the time, according to observations made aboard ships in the vicinity, the prevailing winds are from the east.

PUBLIC HEALTH

Health Services

Pitcairn Island has no public health system or services, and there are no government, religious or private agencies on the island that assist in this capacity. Environmental sanitation is maintained on a communal basis, each family performing its appointed task. Public records are kept of births, marriages and deaths. A record of the causes of death is kept by the people of Adamstown.

Water Supplies

There are no rivers, streams or wells on Pitcairn Island. There is one small spring on the northwestern side of the island; although the spring never has run dry, the quantity of water available is believed to be limited. The inhabitants depend exclusively on collections of rain water from roofs. Each of the 60 houses is supplied with a stone-and-concrete cistern which has an average capacity of about 1,000 gallons. Miscellaneous collections of rain water are obtained in small tanks, oil drums, tin cans and similar containers. This water is not covered or otherwise protected from contamination. No facilities for the treatment of water exist.

Sewage Disposal

Deep-pit privies are used exclusively. The pits are approximately 6 feet square and 12 feet deep. They are of the usual construction, are not provided with lids and are not flyproof.

No provisions are made for the disposal of garbage. The numerous dogs, chickens and rats are scavengers and leave nothing of a decomposable nature. Other débris from about the houses and in the village is collected and disposed of weekly.

Insects and Animals

Adequate information concerning the fauna of Pitcairn Island is lacking, but unidentified species of mosquitoes which bite during the day, cockroaches, black ants, rats and dogs are indigenous to the island. Undoubtedly, some of these insects and animals are capable of serving as vectors of disease, but they are not known to serve in this capacity on Pitcairn Island. Houseflies and black flies were prevalent at one time, but recently have disappeared. Fleas undoubtedly occur in connection with the large population of rats and dogs, but their presence is not recorded. Information is lacking concerning the presence of lice or ticks. The island swarms with rats, both indoors and outdoors, and they are of considerable economic importance.

Food and Dairy Products

Although there is little clinical evidence of dietary deficiencies among the inhabitants of Pitcairn Island, other than early decay of teeth, the diet of the people is deficient in red meats, eggs, milk, dairy products and green vegetables. Goats, chickens and eggs are available, but the supply is very limited. Such standard constituents of the American diet as beef, pork, flour, cereals, rice, spices, salt, white potatoes, milk and other dairy products are not available. There are no cattle on the island, and the half-tamed goats are not used for dairy purposes. There are no facilities for the refrigeration or storage of foodstuffs.

Miscellaneous Problems of Sanitation

Adamstown is reported to be a model of neatness and cleanliness. Old tradition and religious emphasis necessitate a general clean-up on Fridays in preparation for the Sabbath. Household rubbish is cleared away and the precincts of the house are cleaned by each family. The houses of Pitcairn are rough structures with hand-hewn timbers, corrugated iron roofs and elevated wood floors. They contain on the average five rooms and are well kept. The outbuildings include a kitchen, a bathhouse and a privy. The cleanliness of the islanders and their dwellings is not conducive to infestation with vermin. On the other hand, proper provisions are not made for the disposal of waste water or refuse. The uncovered cisterns and other collections of water constitute breeding places for mosquitoes.

MEDICAL FACILITIES

Hospitals

There are no hospitals, infirmaries or first-aid stations on Pitcairn Island. Medical or surgical supplies and equipment are not available.

Medical Personnel

There are no physicians, nurses, pharmacists or other trained medical personnel. The inhabitants are dependent on the services of ship surgeons and medical stocks of ships for medical aid and supplies. Ships call on an average of about every 10 days, and supplies and services are given freely when they are requisitioned. The islanders consider that these services are sufficient for their needs.

DISEASES

The inhabitants of Pitcairn Island are reported to be physically strong and to enjoy good health except for early loss of teeth, an occurrence which is attributed to dietary deficiencies. They have been free from many of the diseases that are prominent elsewhere in the Pacific islands; namely, malaria, dengue fever, yaws, filariasis, ancylostomiasis, trachoma, leprosy, the various kinds of typhus fever, plague and cholera. Except as noted below, the islanders have been surprisingly free from serious endemic and epidemic diseases. Contrary to the general belief, inbreeding has not resulted in physical or mental degeneration. In the absence of a resident medical officer on the island, accurate and detailed information concerning the causes of morbidity and mortality is not available. Some reliable data have been furnished by surgeons of ships, incidental medical personnel and an extensive medical survey (1937).

Diseases Spread Chiefly through Intestinal Tract

Typhoid fever, paratyphoid fevers, bacillary dysentery and amebic dysentery are not endemic on Pitcairn Island. Typhoid fever was epidemic in 1893 and an isolated case of paratyphoid fever was reported in 1937. Nonspecific dysentery or gastroenteritis is a common condition. Because religious and public feeling has resulted in aversion to multiple hypodermic injections, mass vaccination of the population against typhoid fever and paratyphoid fevers has not been carried out.

Clinically, there is no evidence of intestinal parasitism among the islanders and no ova were found on microscopic examination of stools of representatives from 24 different homes (40 per cent of the total).

Diseases Spread Chiefly through Respiratory Tract

Except for common colds and tuberculosis, the common respiratory diseases are not endemic. Deaths caused by pneumonia have been reported and, on infrequent occasions, influenza (1841 to 1853; 1936 and 1937) and measles (1903, 1924) have been epidemic. Other infections such as scarlet fever, mumps, chickenpox, smallpox, diphtheria and poliomyelitis have not been reported. A few deaths caused by whooping cough have been recorded, but the validity of these reports is open to question. In 1937 all persons between the ages of six months and 72 years were vaccinated against smallpox. At the same time, Schick, Dick and Mantoux tests were performed with the following results: reactions to the Schick test, 53 per cent positive; reactions to the Dick test, 43 per cent positive; reactions to the tuberculin test, 21 per cent positive.

It is recognized that this isolated and nonimmune population is threatened with considerable danger, in that introduction of the various respiratory diseases probably would be associated with high morbidity and fatality rates.

Diseases Spread Chiefly through Contact

Although not common, venereal diseases afflict a small number of the population. Of the 14 islanders considered most likely to be infected, only one was found to give a positive reaction to the Wassermann test. Specific information concerning the presence and prevalence of gonorrhea, soft chancre, lymphogranuloma venereum and granuloma inguinale has not been reported. There is a preponderance of men on the island, and, in consequence, most of the eligible women are married. A certain degree of moral laxity is present, but commercialized prostitution does not exist.

Diseases of the skin, except for mild fungous infections, are not common. Occasional instances of scabies, caused by *Sarcoptes scabiei,* are encountered but infestation with *Pediculus corporis* and *Pediculus capitis* is not reported. Secondary infection of cuts and abrasions is of frequent occurrence.

Diseases Spread by Arthropods

Insect-borne diseases such as malaria, yellow fever, dengue fever, sandfly fever and filariasis are not indigenous to Pitcairn

Island. It is considered likely, however, that *Aedes aegypti* and *Culex fatigans* are present and that, under suitable conditions, they could become vectors of disease. The Oriental rat flea probably is present.

SUMMARY

There is no public health system or service on Pitcairn Island. The islanders are without facilities for medical or surgical care. There are no physicians, and professional services are not available except as rendered by the surgeons of ships calling at Pitcairn Island.

Environmental sanitation is carried out on a communal basis, each family performing its appointed task. Sewage is disposed of by means of deep-pit privies. No provisions are made for the disposal of garbage or other refuse. Water is obtained by the collection of rain from roofs. There are no rivers or streams. The existing food supplies are quantitatively and qualitatively inadequate, particularly in respect to meats, green vegetables, milk and dairy products. There are no facilities for the storage of meats or other perishable foods. Insects are not troublesome on Pitcairn Island, but rats are prevalent and are of considerable economic importance.

The inhabitants are reported to have enjoyed good health except for dental decay caused by nutritional deficiencies. They have been surprisingly free from serious endemic and epidemic diseases. Insect-borne and other diseases common to the tropics have not occurred among them. A small number of the population have venereal diseases. Typhoid fever, paratyphoid fevers, bacillary dysentery and amebic dysentery are not indigenous to the island. Except for common colds and tuberculosis, the common respiratory infections are not endemic on Pitcairn Island. Mild fungous infections and scabies are encountered, but infestation with lice has not been reported. There is no evidence of mental or physical degeneracy, arising from inbreeding, among the islanders.

BIBLIOGRAPHY

Gt. Brit. Colonial Office: Pitcairn Island. Colonial Reports, Misc. no. 30. London, H. M. Stationery Off., 1905.

—— Colonial Office: Pitcairn Island. General Administrative Report by Mr. J. S. Neill. Medical Report by Dr. D. Cook. Colonial no. 155. London, H. M. Stationery Off., 1938.

Gt. Brit. Foreign Office: British Possessions in Oceania. London, H. M. Stationery Off., 1920.

Pacific Islands Year Book, 1939. 3d ed., Pacific Publications, Ltd., Sydney, Australia.

Shapiro, H. L.: The Heritage of the Bounty. New York, Simon and Schuster, 1936.

31

Samoa Islands

GEOGRAPHY AND CLIMATE

The Samoa Islands, formerly the Navigator Islands, consist of two groups of islands, American Samoa and the Territory of Western Samoa. The entire archipelago is located within the area described by 167 and 173° of west longitude and 13 and 15° of south latitude.

American Samoa. Those islands situated east of 171° of west latitude constitute American Samoa; they are Tutuila, Manua, Tau, Olosega, Ofu, Rose and Aunuu. Swains Island, about 200 miles north of Tutuila Island, became a part of American Samoa in 1925. The islands are administered by an officer of the United States Navy.

The total area of American Samoa is only 76 square miles. The largest island, Tutuila, has an area of 40 square miles; the area of Tau is 14 square miles; that of Ofu and Olosega together is 4 square miles. Swains Island is one and a half to two miles in diameter. In 1941 the total population of American Samoa was approximately 13,000.

Territory of Western Samoa. The former German Samoa Islands now constitute the Territory of Western Samoa, which has been governed by the Dominion of New Zealand since 1920. The territory includes those islands located west of 171° of west longitude, such as Savaii, Upolu, Apolima, Manono and several other smaller islands. The territory has an administrator, a legislative council and a *fono,* or native council. The latter is elective and functions as an advisory body to the administrator. The area of the territory is about 1,133 square miles. The largest island, Savaii, has an area of about 700 square miles; the next largest, Upolu, has an area of 430 square miles. In 1942 in the territory there were 59,000 native Samoans, 2,800 persons partly of European blood, 300 Chinese, 280 whites, and Melanesians and a few other peoples. The total population in that year was about 63,000.

All the islands in both parts of Samoa, with the exception of the coral atoll, Rose Island, are of volcanic origin. Volcanic craters are numerous; Savaii Island has a smoldering volcano. The predominant geologic formation is lava covered by clay. Coast lines, as a rule, are low-lying and protected by belts of coral reefs. Interiors of the larger islands tend to be mountainous; they are covered with dense forests and are largely uninhabited.

Springs are abundant, particularly near coast lines. Pools can be found throughout the islands; they are fed by the considerable rainfall which occurs at higher elevations and drains down through gorges to the lower reaches. Rivers of appreciable size do not exist.

Samoa has two seasons. The comparatively dry and cool season extends from March or April until November; the hot and rainy season lasts from November to March or April. Heat is said to be greatest in December; the average temperature during that month is 82° F. (27.7° C.). At the Apia Observatory the mean annual rainfall for a period of 16 years was 108 inches (2.7 meters). At Pago Pago the mean annual precipitation, based on the period 1900 to 1920, was 196 inches (5 meters). Rainfall is especially heavy in areas of high altitude, such as the mountainous interiors.

PUBLIC HEALTH

Health Services

Organization. *American Samoa.* The public health organization is entirely in the hands of the United States Navy Department. The senior medical officer of the Naval Station at Pago Pago on Tutuila Island acts as health officer. The Public Health Department consists of seven divisions.

Administration, Finance and Supply. This division is supervised by a chief pharmacist; he is responsible for purchase and procurement of all supplies, for expenditures and for bookkeeping; he distributes medical, surgical and hospital supplies to the Samoan hospital and the district dispensaries.

Vital Statistics. This division is in charge of a chief pharmacist's mate; he handles all matters pertaining to vital statistics of the islands. The systematic collection of these data was begun in 1928.

Public Health Nursing. This division is under the supervision of the chief nurse, whose duties also include the superintendency of the Samoan Training School for Nurses and executive functions connected with the provision of hospital maintenance and supplies, and the supervision of Samoan nurses.

Communicable Diseases. Although this division is given a separate place in the organizational plan, it has no separate chief. The public health officer and the assistant health officer jointly attend to all medical duties. The field personnel, with the exception of the district health officers and interpreters (*fita-fitas*), consists of public health nurses and sanitary inspectors. The nurses are graduate Samoan nurses belonging to the division of public health nursing. They are supervised by the chief of that division in all matters excepting those pertaining to their employment in the field, communicable disease nursing and the collection of statistical information; for those duties they are directly responsible to the public health officer or a district officer. Their subsistence in the field is provided by the village in which they are working. A law requires that the chief of a village provide a policeman to assist them in carrying supplies and equipment.

Maritime Quarantine. This division sends a public health officer who boards all incoming vessels for the purpose of granting pratique and to inspect all passengers who wish to disembark. Communication with the shore is strictly prohibited until pratique has been granted.

Laboratories. This division usually is in charge of a chief pharmacist's mate trained in chemistry and bacteriology; he is aided by a technician; the two carry out all work for the United States Naval Station at Pago Pago and as much field work as time will permit.

Sanitation. Members of this division cooperate with the Department of Public Works in all sanitary construction—reservoirs, latrines, septic tanks, ditching and drainage. A number of Samoan sanitary policemen are engaged in the inspection of villages, although in some districts the district health officers are responsible for sanitary inspections.

Dental Medicine. The head of this division is a dental officer attached to the Naval Station. He is the only dentist in American Samoa. With the aid of his technician he gives as much dental care to the Samoans as time permits.

For the purpose of administration of public health, American Samoa has been divided into districts. Each district, with the exception of the central district, is controlled by a chief pharmacist's mate who acts as district health officer. The eastern district comprises the eastern part of Tutuila Island, including Fagaitua; headquarters and dispensary are located at Amouli. The central district includes Afono and Laulii to the east and Fagasa, Nuu'uli and Tfuma to the west; headquarters are at the United States Naval Station at Pago Pago. The western district consists of the western third of the island of Tutuila, the villages of Asu on the north shore and Vaitogi on the south shore, as well as Maupasaga to the east; headquarters and dispensary are situated at Leone. The Ofu-Olosega district includes the islands of Ofu and Olosega, approximately 60 miles from Tutuila; headquarters and dispensary are located at Ofu village; a small field dispensary also is situated at Olosega.

TERRITORY OF WESTERN SAMOA. Public health in British Samoa is governed by the Samoan Hospital Ordinance of 1921, patterned after the New Zealand Health Act of 1920, but adjusted to suit local conditions. In 1941 the staff of the health organization consisted of two groups. The first included three medical officers, one dental officer, one dispenser and 10 nurses. These persons were non-natives. The second part of the staff consisted of 16 native medical practitioners, four medical cadets, five dispensing assistants and 78 nurses and nurses in training.

The center of public health activities in the Territory of Western Samoa is the government hospital at Apia. District hospitals are maintained in Tuasivi district on Savaii and in Aleipata district on the island of Upolu. District government dispensaries, numbering seven in 1941, are usually attached to mission stations and have native nurses in attendance. Native medical practitioners educated at Suva in the Fiji Islands play an important rôle in the public health system of the islands, caring for the sick and carrying out a widespread program of sanitary education. A dental clinic was established at Apia in 1937, and dental inspection of school children has been instituted. A code of native sanitary regulations was agreed upon by the *fono* (native council). The enforcement of these regulations is the major task of the native officials and local councils. In 1923 the Samoans were persuaded to agree to payment of an annual medical tax of one pound levied on all adult males, in return for which all Samoans are entitled to free medical attention. An additional means of promoting public health work has been developed in the women's committees organized in each community, consisting of influential Samoan women, usually wives of chiefs. These committees function chiefly in relation to child welfare. Certain stores of medicines are placed in their charge and they receive instruction in basic medical practice.

Relative Effectiveness. AMERICAN SAMOA. Public health achievements in American Samoa are the results of more than a quarter of a century of activities on the part of the Medical Department of the United States Navy. From the first years of the Navy's government, Navy medical men devoted themselves to problems of native health. A board of health was formed and a code of native regulations governing public health and sanitation was established. Samoans were enlisted as naval personnel and trained to act as sanitary inspectors. The Samoan hospital was constructed in 1912; it serves also as a training station for Samoan nurses. Dispensaries were established in the various districts. Water supplies were constructed and educational work in schools was instituted. Child welfare methods were patterned according to those found successful in Western Samoa. Compulsory vaccination against smallpox and periodic examination of school children were introduced. Old Samoan methods of medical treatment were discouraged and later were prohibited by law.

TERRITORY OF WESTERN SAMOA. The government of New Zealand, with its high cultural and public health standards, has been greatly interested in public health. Education and public health took first place in the program for the administration of the mandated territory.

The hardest blows to the health of the Samoans occurred in the form of the 1918 pandemic of influenza and the Mau rebellion of 1927. The latter destroyed much of what had been accomplished by devoted men in many years of work. Vital statistics were ignored, latrines torn down and water supplies polluted. When normal conditions were re-established the devastation proved to be less than expected; with the help of the International Health Division of the Rockefeller Foundation new campaigns, particularly against yaws, were organized and carried out with success. In 1929 the medical training college was opened at Suva in the Fiji Islands through the co-operation of the Rockefeller Foundation and the British Pacific island dependencies, and intelligent young Samoans were sent to this school for training as native medical practitioners. This development of competent medical men among the natives is considered one of the most significant advances made in public health in Samoa.

Water Supplies

Surface water and springs are generally abundant on the main islands of Samoa. Rainfall is heavy in the hills or mountains. The water usually is carried off in gorges, descending in cascades and rapids until it reaches the lower and less steep areas. As it descends, the total volume diminishes because a large part of the drainage is carried away by subterranean channels. The water again reaches the surface near the level of high tide in the form of springs which emerge all along the coast. It is said that there is hardly a village without a spring and a bathing pool.

Although a considerable amount of money has been spent in attempts to provide sanitary water supply systems for the natives, many villages still have primitive systems. Of 70 villages in American Samoa 24 had no water systems in 1940. Several villages in the Manua group, particularly Ofu, Luma and Siufaga, have supplies of water that are inadequate after a week without rain. The United States Naval Station at Pago Pago is amply supplied with excellent water from the watershed of Matafoa. Two reservoirs, a new and an old one, constructed in the mountains back of the station are filled by water from natural streams and are located at sufficient height above the station to assure adequate pressure. This water is chlorinated. The island of Tau is well provided with water, part of which is piped from the mountains. The village of Tau, however, depends on rain water and water from small wells. Olosega also has sufficient water, which is piped from the eastern slopes of the mountains around the southern point near the village of Olosega. The island of Ofu has an abundant supply of good water, piped from the mountains to the village. Rose and Swains islands depend entirely on rain water, although slightly brackish water can be obtained by the digging of wells near the beach.

In the Territory of Western Samoa conditions do not differ much from those in American Samoa. The town of Apia is said to have an ample supply of safe water piped down from the mountains. It is subjected to bacteriologic examination at regular intervals. In many villages the administration has provided large (capacity of 800 to 10,000 gallons) storage tanks made of galvanized iron or redwood. Rain water is collected from the roofs of churches and halls and stored in these tanks.

Sewage Disposal

The problem of regulating the disposal of human excreta among Samoan natives is not easy. Attempts have been made to enforce the erection and use of latrines and privies, but Samoan philosophy is not conducive to actual use of these facilities. Various forms of latrines have been constructed (beach drop latrines, pit latrines, and in some places, flush-type latrines discharging into the sea). The consensus appears to be that the bored-hole type pit latrine is the most practical for use in the Samoa Islands. According to official estimates (1940) in American Samoa, 51 of 70 villages had no latrines; in the 19 villages listed that had latrines there was ample evidence that they were not in general use. The Samoan does not see why he should be required to walk several hundred yards when a convenient beach is near by. The sanitarian has not had much success in convincing him that there is a distinct difference between defecating on the beach and defecating into a prepared pit. The danger of disposing of human excreta into the sea is enhanced by the fact that Samoans employ sea water to season food and use coconut milk mixed with raw sea water for a beverage during hard work. It is thought that pollution of the sea in the vicinity of the villages may have contributed to the prevalence of intestinal parasites, particularly *Ascaris lumbricoides*. Another factor contributing to pollution of the soil is the ubiquity of pigs. Although strict regulations exist to keep pigs out of the villages and penned up in certain areas, enforcement of this regulation has not met with much success, since these animals are regarded by the Samoans as useful scavengers which remove refuse from the villages.

A simple type of sewerage system exists in the Naval Station at Pago Pago, but it serves only the naval personnel. Similar conditions exist at Apia in the Territory of Western Samoa. Non-native habitations usually are provided with the septic-tank type of privy.

Insects and Animals

Vectors of Disease. Mosquitoes. Anopheles mosquitoes are entirely absent from Samoa. It should be remembered, however, that the vectors of malaria geographically nearest Samoa, *Anopheles punctulatus moluccensis* and *A. punctulatus punctulatus*, have spread as far eastward as the Solomon Islands and the Condominium of New Hebrides. Since conditions suitable to the existence of these mosquitoes apparently are present in Samoa, they might, if introduced by ship or other means, gain a footing.

Five species of Aedes mosquitoes have been reported: *Aedes scutellaris pseudoscutellaris, A. aegypti, A. albopictus, A. samoana* and *A. vexans*. *Aedes scutellaris pseudoscutellaris* is the most important mosquito because of its relationship to filariasis. It is practically ubiquitous, being found in abundance during all seasons. It breeds most commonly in fresh water in coconut husks or cavities in trees caused by pollarding (cutting of branches back to the trunk), the cutting of steps in coconut trunks, damaging of bark and in similar places. The breeding places are small; their importance lies in the enormous number in a country with heavy tropical rainfall at all times. The mosquito is said to be diurnal in habit, being most active at dawn and just before sunset. Its preferred haunt is the shady brush around villages; it never bites in sunshine.

Aedes aegypti is considered to have been introduced only recently, since it is found principally on islands which are in contact with the outside world. It is most abundant around ports and Occidental settlements. In Samoa it never has been found far from the houses of non-natives. It breeds in receptacles and other small accumulations of water. It is the vector of dengue fever in Samoa and is a potential vector of yellow fever.

Aedes albopictus has been reported recently from Samoa. Like *A. aegypti*, it is essentially domestic in habits, breeding in small receptacles in and around human habitations. In association with *A. aegypti*, it is an effective vector of dengue fever in the Philippine Islands and may be assumed to play a similar rôle in the Samoa Islands. Under experimental conditions it is capable of transmitting yellow fever.

Aedes samoana has not been shown to have any epidemiologic importance. It is particularly troublesome because it bites at night. The mosquito is encountered in practically every village, and has been seen at altitudes of 2,000 feet on Savaii Island. It breeds in water which collects in the base of leaf stalks of the taro, *Colocasia esculenta*, within the axils of the leaves of the screw pine, *Pandanus tectorius*, in the imbricating leaves of the crown of the pineapple and occasionally in the unfolding leaves of wild canna. *Aedes samoana* is a very aggressive nocturnal insect; it can penetrate netting of 16 meshes to the square inch. Its bite is painful and irritating. It is usually not found far from native taro patches.

Aedes vexans has no medical importance in Samoa, but may be a pest. It breeds in shallow, usually temporary, pools which form after heavy rains.

Three species of Culex mosquitoes are recorded: *Culex fatigans, C. annulirostris* and *C. samoaensis*. *Culex fatigans* is not very prevalent and is reported to be absent from Swains Island and Olosega Island. Its domestic habits are reflected by the type of its breeding places—old tin cans containing water, barrels of rain water, coconut shells and husks, cesspools and open drains. Although this mosquito is the predominant vector of *Wuchereria bancrofti* in many tropical countries, it has not been shown to have any importance in the transmission of filariasis in Samoa, possibly because it is comparatively scarce. *Culex annulirostris* breeds during the entire year in a great variety of places, usually in clean water containing green algae. It is found also in water in hoof marks, stagnant pools and slowly running streams. Larvae of *C. annulirostris* often are found together with larvae of *C. fatigans, Aedes aegypti* and *A. scutellaris pseudoscutellaris*. It appears to be purely pestiferous. *Culex samoaensis* has been found only in Samoa, where it is very rare. Nothing is known about its breeding and biting habits.

Lice. The head louse, *Pediculus capitis*, is common. The natives, however, usually are clean in person, and body lice, *P. corporis*, have not been reported.

Flies. *Musca domestica* is widely distributed and common; its breeding places and habits do not differ from those in other parts of the world. *Musca sorbens* is said to be even more abundant than *M. domestica* in Samoa. *Musca sorbens* is often found on human feces, kitchen refuse and ulcers and sores of human beings and horses. *Stomoxys calcitrans* has been reported from Apia on Upolu Island, but has not been found in any of the other islands. *Chrysomyia megacephala* is widespread. It is known to cause myiasis in animals and man in many countries, but no cases of this condition have been reported from Samoa. Other species of the same family which are reported are *C. rufifacies, C. leucosticta, Paurothrix bisetosa, P. xiphophora,* and *Lucilia rhodocera*. The most common species of flesh flies are *Sarcophaga dux, S. peregrina* and *S. peltata*. The rarer species include *S. cirrhura* and *S. froggatti*. Some of these species have been shown to be responsible for myiasis among human beings.

Flies of the family Drosophilidae are very common in Samoa, some 27 species having been identified. The most common is *Spinulophila nasuta*. It is thought that the larvae of this fly may give rise to intestinal myiasis. *Megaselia scalaris*, of the family Phoridae, was found at Apia on Upolu Island. Since it breeds in foods consumed by humans, it is thought possible that it may cause intestinal myiasis.

Tabanus samoaensis is the only species of horsefly known in Samoa. It attacks both man and horses. Sand flies, moth flies and others of the family Psychodidae have not been reported. Buffalo gnats, black flies, turkey gnats and other Simuliid flies are present.

Ticks. *Rhipicephalus sanguineus*, the dog tick, has been reported, but does not appear to be common, even on neglected dogs.

Fleas. *Pulex irritans*, the flea of human beings, is not common in Samoa; it is not indigenous to the islands but was introduced by non-natives. *Xenopsylla cheopis*, the flea of rats, has been reported, but does not appear to be prevalent. It occurs chiefly on rats, but has also been found on *Mus exulans* and *M. decumanus*. *Ctenocephalus felis*, the flea of cats, is rarely encountered.

Rodents. *Mus exulans* is the only rodent indigenous to the Samoa Islands. *Rattus rattus* and *Mus decumanus*, however, have been imported and have settled in harbors.

MITES. *Sarcoptes scabiei,* the mite which causes scabies, is common in Samoa. No other mites of medical importance appear to be present.

Snakes and Other Dangerous Animals. There are four species of Laticauda, a genus of sea snake which usually is quiet and inoffensive, but which will bite if restrained or frightened. One species of Pelamydrus, an eel-like sea snake, is seen commonly. A species of Boa is reported. There are no crocodiles in Samoa.

Pests. Except for the flies and mosquitoes to which reference already has been made, there are very few pestiferous insects. The only domestic cockroach which has been found is *Periplaneta americana;* it is said to be widespread. None of the termites occurring in Samoa does damage to houses. The copra bug, *Necrobia rufipes,* responsible for the destruction of copra, may inflict a painful bite if it is carelessly handled. *Polistes macaëensis,* a species of wasp, is very common and builds its nest in houses and verandas. The sting inflicted by this insect is painful but without serious consequences. *Cimex rotundatus,* the tropical bedbug, is a comparatively recent introduction, found mainly in places frequented by foreigners. When last reported, it had not invaded the native huts.

Bites inflicted by a centipede, *Scolopendra subspinipes,* are common, particularly among men engaged in the moving of timber. The symptoms caused by the bite are not severe, but occasionally caused local edema. Two species of scorpions, *Isometrus maculatus* and *Hormurus australasiae,* have been identified. So far as is known the effect of the sting of either species is very slight.

DANGEROUS MARINE LIFE

Serious poisoning from fish caught in Samoan waters is said to be comparatively frequent. The toxic properties are limited to certain species and depend largely on the locality and the season in which the fish are caught. Most important representatives of poisonous fish belong to the order Plectognathi. They may be recognized by their rough spiny scales or thorn-like spines. If eaten, no matter how fresh, they may give rise to more or less violent symptoms of intoxication and even death. In addition, the following are said to be poisonous: the Indo-Pacific sea perch, *Epiniphelus merra;* an eel, *Muraena mauritiana;* a parrot wrasse, *Scarus sordidus;* and a sea bream, *Monotaxis grandoculis.* Puffer fish also occur.

In addition to causing painful wounds with their sharp and serrated spines, many tropical fish inject venom into the flesh of their foes. The effectiveness of the poison varies considerably, but in some fish it is said to compare with that of the dangerous snakes. The most dangerous of the venomous fish reported from Samoan waters is the scorpion fish, *Synancea verrucosa.* It lies quietly on the bottom of the sea and is scarcely visible. On the slightest contact of a person with its fins, venom is injected into the victim through the needle-sharp spines. A full dose of venom from the dorsal fin of the scorpion fish may cause death. The zebra fish, *Pterois volitans,* is one of the largest of its kind, brilliantly colored and highly aggressive, with a long row of spines. Another species of the same genus reported from Samoa is *Pterois radiata.* The sting ray or stingaree, of which the species *Dasyatis kuhlii* is reported, lies well concealed in shallow lagoons. It has a flat body and a long, whip-like tail armed with a hard, serrated spine. If a ray is stepped upon this spine may be jabbed with great force into the flesh of the aggressor. At the same time poison is injected into the wound.

Many corals, some of which have exceedingly sharp and knife-like spines, render bathing and wading in the lagoons hazardous. Cuts and lacerations caused by contact with these animals almost invariably become infected and heal very slowly.

Mollusks are of interest because of their rôle as intermediate hosts of trematodes which parasitize human beings. Autochthonous schistosomiasis never has been reported, yet, in the presence of Chinese laborers and possibly suitable snail hosts, the possibility of the introduction of schistosomiasis must be kept in mind. A genus of fresh-water snail has been recorded from the island of Upolu; the species is not known.

Food and Dairy Products

The diet of the Samoan native generally is well balanced, as evidenced by the good physical condition of adults and children. Samoan vegetables consist mainly of taro, breadfruit, yams, bananas, papaya and coconuts. Pork, chicken, shellfish and fish are consumed. It is said that nearly all vegetables of the tropical and subtropical zones flourish in Samoa. Samoan fruits comprise the orange, lemon, lime, mango, alligator pear and pineapple. The quality of these fruits does not appear to be high. Since certain canned foods became available the natives have developed an increasing tendency toward supplementing their diet with such products as canned corned beef and salmon. Preparation of food is primitive. Food poisoning caused by contamination is said to be frequent, a fact which is not surprising in view of the lack of means of preservation. The frequent use of polluted sea and fresh water to prepare certain foods constitutes an additional source of danger.

Slaughtering of cattle is controlled by the health authorities in both American Samoa and the Territory of Western Samoa. Abattoirs in the usual sense of the word, however, are not present. In the Territory of Western Samoa an arrangement has been made for examination, by a medical officer, of all animals slaughtered. In American Samoa slaughtering is carried out on a concrete platform which has been constructed near Maupasaga on Tutuila Island. The Samoan native does not generally drink milk. Cows are few, since suitable food for them is hard to grow. If milk is available, the quality is inferior. Canned or powdered milk is being increasingly used by the natives, particularly for infants. Infections are known to have followed the use of contaminated water for the dilution of powdered milk.

Miscellaneous Problems of Sanitation

The problems which arise in connection with the advent of modern concepts of hygiene and sanitation among a primitive people are manifold. Maintenance of a harmonious balance between the culture and traditions of the native and indoctrination with ideas of modern medicine is a delicate and difficult matter. As a consequence, infant mortality rates are high; in American Samoa in 1940 the rate per 1,000 live births was 102; in the Territory of Western Samoa in the same year the rate was 74. In 1939 the rate in American Samoa was 126; in the Territory of Western Samoa, 84. It has been said that some alteration in native habits and customs will have to be made before these rates, as well as the prevalence of certain diseases, can be reduced.

MEDICAL FACILITIES

Hospitals

Number of Beds. American Samoa. Before the outbreak of the war there were two hospitals and four outlying dispensaries. The Central Naval Dispensary at Pago Pago on Tutuila Island is the headquarters for all medical, surgical and public health work in American Samoa; it also serves as a hospital for the personnel of the Naval Station. The Samoan Hospital at Pago Pago was founded in 1911 to provide medical and surgical care for the natives. In 1932 it had 75 beds; but in 1940 was reported to be inadequate. Almost all Samoans provide their own linen and food while they are hospitalized, and usually are attended by a member of their family during hospitalization.

Four dispensaries are located in American Samoa; one at Amouli on Tutuila Island, one at Leone on the same island, one at Ofu on Ofu Island, and one at Luma on Tau Island, all supervised by pharmacist's mates of the United States Navy.

A dental station in charge of a dental officer is attached to the Central Naval Dispensary at Pago Pago.

Territory of Western Samoa. Three hospitals are in operation: Apia Hospital at Apia on Upolu Island, Aleipata Hospital in Aleipata district on that island, and Tuasivi Hospital at Cape Tuasivi on Savaii. In 1940 Apia Hospital admitted 1,315 patients; Tuasivi Hospital admitted 105; and Aleipata Hospital admitted 134.

There are three dispensaries on Savaii Island and four on Upolu Island. They are in charge of native medical practitioners educated at the native medical school at Suva in the Fiji Islands.

A dental unit is attached to Apia Hospital. It is conducted by a British dental officer who is aided by Samoan practitioners.

Equipment. The Central Naval Dispensary and the Samoan Hospital are well equipped to carry out major surgery, laboratory and roentgenologic work. A new shock-proof diagnostic x-ray unit was installed at the naval dispensary in 1939. A portable x-ray unit functions at the Samoan Hospital. Electricity and refrigeration are available. Ambulance service is available for the villages on the southern coast and on part of the northern coast. Approximately 80 per cent of the people of Tutuila Island thus have direct communication from their villages to the hospital. New x-ray and diathermy units were installed in 1939 at Apia Hospital on Upolu Island in the Territory of Western Samoa. This hospital is equipped to carry out major surgery and laboratory work.

Supplies. All medical supplies must be imported.

Medical Personnel

Physicians. In 1940 the number of Navy medical officers stationed in American Samoa was three. They were assisted by a number of experienced hospital corpsmen and native practitioners. In the Territory of Western Samoa, according to the government report of 1940, the medical staff consisted of three medical officers and 16 native practitioners.

Dentists. In 1940 there was a naval dental officer at the Central Naval Dispensary at Pago Pago in American Samoa, and another at Apia Hospital on Upolu Island in the Territory of Western Samoa. One dental assistant was stationed at the Central Naval Dispensary at Pago Pago; six native dental officers assisted the dental officer at Apia Hospital in Western Samoa.

Nurses. In 1940 there were four American and 27 graduate Samoan nurses in American Samoa. In the Territory of Western Samoa in 1941 the nursing staff consisted of ten non-native nursing sisters, 78 Samoan nurses and trainees and a certain number of native ward attendants.

Others. A naval pharmacist is stationed at the Central Naval Dispensary at Pago Pago in American Samoa. A bacteriologist, a dispenser and five native dispensary assistants are stationed in the Territory of Western Samoa.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Bacillary Dysentery. Bacillary dysentery appears to be more or less endemic in the Samoa Islands, with serious outbreaks occurring from time to time, chiefly among children. The serious outbreaks, particularly in the Territory of Western Samoa, have been traced to *Shigella dysenteriae;* milder outbreaks have been caused by the Flexner type of *S. paradysenteriae.* Six deaths that occurred among infants on the island of Ofu in American Samoa in 1939 were attributed to bacillary dysentery contracted by the drinking of contaminated water.

Amebic Dysentery. Amebic dysentery does not appear to be more prevalent in

Samoa than in temperate climates. In 1939 surveys based on examination of stools in the Pago Pago area revealed that approximately 10 per cent of the population were infected with *Endamoeba histolytica.* Only one case of clinical amebic dysentery has been reported in American Samoa since 1928.

Typhoid Fever and Paratyphoid Fevers. Both typhoid fever and paratyphoid fevers occur throughout the Samoa Islands. Outbreaks of typhoid fever have been traced to contaminated water supplies, food and ice cream. Prompt application of control measures has prevented spread to any great number of the population. The view has been expressed that a high degree of mass immunity probably exists among adult Samoans. Immunization of the general population on a large scale has not been carried out. In 1940 in American Samoa only one case of typhoid fever was reported. In the Territory of Western Samoa in 1937 there were 189 cases of typhoid fever and paratyphoid fever (the two diseases were not reported separately).

Cholera. Cholera never has occurred in the Samoa Islands, but the living habits of the natives are such as to favor spread of the disease, should it be introduced.

Helminthiasis. Helminthiasis is extremely common in the Samoa Islands. Infection with hookworm (chiefly *Necator americanus*), roundworm (*Ascaris lumbricoides*) and whipworm (*Trichuris trichiura*) is most commonly encountered. Pinworms (*Enterobius vermicularis*) and *Strongyloides stercoralis* represent only an insignificant percentage of the intestinal parasites seen generally. There appears to be no essential difference in the prevalence of helminthiasis in American Samoa and the Territory of Western Samoa, although the incidence of infection with hookworm seems to be somewhat higher in the latter. In 1923 and 1924 vigorous campaigns against infection with hookworm were carried out in Western Samoa; the anthelmintic agents used were carbon tetrachloride and oil of chenopodium. Thousands of treatments were administered and an educational program was combined with the erection of sanitary latrines. Similar action was taken in American Samoa, where anthelmintic treatments are still administered at regular intervals to the Samoan guard. The people, also, are urged to submit to such treatment twice yearly. As a rule Samoan children are infected as early as they are capable of crawling. A high degree of pollution of the soil, particularly in the plantation areas, and lack of domestic sanitation are the chief factors responsible for infection and re-infection with helminths. In American Samoa in 1940 the frequency of occurrence of specific parasites, based on the genera of parasites recovered from stools, was: Ascaris, 56; Trichuris, 54; Necator, 14; and Strongyloides, 0.7. In the Territory of Western Samoa in 1938 ascariasis was found in 18 per cent of adult persons; infection with hookworm in 50 to 60 per cent; and trichuriasis in 40 to 50 per cent. In 1924 it was discovered that 97 per cent of the natives in Western Samoa were discharging the eggs of hookworms in their stools. It is said that in some cases "asthma" is caused by ascariasis. Symptoms promptly subside after anthelmintic treatment.

Diseases Spread Chiefly through Respiratory Tract

Pneumonia. Pneumonia is common in the Samoa Islands, and in association with tuberculosis is responsible for the greatest number of deaths. The high fatality rate from pneumonia does not appear to be caused by any particular malignancy of the type of disease present, but chiefly by ignorance and negligence of the natives as well as by lack of and disregard for medical care. In 1940 the mortality rate from pneumonia per 100,000 of population was 124; in 1939 it was 301; in 1938 it was 318.

Tuberculosis. Tuberculosis is a serious problem in all the islands of the South

Pacific. The disease is prevalent in both American Samoa and the Territory of Western Samoa. Samoans call it *mama palam,* which means rotting of the lung. Tuberculosis is generally considered to be a relatively recent introduction to the islands. The disease has a rapid and lethal course among all the Polynesians. Tuberculous peritonitis is common among children, and accounts for a high proportion of the infant mortality. Tuberculous meningitis is not rare. Tuberculosis of the lymph nodes is very common among older children and adolescent persons. These nodes caseate rapidly. In adult persons pulmonary tuberculosis is said to be common in Samoa. Death often occurs from tuberculous bronchopneumonia. Frequently, entire families are found to be infected. Living conditions and habits of the Samoans are conducive to the spread of tuberculosis. Families frequently sleep under a single mosquito net. Samoans customarily expectorate under the floor mat. Kava ceremonies, in which containers of this beverage are handed from person to person, favor dissemination.

In general, little has been done to control tuberculosis in the islands. Funds have been inadequate and the problem of segregation and isolation extremely difficult to solve. Many Samoans have unrecognized tuberculosis and thus contribute to new infections. The mortality rate from tuberculosis, per 100,000 of population, was 179 in American Samoa in 1940; in 1939 it was 206; in 1938 it was 226.

Reports from the Territory of Western Samoa indicate that tuberculosis is particularly prevalent in the area around Apia, where comparative congestion and close contact with white people may be responsible for such prevalence. The health authorities of Western Samoa have endeavored to educate the members of the women's committees to recognize the symptoms of tuberculosis and to report patients immediately. Separate huts have been constructed in some villages to isolate patients as far as possible.

Influenza. Severe epidemics of influenza have repeatedly passed over the South Pacific Islands; Samoa has not been spared. The pandemic of 1918 caused enormous destruction of life in the islands. Serious epidemics were reported in 1923 and 1928. In 1928 the epidemic spread out steadily from the primary focus; at first around Pago Pago to the eastward by direct extension. At the same time, secondary foci of infection began to appear along the motor-bus routes east and west, especially in the larger villages. The attack rate during this epidemic was 26.5 per cent; that is, 2,385 cases of influenza were recorded in an estimated population of 8,945. In the central district of the island of Tutuila, where the epidemic was most severe, the rate of attack was 40 per cent.

Smallpox. There is no evidence to show that smallpox has occurred in recent years. Vaccination is compulsory in both American Samoa and the Territory of Western Samoa. In American Samoa all school children who do not show signs of previous vaccination are vaccinated. A health survey in 1930 showed that 58.8 per cent of the population of American Samoa had one or more vaccination scars.

Diphtheria. There is no reliable evidence that diphtheria is present in the Samoa Islands.

Scarlet Fever. There are no data to show that scarlet fever has occurred among Samoans in recent times.

Meningococcic Meningitis. Verified cases of meningococcic meningitis have been reported from American Samoa, but epidemic spread of the disease has not been observed. Several cases of pneumococcic and influenzal meningitis also have been recorded.

Measles. Measles is reported to be endemic in the Territory of Western Samoa. Sporadic cases and small outbreaks also have been reported from American Samoa in recent years. The disease is a serious hazard to Samoans, who have developed little resistance. The seriousness of outbreaks of measles among such people was demonstrated in 1911, when the disease affected 68 per cent of the entire population of American Samoa, causing 219 deaths (fatality rate, 4.8 per cent).

German Measles. This disease has been reported from American Samoa, but never in appreciable numbers of cases.

Whooping Cough. Whooping cough has appeared in epidemic form in both the Territory of Western Samoa and American Samoa. It has been the cause of many deaths among infants and small children. An epidemic in 1936 accounted for the death of 400 native children in the Territory of Western Samoa.

Chickenpox. A mild form of chickenpox is endemic throughout the Samoa Islands.

Mumps. Mumps likewise is endemic in the islands. A few cases are reported annually.

Diseases Spread Chiefly by Contact

Venereal Diseases. Gonorrhea occurs in the Samoa Islands, but is thought not to be prevalent. The actual incidence among the natives is difficult to ascertain because they are exceedingly secretive concerning genital diseases. Native treatment usually is given first in such cases, and the white physician is only rarely taken into confidence. Most of the patients with gonorrhea come from villages near or within easy access to the port areas. Outlying stations rarely report gonorrhea. The reasons for the apparent scarcity of the disease are a matter of conjecture. Syphilis appears to be absent generally among the Samoan natives. Prostitution, in the customary sense of the word, does not exist in Samoa, although there are women in the vicinity of the ports who are willing to prostitute themselves when the opportunity arises. Samoans are not "immoral" in matters of sex but completely "unmoral"; that is, their civilization does not require any form of continence.

Yaws. Yaws is an important problem in Samoa. The disease has been endemic in the islands for several hundred years, traditional reports going back as far as the year 1500. Records from the beginning of the current century reveal that infection at an early age has been practically universal. Even today Samoan mothers deliberately expose their children to yaws because of the belief that children "should have it" before the age of 10 or 12 years. They believe that infection at a later stage is dangerous and more debilitating.

Both the American health organization and that of the Territory of Western Samoa have given special attention to yaws. Mass treatments of the natives with neoarsphenamine have been carried out with beneficial effect. Serious symptoms of tertiary yaws have become a rarity. The problem of including an entire population in a therapeutic campaign is complicated and difficult; the disease has by no means been exterminated, as some reports would suggest.

In American Samoa women are required to bring their children to dispensaries for treatment of yaws. In practice this procedure has not been entirely effective. It has been complicated by numerous factors. Some villages are too far away from medical assistance and women refuse to travel with their small children. The rapid disappearance of the secondary cutaneous lesions under specific treatment gives rise to the assumption that the disease has been cured and that additional treatment is unnecessary. Experience shows that many of the inadequately treated patients experience relapses. In the Territory of Western Samoa treatment generally has been carried out by mobile medical units in village-to-village visits.

As would be expected, the reaction to the Kahn test is almost universally positive among Samoans. A survey made in this respect among 69 members of the *fita-fita* guard resulted in only eight negative reactions. Inquiry into the history of these men, however, also revealed a definite history of yaws in childhood. Since a large proportion of the treatment of yaws is in the hands of native medical practitioners, it is thought that a considerable number of patients with simple diseases of the skin may be reported as having yaws and treated accordingly.

Results of a survey carried out in Western Samoa in 1932 showed that approximately 59 per cent of the population had symptoms of either primary, secondary or tertiary yaws. It may be assumed that present figures are considerably lower. During a campaign in 1933 in Western Samoa 74,088 treatments were administered. It was said that 38,644 injections were given in 1934. In 1940 there were 18,491 treatments.

Leprosy. Leprosy is endemic in the western islands, but the incidence is low. Lepers are transferred to the leper station on the island of Makogai in Fiji. Cured patients are returned to the island, where they have to undergo strict periodic examinations. An educational program was started among the committees in the Territory of Western Samoa to assure earlier diagnosis of the disease. The number of patients transferred to the leper colony each year fluctuates between 10 and 15. A few cases of leprosy have been reported from American Samoa, but in these cases it was thought that the disease did not originate in the American islands.

Conjunctivitis. "Samoan conjunctivitis" is a highly infectious acute disease of the conjunctiva with occasional corneal involvement. Many organisms have been suspected of causing this infection; the Koch-Weeks bacillus, Morax-Axenfeld diplococcus and gonococci have been isolated from the conjunctival sac. The consensus, however, is that a gram-positive diplococcus is mainly responsible for the disease. This organism has been repeatedly described and it is said to assume gram-negative properties if it is not carefully stained, thus giving rise to confusion with the gonococcus.

Samoan conjunctivitis is essentially a disease of childhood and is thought to be spread by contact and flies. Symptoms, in general, are similar to those caused by gonococci in the eyes, although less severe. In the past this disease has been the cause of much blindness which, however, has not been due altogether to the infection, but also to native methods of treatment. This treatment consisted in instilling the irritating sap of a tree into the conjunctiva and in scraping corneal lesions with the sharp edges of leaves of the coconut palm. In 1923 in American Samoa 454 cases of blindness were recorded from a population of 8,184. Eighty-six persons were totally blind in both eyes. A survey completed in 1930 revealed that 270 persons of all ages in American Samoa were blind in one eye (2.9 per cent of the total population).

Conjunctivitis is endemic and particularly prevalent during the breadfruit season, when flies are most numerous. Children are continually re-infected. Effective measures against this disease were first introduced in American Samoa. All parts of the islands were visited and natives were taught the use of argyrol. A 10 per cent solution of this drug has been found most effective in preventing and treating Samoan conjunctivitis. Since that time argyrol in solution has been made a standard item of supply in all villages and particularly in schools.

Trachoma. Trachoma occurs in a mild and chronic form in all the Samoa Islands. In 1936 the health authorities of the Territory of Western Samoa reported that approximately 10 per cent of the school children were infected with trachoma. In 1940 all school children of the eastern and western districts of American Samoa were examined for this disease; of a total of 630 pupils, 68 showed evidence of trachoma. In the eastern district the incidence was much lower (approximately 2.5 per cent). In the official sanitary report of American Samoa for 1941 it is stated that trachoma is the most common disease of the eyes seen at the clinic: When the disease is acute, treatment with sulfanilamide is carried out;

when it is merely chronic, a 1 per cent solution of silver nitrate is applied locally.

Diseases of the Skin. Mycotic infections of the skin are commonly seen. Ringworm of all types predominates. Impetigo, furunculosis and scabies are not infrequently seen. Pemphigus and tropical ulcer-like sores occasionally are observed.

Malignant Jaundice. This term was introduced in the Territory of Western Samoa to designate a disease which first appeared in 1935. Apart from the jaundice, the disease is characterized by fever, bradycardia, delirium and gastro-intestinal hemorrhage. Death may occur within five to seven days. By the year 1939, almost 70 cases of this disease officially had been reported in Western Samoa and 45 deaths had occurred. It is believed by the health authorities that a considerable number of cases previously diagnosed as "catarrhal" jaundice may have been of the "malignant" type. The disease has been of considerable concern to the local health authorities and repeated attempts at determining the causation have been made. So far, however, definite conclusions have not been made. Various institutions, such as the Rockefeller Foundation, Hooper Foundation, National Health Service Laboratories of New Zealand and Australia, and the United States Naval Medical School have received blood serum and histopathologic material for study. Yellow fever, leptospirosis (Weil's disease) and toxic atrophy of the liver have been suspected. The theory of the leptospiral origin of "malignant jaundice" has found the greatest support. Approximately 20 per cent of the rats caught and examined in the Territory of Western Samoa were found to have spirochetes not conclusively identified as *Leptospira icterohaemorrhagiae*. By 1940 the disease apparently had not spread to American Samoa. Of 253 rats caught at random in various districts of the American islands in 1939, none had any species of Leptospira. The opinion has been expressed that sooner or later the disease would also spread to the American islands because of the close commercial and passenger interchange and the identical climatic and living conditions. Whether this spread already has taken place is not known. Before the outbreak of the war the health authorities of American Samoa had taken strict precautions against the introduction of rats through ships and other means. In the Territory of Western Samoa a vigorous campaign against rats has been instituted.

Diseases Spread by Arthropods

Filariasis. Filariasis is a serious problem in the Samoa Islands. Examinations reveal that 40 to 60 per cent of Samoan adults have filariasis. A survey carried out in American Samoa in 1930 showed 13 per cent of all adult persons had serious clinical manifestations. The highest incidence is encountered between the ages 30 to 60. From infancy to about the age of 20 years, Samoans usually are free from clinical symptoms, although microscopically the blood may reveal the presence of the microfilariae. In 1922 and 1923 on Upolu Island in the Territory of Western Samoa 236 of 349 males examined were found to have the disease; 74 of 162 females examined were found to be infected. On Savaii Island in the same years, 484 of 717 males and 460 of 839 females were found to have the disease. In American Samoa during the same period 107 of 174 males examined were infected, and 102 of 268 females were infected. The percentage of infection, based on the total number of Samoans examined in both divisions of the Samoa Islands, was 58. For the males the percentage of infection was 67; for females it was 50. All were persons more than 16 years old.

The clinical manifestations of filariasis in Samoa are lymphadenitis, with or without lymphangitis (known in the islands as *mumu*); filarial abscess; varicose glands; epididymitis, orchitis and hydrocele; elephantiasis; and filarial fever without local manifestations. The Samoan type of filariasis does not exhibit the customary nocturnal migration of microfilariae.

The principal vector is considered to be *Aedes scutellaris pseudoscutellaris*, which is abundant in the entire Samoan area. It abounds in both the bush and around native habitations. Since Samoans spend much time in the bush, working on plantations, ample occasion for repeated infection is provided. The problem of control of filariasis is difficult, and consists chiefly of attempts to reduce the numbers of the mosquito vector. The reduction of mosquitoes is not easy because *A. scutellaris pseudoscutellaris* occurs in both a domesticated form and a so-called wild form in forested areas. Hence, control of breeding in such regions would be not only expensive but practically impossible. The problem of screening is complicated by the open construction of the huts. In recent years Samoans have taken more and more to the use of mosquito nets, mainly for protection against flies; it is thought that this habit may have a favorable influence on reduction of the incidence of filariasis.

For a long time it was the consensus that non-natives, and particularly those of white blood, were rarely if at all affected by filariasis. Recent evidence, however, indicates that such persons exposed to prolonged association with natives and frequently bitten by infected mosquitoes readily acquire filariae.

Dengue Fever. Epidemics of dengue fever have repeatedly swept the Samoa Islands in recent years. Usually, these outbreaks have occurred simultaneously with outbreaks in other areas of the Pacific Ocean. The epidemic of 1930 has been accurately studied and is said to have affected approximately 50 per cent of the native population within a period of two months. The mosquito vectors, *Aedes aegypti* and *A. albopictus*, are found throughout the islands in great abundance.

Malaria. Malaria does not occur in the Samoa Islands. The absence of anopheline mosquitoes, however, should not obscure the fact that *Anopheles punctulatus moluccensis* and *A. punctulatus punctulatus* occur in the British Solomon Islands and the Condominium of New Hebrides, where they are dangerous vectors of malaria. It would be possible for these mosquitoes to be introduced into the Samoa Islands.

Plague. Plague does not occur, but since rats are plentiful, conditions which would favor the spread of this disease are present.

Yellow Fever. Yellow fever does not occur, but the presence of the chief vector, *Aedes aegypti*, indicates that a favorable background exists for spread of the disease should it be introduced.

Nutritional Diseases

Beriberi. A small number of cases of beriberi are reported each year. The disease usually is seen among children, and ignorance or lack of interest in progeny may be a factor in the development of the disease. The suspicion has been expressed that a certain number of infants are intentionally neglected to the point of starvation, a practice which is not unusual among primitive tribes, especially if the children are deformed, sick or of unwanted sex.

SUMMARY

The public health organization of American Samoa is entirely in the hands of the United States Navy. For administrative purposes the islands are divided into sanitary districts, each of which, with the exception of the central district, is controlled by a chief pharmacist's mate acting as district health officer. Navy personnel receive medical care at the Naval Dispensary. Samoans are cared for in the Samoan Hospital at Pago Pago on Tutuila Island and in the four outlying dispensaries at Leone, Amouli, Tau and Ofu. Valuable help is given by the native Samoan public health and medical staff. Before the war public health facilities were considered to be adequate to serve the small native population.

The supply of water is ample in the main islands, where springs and surface water are plentiful. People on Rose Island and Swains Island depend on rain water and water stored in tanks. Despite consistent efforts on the part of the health authorities, native supplies of water, in so far as they exist, are not entirely safe because of extensive pollution of the soil with excreta of human beings and animals. The Naval Station has safe and regularly controlled drinking water.

A rudimentary sewerage system serving the Naval Station and emptying into the bay is in operation at Pago Pago on Tutuila Island. Although natives have been educated in the use of latrines and many types have been built for them, latrines are not generally used, the beach being preferred. A high degree of pollution of soil is said to be present around the native plantations.

The Samoan generally is in a good state of nutrition, and in the absence of natural catastrophes is well able to take care of himself. Milk and dairy products do not play important rôles in the nutrition of the Samoan. The diet of the Samoan native is rich in carbohydrates consisting mainly of taro. Proteins are provided by the eating of fish, chicken, shellfish and pigs.

The public health organization of the Territory of Western Samoa is patterned essentially according to the provisions of the New Zealand Health Act of 1920, although some alterations have been made to allow for local conditions. The center of medical activities in the Territory of Western Samoa is the government hospital at Apia. District hospitals were maintained at Cape Tuasivi on Savaii and in Aleipata district on Upolu. Seven district dispensaries are in charge of native medical practitioners assisted by Samoan nurses. Native medical practitioners play an important rôle in the control of sanitation and public health. In 1923 an annual medical tax was levied on all adult males, in return for which all Samoans of the territory are entitled to free medical care.

The government of New Zealand has been highly interested in health matters, and health conditions may be regarded as generally good. Conditions as to water supplies, food, milk and dairy products, and the disposal of wastes are similar to those in American Samoa. Before the war medical facilities were considered adequate to serve the white and Samoan population.

The Samoa Islands always have been considered to be comparatively healthful, marked by the absence of many of the diseases of other tropical lands. Malaria does not exist, and no species of Anopheles mosquito has yet been found. Plague and cholera never have been observed. Many of the usual arthropod-borne diseases such as typhus fever, relapsing fever, sandfly fever and leishmaniasis are nonexistent. Filariasis is a major problem. So-called malignant jaundice, possibly of leptospiral origin, has been a matter of growing concern to the health authorities in the Territory of Western Samoa. Dengue fever has repeatedly occurred in epidemic proportions; the presence of abundant numbers of *Aedes aegypti* could at any time facilitate spread of a new outbreak. Typhoid fever, paratyphoid fevers and dysentery are endemic; they are related to insanitary water supplies and primitive habits of the natives. Intestinal parasitism is widespread. Trachoma, yaws, leprosy, Samoan conjunctivitis, measles, whooping cough, meningococcic meningitis, chickenpox, tuberculosis, mumps and beriberi all have been observed among the Samoans.

BIBLIOGRAPHY

American Samoa, Naval Governor: American Samoa, A General Report by the Governor. Washington, U. S. Govt. Print. Off., 1927.

American Samoa, Public Health Dept.: Report of the Health Department for the Year Ending June 30, 1929. Tutuila, Samoa, 1929.(Processed.)

British Museum (Nat. Hist.) Department of Entomology: Insects of Samoa and other Samoan Terrestrial Arthropoda. London, British Museum, 1927-35. 5 vols.

Buxton, P. A.: Researches in Polynesia and Melanesia, Parts V-VII (Relating to Human Diseases and Welfare). London, The London School of Hygiene and Tropical Medicine, 1928. (Memoir Series No. 2.)

Cottle, G. F.: Medical Conditions in American Samoa. Bull. Manila M. Society, **4**:4-11, 1912.

Dempster, G. O.: Intestinal Parasites in Western Samoa. New Zealand M. J., **37**:214-218, 1938.

Dickson, J. G., Huntington, R. W., and Eichold, S.: Filariasis in Defense Force, Samoan Group. U. S. Nav. M. Bull., **41**:1240-1251 (Sept.) 1943.

Fa'atiga, T.: Medical Work in Western Samoa. Native M. Pract. [Suva], **3**:424-425, 1939.

Ferguson, E. W.: Tabanidae of the Samoan Islands. Bull. Entom. Research, **17**:315-316 (March) 1927.

Germany, Reichs-Kolonialamt: Medizinal-Berichte über die Deutschen Schutzgebiete für das Jahr 1906/07, VII, Samoa, pp. 263-288; 1907/08, pp. 498-514; 1908/09, pp. 514-596. Berlin, E. Siegfried u. Sohn, 1908-1910.

Harbert, F.: Trachoma in American Samoa. Am. J. Ophthalm., **21**:406-412 (Apr.) 1938.

Hargrave, W. W.: Report of Dengue Epidemic in American Samoa. U. S. Nav. M. Bull., **29**: 565-572 (July) 1931.

Hollander, B.: Gonorrheal Infections in Samoa. U. S. Nav. M. Bull., **34**:235-242 (Apr.) 1936.

Jordan, D. S., and Seale, A.: The Fishes of Samoa. Washington, U. S. Govt. Print. Off., 1906. (U. S. Bureau of Fisheries, Doc. 605.)

Keesing, F. M.: Modern Samoa, Its Government and Changing Life. London, Allen & Unwin, Ltd., 1934.

Lambert, S. M.: Health Survey of Western Samoa. Suva, Fiji, 1924.

——: Yankee Doctor in Paradise. Boston, Little, Brown & Co., 1941.

Leber, A., and Von Prowazek, S.: Berichte über medizinische Beobachtungen auf Savai'i und Manono [Samoa]. Arch. f. Schiffs- u. Tropen-Hyg., **15**:409-430, 1911.

——, ——: Elephanthiasis auf Samoa. Arch. f. Schiffs- u. Tropen-Hyg., **18**:386-394, 1914.

Mail, L. C.: The Treatment of Hookworm Disease in Samoa. New Zealand M. J., **23**:253-257 (May) 1924.

Mead, M.: Coming of Age in Samoa. New York, Blue Ribbon Books, 1928.

New Zealand, Census and Statistics Office: The New Zealand Official Year-book, 1941. Wellington, N. Z., 1941.

New Zealand, General Assembly: Annual Report to the League of Nations on the Administration of Western Samoa, 1921-1941. Wellington, N. Z., 1922-1941.

O'Connor, F. W.: Researches in the Western Pacific, Being a Report on the Results of the Expedition Sent from London School of Tropical Medicine to the Ellice, Tokelau, and Samoan Islands in 1921-1922. London, J. C. Phelp & Son, 1923.

Phelps, J. R.: Surface Pollution of the Water Supply at the U. S. Naval Station at Tutuila, Samoa. U. S. Nav. M. Bull., **26**:742-747 (July) 1928.

——: Tuberculosis in American Samoa. U. S. Nav. M. Bull., **28**:487-494 (Apr.) 1930.

Poleck, H.: Über einige bemerkenswerte in unseren ehemaligen Sudseekolonie Samoa beobachteten Erkrankungen. Arch. f. Schiffs- u. Tropen-Hyg., **29**:16-35, 1925.

Reed, E. U.: Medical Observations in the Tropics. U. S. Nav. M. Bull., **32**:463-467 (Oct.) 1934.

Schultz, L. P.: Fishes of the Phoenix and Samoan Islands Collected in 1939 During the Expedition of the U.S.S. "Bushnell." Washington, U. S. Govt. Print. Off., 1943. (U. S. National Museum Bull. 180.)

Schwartz, J. L.: The Practice of Medicine in American Samoa. U. S. Nav. M. Bull., **33**:27-35 (Jan.) 1935.

Stephenson, C. S.: Sanitary Report of Swain's Island 1934. U. S. Nav. M. Bull., **35**:357-361 (July) 1937.

Thieme, R.: Die operative Behandlung der Filariasis in Samoa. Arch. f. Schiffs- u. Tropen-Hyg., **18**:777-790, 1914.

32

British Solomon Islands

GEOGRAPHY AND CLIMATE

The British Solomon Islands constitute a protectorate which includes the Solomon Islands with the exception of Bougainville and Buka. They are governed by a Resident Commissioner who is responsible to the High Commissioner for the Western Pacific in Fiji. The entire group is situated, in the main, in the area described between 5 and 13° of south latitude and 155 and 170° of east longitude, between the Bismarck Archipelago on the north and the New Hebrides Condominium on the south. Bougainville and Buka are part of the Kieta district of the Territory of New Guinea, and hence are not parts of the protectorate, although geographically they would be considered as islands of the Solomon group. The chief land masses of the British Solomon Islands are Choiseul, Ysabel, Malaita, New Georgia, Guadalcanal, San Cristóbal, Florida and the Santa Cruz Islands. The entire group extends, northwest and southeast, from Bougainville Straits 600 miles to the remote island of Mitre in the Santa Cruz group; and, north and south, from the Ontong Java group to Rennell Island. The total area of the British Solomon Islands has been estimated at between 11,000 and 15,000 square miles. The large islands are from 80 to 120 miles long and nowhere more than 30 miles wide.

What is called the "rural population" of the British Solomon Islands is about 94,000. Most of the inhabitants seem to be Melanesians, with a Polynesian strain in varying proportions. It is thought that true Polynesians do not number more than 4,000. About 200 Chinese have settled throughout the islands. The white population has never been greater than 500. The island of Malaita is the most densely populated of the group, with no less than 40,000 native inhabitants. Guadalcanal Island has perhaps 15,000 natives. The islanders use no uniform language; dialect forms vary from island to island.

Physically, the islands appear as chains of lofty, heavily forested mountains, which are bordered by plains sweeping from the uplands to the sea. The elevated portions are of volcanic origin. They attain to heights of from 2,000 to 5,000 feet. On Guadalcanal Island certain eminences are more than 8,000 feet high. Almost all the islands slope gently to the coast line.

The islands are favored hydrographically. Numerous streams and springs occur on those islands which have elevated terrain, but the atolls are deficient in potable water. Tulagi, the seat of government as represented by the Resident Commissioner, is a very small island off the southern coast of Florida Island.

The climate of the British Solomon Islands is wholly tropical. Changes are most noticeable in those regions which mark the transition between plains and uplands or mountains. Heat is constant and the relative humidity is excessive. The temperature at sea level varies from a maximal of 97° F. (36.1° C.) during the day at Tulagi to a minimum of 64° F. (17.7° C.) at Kieta on Bougainville Island, which is geographically but not politically a part of the British Solomon Islands. At an altitude of 6,000 feet the temperature may be as low as 49° F. (9.4° C.). Rainfall varies greatly. At Tulagi, for instance, rain normally falls on almost every day of the month, but in January has ranged from 4 inches (10 cm.) to 60 inches (1.5 meters). The wet season begins with the onset of the northwestern monsoon and lasts from November to April. The dry season is marked by the predominance of the southeastern monsoon, from April to November. Earthquakes are frequent. The salient climatic data, expressed in annual figures, concerning certain places in the vicinity, are seen in Table 31.

nonmedically trained sanitary officers are appointed in each district, and village dressers trained in the use of simple medicines and surgical dressings work in various villages throughout the protectorate, under the supervision of the district medical officer. There is a traveling medical officer who visits the various districts and district hospitals and keeps in touch with the work of the native medical practitioners. There is one field unit for the control of yaws and hookworm, in charge of a non-native officer.

TABLE 31

Salient Climatic Data, Annual Figures, Certain Places in or Near British Solomon Islands

	Temperature, ° F.						
Place	Extreme maximal	Extreme minimal	Mean	Precip., inches	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Tulagi	97	67	81	121	79	SE, 52	7
Shortland Island	..	..	81	105	..	......	16
Kieta *	96	64	81	119	79	C, 42 †	240
Woodlark Island *	..	..	80	168	84 ‡	......	404

* Situated in the geographic area, but not included in the political scheme, of the British Solomon Islands.
† C = calm.
‡ This particular observation was taken at 8:00 A.M., an hour at which humidity is greater than at midday.

PUBLIC HEALTH *

Health Services

Organization. The seat of government is at Tulagi, where there are stationed the Resident Commissioner and the heads of all departments, and where the government hospital is located. The health and medical services (public health and port health work, hygiene and sanitation, and administration of hospitals and dispensaries) all are performed by members of the same staff.

The protectorate staff consists of one senior medical officer, two medical officers, seven native practitioners of medicine, two officers who carry out measures for the control of yaws and infection with hookworm, one dispenser and clerk, one native sanitary inspector and three nurses. In addition,

* Conditions described in this chapter are set forth as they were known to exist at the beginning of the war in the Pacific.

This unit carries out mass treatment of the native inhabitants for these and other diseases. These various agencies come into close contact with the native inhabitants in their villages and the opportunity is taken to teach and promote improvement in health conditions. The medical department also recommends and supervises the quarantine measures among the various islands and districts, and enforces "closed-district" regulations which are designed to protect the unexposed inhabitants of isolated islands against the introduction of infections from the outside.

Relative Effectiveness. The Solomon Islands are wholly within the tropical zone. The administration of health and sanitary measures is complicated. Communication between various districts on the same island, as well as between the different islands, is extremely difficult and for the most part must be achieved by water. The population is entirely rural. The inhabitants are a heterogeneous people of varying races, customs, cultures, religions, social development and standards of living. All medical, health and sanitary work has to be carried out by members of the same small staff. The problem is further complicated by the fact that most of the natives require constant supervision in all matters pertaining to their health and welfare and do not readily adapt themselves to modern concepts of sanitation. Because of the extremely limited staff, it is frequently difficult or impossible to institute or enforce any sort of compliance with public health regulations. The major problems of public health concern pollution of the soil, protection of water supplies, control of tropical diseases and prevention of the introduction of highly communicable diseases among the nonimmune native population. On Tulagi a sanitary inspector makes routine weekly inspections of all houses, buildings and grounds, and insures compliance with health and sanitary regulations. The medical department, in collaboration with the public works department, administers measures for the control of malaria and mosquitoes (oiling, spraying, clearing, weeding, drainage and reclamation) at Tulagi and other localized areas. All government, and most other non-native, houses have screened bedrooms, and labor regulations require that all laborers (prison, free and indentured) be supplied with mosquito nets. Various plantations have supplemented the usual measures for the control of mosquitoes with the introduction of larva-eating fish (*Gambusia affinis*). Little has been done to alter or improve the native customs of housing and sanitation, other than to insist on reasonable standards of accommodation and cleanliness in the villages. Frequently health and sanitary conditions are deplorable but, because some tribes resent interference in their affairs, officials are reluctant to resort to coercion to obtain compliance with the regulations. As a result, customs follow tradition and the habits of the natives have not been materially changed.

Water Supplies

Surface water is abundant on the majority of the mountainous and hilly islands. On the low-lying atolls surface water is scarce. On Tulagi and in the districts water, other than that used by the natives, is obtained by the collection of rain from the roofs. It is stored in tanks or concrete cisterns. During periods of average rainfall (105 to 168 inches or 2.7 to 4.3 meters per year) the supply is adequate for local needs but, in the event of prolonged dry weather, there is danger of shortage of water. The natives use water from streams, rivers, springs and wells. Most of the islands are mountainous and possess many rivers. Although the water of these rivers is hard, the supply is satisfactory and little or no pollution is reported. Springs are likely to be dangerous since frequently they consist of reappearing surface waters that temporarily have passed underground. They are therefore subject to pollution; this is particularly true of intermittent springs which are most commonly discovered during the rainy season. It is said that pollution of surface water is not of as common occurrence as might be expected, because of the habits of the natives in respect to disposal of sewage.

Sewage Disposal

Flyproof pans or pit latrines are in general use at Tulagi, at headquarters of the various districts, at missions and at plantations. The pans are collected nightly and emptied into the sea. The newer houses and government buildings are being equipped with water-flushing closets that empty directly into the sea or into septic tanks. Latrines built over the sea at suitable places are provided for the use of natives on Tulagi. In the coastal districts, the natives dispose of body wastes in the sea, but the natives of the interior set apart certain areas for this purpose. Among some of the nomadic tribes of the flat islands there is indiscriminate pollution of the soil. At Tulagi garbage and other refuse are collected in covered garbage bins which are taken daily to public incinerators for disposal. In the districts garbage is buried or dumped into the sea.

Insects and Animals

Vectors of Disease. Mosquitoes. *Anopheles punctulatus punctulatus, A. punctulatus moluccensis*, and *A. bancroftii* are the vectors of malaria in the Solomon Islands. Of these, *Anopheles punctulatus moluccensis* is considered to be the most important. It breeds in permanent bodies of water, pools, brackish drains or open wells. It tolerates pure water less than does *Anopheles punctulatus punctulatus* and often is found in pools and swamps close to the sea, the levels of which vary with the tides. It also breeds in moving water and in the grass along river banks. Its breeding spots are usually sunny. It frequents houses and feeds at night. *Anopheles punctulatus punctulatus* breeds chiefly in shallow pools of rain water, temporary puddles, swamps and local depressions in the ground, such as those created by hoof marks, automobile ruts and cart tracks. It usually breeds in fresh water and prefers open and sunny places. It frequents human habitations, bites at night and prefers human blood. *Anopheles bancroftii* is a minor vector which breeds in semishaded permanent and casual water. Ordinarily it feeds at night, but it has been known to bite during the daytime when or where the light is subdued.

Aedes aegypti and *A.* (*Finlaya*) *kochi* are widely distributed throughout these islands. The latter is a vector of filariasis. It breeds in swamps in which the water may vary from fresh to brackish. *Aedes aegypti* is the vector of dengue fever; in other parts of the world it is the vector of yellow fever. It is a domestic mosquito which breeds in any collection of clean water, such as water in a roof gutter, house tank, tin can, barrel, bottle or tire casing.

Culex fatigans, C. annulirostris and *C. sitiens* are prevalent and are vectors of filariasis. *Culex fatigans* is a domestic mosquito. It breeds in dirty and contaminated water, such as household water and water in septic tanks, street gutters and so forth. The other two culicines breed in swamps.

Lice. Body lice (*Pediculus corporis*), head lice (*Pediculus capitis*) and crab lice (*Phthirus pubis*) are commonly found among the native population. They are pests, but are not known to be the vectors of any specific disease in the Solomon Islands. However, the body louse is a potential carrier of epidemic typhus fever, relapsing fever and trench fever.

Flies. Houseflies (*Musca domestica*) are universal in distribution. In some islands they occur in great numbers. These flies, by mechanical means, are capable of transmitting enteric infections. Screening is practiced only by the Occidentals. Information concerning the presence or absence of sand flies of the genus Phlebotomus and gnats of the genus Culicoides is not available.

Ticks. There is no information concerning the presence or absence of ticks in the Solomon Islands. No tick-borne diseases (tick paralysis, Q fever, spotted fever, tick-bite fever, relapsing fever) have been reported from these islands. The scrub tick, *Ixodes holocyclus,* is present in eastern Australia and probably is present in New Guinea and Papua. In these regions this tick is the cause of tick paralysis.

Fleas. Information concerning fleas is lacking but the presence and prevalence of rats, especially in Malaita, would suggest that the rat flea, *Xenopsylla cheopis,* also is present. It is also probable that the cat flea, *Ctenocephalus felis,* is present. Although no flea-borne diseases (plague or endemic typhus fever) have been reported from the islands, these fleas are capable of transmitting the diseases.

Others. Mites belonging to the family Trombidiidae are known to be present and are capable of transmitting tropical or scrub typhus fever. As a rule, these mites will be found in the dense, damp jungles of river basins and in the smaller valleys. Infestation by these mites is of common occurrence among those who are actively engaged in the clearing of bush and kunai in infested areas. Scabies, caused by *Sarcoptes scabiei,* is widespread.

Snakes and Other Dangerous Animals. No information is available concerning snakes in the Solomon Islands, and detailed information is lacking concerning the fauna and flora of medical significance. Rats, bats and dogs are common. It is reported that during certain seasons some fish caught in the lagoons of the atolls are poisonous when eaten, whereas the same fish caught outside the reefs at different seasons are said not to be poisonous. The toxic substance exists in certain parts of the fish, and seems to be related to a change in the feeding and breeding habits of the different species. Lizards and crocodiles are commonly encountered in some regions. The indigenous land fauna is sparsely distributed, whereas the marine and aerial fauna is found in abundance. Of the aerial fauna, various birds, such as the bush fowl, *Megapodius duperreyi,* the bush turkey, *Talegallus jobiensis,* and the ground pigeon, *Gallicolumba jobiensis,* should be mentioned. In New Guinea these birds are known to be primary hosts of the mites which are capable of serving as vectors of tropical typhus fever.

Pests. The "red-back" spider, *Latrodectus hasseltii,* is the only poisonous spider in this region. Its potent venom may cause serious illness and at times death.

Food and Dairy Products

Imported fresh meat usually is available on Tulagi. Fresh vegetables are obtained by steamer from Australia, and locally grown vegetables and fruits are fairly plentiful. The following native foodstuffs are generally available: taro, yams and sweet potatoes; bananas, plantain, breadfruit, sago, cassava and mangoes; native cabbage and spinach; coconuts; and fish, crabs, shellfish, eels and turtles. Pork and beef are available in limited amounts, but most of the pork is reserved by the natives for ceremonial occasions. Eggs and poultry (fowl, duck, maleo, leipoa, bush turkey and jungle fowl) are not much appreciated by the natives. Milk and milk products are almost unobtainable. Corn and rice have been successfully cultivated, but not in large amounts. The natives evaporate sea water to obtain salt. Facilities for refrigeration are limited to the island of Tulagi.

Miscellaneous Problems of Sanitation

Enforcement of any control or protective measures is complicated. Rigid control cannot be exercised because of the limited staff and facilities and the area to be patrolled. Major efforts are directed toward quarantine control of the more densely populated islands and enforcement of "closed-district" regulations on the isolated islands. Measures for the control of malaria are confined largely to Tulagi, headquarters of the various districts, missions and plantations, and are only locally effective. Campaigns against yaws and infection with hookworm have been energetically and systematically carried out for many years, with beneficial results. The dramatic results obtained in the mass treatment of yaws have had a profound effect on the attitude of the natives toward the white man, the government he represents and some of the measures employed in behalf of the natives. The treatment of yaws exerts great influence among the primitive and sometimes savage people. Measures of control of communicable diseases are not enforced. There are two leprosariums in the British Solomons (Auki and Fauabu), but residence and confinement are not compulsory. There are no tuberculosis sanatoriums or other facilities for either control or treatment of this disease. No effort has been made to control trachoma. There is no isolation of patients who have acute infectious disease except those admitted to the hospitals.

MEDICAL FACILITIES

Hospitals

The main government hospital for the British Solomons is situated at Tulagi and has separate wards for Occidentals (12 beds), Asiatics (12 beds), and natives (100 beds). This hospital is equipped for the performance of surgical operations and has a portable x-ray unit. Power for the x-ray unit, as well as for other purposes, is supplied from the hospital lighting plant. Throughout the protectorate, native practitioners of medicine are in charge of small district hospitals at district headquarters. These hospitals are located at Auki (Malaita Island); Aola (Guadalcanal Island); Tataba (Ysabel); Kira Kira (San Cristóbal Island); Santa Cruz Islands; and Wairokai (Malaita). Each district has a vessel under the charge of the district officer who co-operates in the matter of transporting patients to the Tulagi hospital for care and treatment. In addition, three mission hospitals, in charge of medical officers, are subsidized by the Administration; these hospitals are the Melanesian Mission Hospital at Fauabu, North Malaita; the Seventh-Day Adventist Hospital at Ariel Cove, Kolombangara, Gizo district; and the Methodist Episcopal Mission Hospital at Biloa, on Vella Lavella Island. The Seventh-Day Adventists in 1937 were building a hospital on Malaita Island, near Makwanu. The hospital at Fauabu has 70 beds and is said to be well run. There is also a number of smaller hospitals in charge of trained nurses.

Equipment and Supplies. The only hospital that is fully equipped is the one at Tulagi. It possesses an operating room, surgical equipment and supplies, a Nuffield respirator and a portable x-ray unit. The concrete hospital at Fauabu has a well-equipped operating room. Other than the drugs incident to the conduct of the campaign against yaws and infection with hookworm, no large supplies of drugs are kept on hand. The Solomon Islanders are entirely dependent upon outside sources for supplies and equipment.

Medical Personnel

Physicians. Under optimal conditions there are three government physicians, three missionary physicians, and two plantation physicians in the British Solomon Islands. In addition to these, seven native medical practitioners are assigned to the different administrative districts. The native practitioners of medicine in the British Solomon Islands are valuable adjuncts to the medical and health service. These natives have received basic medical training under competent white tutelage. They have been instructed in, and for the most part speak, English very well. In addition to their medical background and to the fact that they speak English, they are of particular value in that they are thoroughly acquainted with the native languages and customs.

Nurses. There are three government nurses (white) in the protectorate. There are a few nurses in nongovernment hospitals but their number is not known.

Dentists. No dentists are attached to the health service of the protectorate.

Others. In the protectorate there are one pharmacist, one inspector associated with the campaigns against yaws and infection with hookworm, one native sanitary inspector, an unspecified number of native dressers trained at the Tulagi Hospital, eight nonmedical sanitary inspectors, and an unspecified but not large number of native orderlies and attendants. There are no Red Cross or social services in the protectorate.

DISEASES

General Considerations. The hot and humid climate is not healthful. Malaria, blackwater fever, bacillary dysentery, pneumonia, and infectious ulcers of the skin are of common occurrence among the Occidentals. Morbidity and mortality statistics for the white population are of practically no value because most of those who become seriously ill leave the islands. Information abstracted from the reports of the Tulagi Hospital (1928 to 1940, inclusive), however, indicates that a total of 618 white patients were admitted to the hospital, with 41 deaths. These figures (probably much too low) indicate that each year approximately 10 per cent (47.5 patients) of the total white population of the protectorate (estimated at between 475 and 500) requires hospitalization and that the mortality rate is approximately 6.5 per 1,000. About a third of the deaths can be considered as being caused by diseases that are peculiar to the region, such as malaria, blackwater fever, dysentery and infections of the skin. The rest of the deaths were due to causes common to all climates, but deaths from pneumonia seem unusually high.

Diseases that occur commonly throughout the temperate and tropical zones are encountered in the Solomon Islands. The former, and particularly the acute infectious diseases, assume abnormal importance as far as the native population is concerned, and the morbidity and fatality rates incident to them assume alarming proportions. This point is emphasized by the fact that the government establishes "closed districts" for the specific purpose of protecting the natives of isolated islands from the ravages of infections introduced from the outside.

Diseases Spread Chiefly through Intestinal Tract

Enteric Diseases. Bacillary dysentery predominates, but cases of bacillary and of amebic dysentery are reported throughout the protectorate. Epidemics of bacillary dysentery or typhoid fever occur annually in localized areas or districts. The native habit of defecating into the sea or in restricted areas limits the danger of gross pollution of the water or soil, but by no means obviates it. The natives do not use night soil as fertilizer, but probably it is so used by the small resident Asiatic population.

Intestinal Parasitism. Intestinal parasitism, and particularly infection with hookworm, is commonly found among the native inhabitants. Infection with worms is said to be a common cause of secondary anemia and chronic debility. Results of a hookworm survey in 1928 indicated that the incidence of this disease among the native population was remarkably high. Genera discovered, including others than hookworm, were: Necator, 84 per cent; Ascaris, 7 per cent; Trichuris, 15 per cent; Strongyloides, 0.01 per cent, and Enterobius, 0.2 per cent.

Diseases Spread Chiefly through Respiratory Tract

Acute Communicable Diseases. Pneumonia and influenza are endemic and not infrequently assume epidemic proportions. The occurrence of these diseases is associated with high morbidity and fatality rates, particularly among the native inhabitants. Other communicable diseases, like poliomyelitis, cerebrospinal meningitis, measles, rubella, whooping cough, scarlet fever, diphtheria, mumps, chickenpox and smallpox, are not endemic in these islands. Almost invariably they are introduced from the outside, rapidly assume epidemic proportions and take a high toll of life among the nonimmune natives. Diphtheria, scarlet fever and smallpox have not been reported during the past 15 years.

Tuberculosis. Tuberculosis is widespread, and the incidence among the natives is high. Measures of control are lacking and many patients have the active form of the disease. Most hospitalized patients are those who have the terminal phase of the disease. The distribution of the disease closely parallels the extent of contact of the natives with civilization and it is estimated that about 75 per cent of the population have positive reactions to the tuberculin test.

Diseases Spread Chiefly by Contact

Venereal Diseases. The problem of venereal disease is limited almost exclusively to persons in the few port towns and to some of the coastal tribes that have had contact with civilization. Among these people gonorrhea is of fairly common occurrence (particularly in the southern part of Guadalcanal), and "venereal granuloma" occasionally is seen. Syphilis is no problem; it is said that it does not occur among the native inhabitants. In the southern part of Guadalcanal Island promiscuity is common among the young and gonorrhea is prevalent. On San Cristóbal there is an indigenous moral laxness. In the Star Harbor district "venereal granuloma" exists among the natives. On Rennell Island the men sometimes offer their women to traders. Except for these isolated islands, promiscuity either is not common or is not tolerated. There is very little adultery, and prostitution is almost nonexistent. It should be emphasized that among some of the primitive tribes there are rigid tabus in respect to their women and family lines, and retribution for defilement is sought in murder.

Yaws. Yaws is rare among the nonnative population, but is extremely prevalent among the natives, particularly those of the bush. In 1940 approximately 40,000 treatments were given. It is estimated that two thirds of the total native population is infected with yaws. During recent years there has been a considerable reduction in the incidence of this disease as the result of control campaigns.

Diseases of the Skin. Several different mycotic (fungous) infections of the skin are of common occurrence among the natives, especially tinea imbricata. Approximately 8 per cent of the population is infected with this or other ringworm disease. Scabies, caused by *Sarcoptes scabiei,* is much more prevalent among some tribes than others, but is essentially universal in distribution. Other common diseases of the skin include pityriasis (type unspecified), impetigo and sycosis. It is estimated that about 25 per cent of the total population is affected with some type of disease of the skin, tropical ulcer excluded. In the tropics, ringworm of the foot and dhobie itch are especially troublesome, and control of them necessitates careful attention to care of the skin, and especially the body folds. The incidence of tropical ulcer (tropical sloughing phagedena) is high, and reaches its greatest endemicity on Malaita. The disease is probably bacterial in origin, but its exact etiology is unknown. Among the natives the development of tropical ulcers probably is related to debilitation from other chronic diseases and from dietary deficiencies.

Leprosy. Leprosy is encountered in all the districts, but is most prevalent in the Malaita, Nggela, Guadalcanal and Ysabel islands. The frequency of occurrence is much greater among the bush tribes and in the villages than among the natives along the coast.

Trachoma. Trachoma is most prevalent in the San Cristóbal and Guadalcanal districts, where the incidence among the inhabitants is between 6 and 8 per cent. For the protectorate as a whole the incidence is between 2.5 and 3 per cent.

Conjunctivitis. An epidemic form of conjunctivitis prevails throughout this region. It is of common occurrence among the native population. It is thought to be due to the Koch-Weeks bacillus. Complications are rare.

Diseases Spread by Arthropods

Malaria. Malaria is endemic throughout the Solomons and reaches hyperendemic proportions in most of the coastal regions. It has been pointed out by Ford that epidemiologic conditions prevailing throughout the greater part of the islands make control of the disease, both in communities and in individuals, a problem of the utmost difficulty. The large, heavily infected native population, associated with conditions which are eminently suitable for the breeding of anopheline vectors, provide a situation of the gravest menace, particularly for newly arrived persons from nonmalarious countries. *Anopheles punctulatus punctulatus* and *A. punctulatus moluccensis* are the principal vectors. It is estimated that about 80 per cent of the natives have palpable malarial spleens and that between 10 and 20 per cent of all persons admitted to hospitals are admitted for treatment of malaria or blackwater fever. With the exception of the control work carried out at Tulagi, measures for control of malaria and mosquitoes are not generally employed, and elsewhere throughout the Solomons residents are almost universally infected. This is particularly true of newcomers who are readily infected and among whom the occurrence of blackwater fever is not uncommon. As has been mentioned, malaria is hyperendemic in the coastal regions but in the mountainous country, above 2,000 feet, the incidence declines to a minimum.

Filariasis. Filariasis, caused by *Wuchereria bancrofti,* is reported from all districts of the protectorate. The estimated rate of endemicity (0.6 per cent) is low. Several species of Aedes and Culex mosquitoes are distributed throughout the islands, and are known to be vectors of this disease. The gross physical effects of filariasis are not much in evidence, but it is believed that the true incidence of the disease is probably higher than the recorded incidence.

Dengue Fever. The vector of dengue fever, *Aedes aegypti,* is widely distributed throughout the Solomons, and dengue fever was endemic on these islands in 1928 and 1933. In 1934, it was reported that on Rennell Island there was a disease called *onggia* which was believed to be dengue fever. This disease is of considerable importance because it strikes suddenly and temporarily incapacitates large numbers of nonimmune people.

Rickettsial Infection. Reports of a typhus-like disease in southern Malaita were received in 1937, but in subsequent reports this disease has not been mentioned or identified. Although the existence of a "typhus-like disease" in Malaita is open to question, it is considered highly possible, since tropical typhus fever and the mite vector are known to exist in the territory of New Guinea and in Australia. This disease is almost exclusively a disease of the whites. Because the white population of the Solomon Islands has been small, it is entirely possible that it may have escaped notice. This disease is most commonly observed among those engaged in clearing brush and kunai grass. The fatality rate among those who contract the disease is 5 to 20 per cent. In the northeastern part of New Guinea, where the disease is known to be endemic, one of every 24 Occidentals admitted to a hospital was received for treatment of this disease.

Miscellaneous Conditions

Deficiency Diseases. The average native diet is grossly deficient in whole grains, green vegetables, fresh red meats, fats, milk and dairy products. Deficiencies of vitamin A and vitamin B_1 are of fairly common occurrence.

Addiction to Betel Nuts. Chewing of a mixture of betel nuts and other ingredients is a common practice among the natives. The constituents of this mixture are the leaves of the climbing pepper, *Piper betle,* the seed of the betel palm, *Areca catechu,* and lime. The material is commonly chewed for its stimulant and astringent effects and because it allays hunger.

SUMMARY

The efficient but grossly inadequate public health and medical services are administered through the medium of traveling medical officers. Hospital launches are used for visits to the many widely separated islands. Hospital facilities and equipment are inadequate. The number of physicians and other medical personnel is insufficient to serve properly the needs of the native population. A limited number of trained medical orderlies and dressers is used by the medical service. Except at Tulagi, there are no facilities for the storage or preservation of meats or other perishable foods. The majority of the staple items of the European dietary must be imported. Native foods are plentiful, but qualitatively inadequate. In the absence of measures of control, meat, milk, dairy products and other foods should be considered unsafe. Water used by nonnatives is derived from collections of rain water, whereas water used by the natives is derived from rivers, mountain streams, springs and wells. There are no facilities with which to insure the safety of any of the water supplies. Disposal of sewage is accomplished by primitive measures, except at Tulagi, where latrines and a few septic tanks are used. The islands abound with vermin, and particularly mosquitoes, flies, lice and rats. Native habitations and villages are primitive, and usually are insanitary and infested with vermin.

The diseases of greatest importance are malaria, blackwater fever, intestinal diseases (typhoid fever, paratyphoid fever, bacillary dysentery and amebic dysentery), dengue fever, venereal diseases, and dermatologic diseases. Whenever the common communicable diseases are introduced, they become epidemic among the native inhabitants.

BIBLIOGRAPHY

British Solomon Islands Protectorate Annual Medical and Sanitary Reports (1928-1940).

Craig, C. F., and Faust, E. C.: Clinical Parasitology. 2d ed., Philadelphia, Lea & Febiger, 1940.

Encyclopaedia Britannica, 14th ed. London, Chicago, Encyclopaedia Britannica, Inc., 1939.

Epidemiological Record of the Austral-Pacific Zone for the Year 1939. J. Commonwealth Dept. Health, Austral., **18**:25-31, 1940.

Ford, E.: Notes on Malaria in the South-West Pacific (unpublished).

Gt. Brit. Colonial Office: Information as to the Conditions and Cost of Living in the Colonial Empire. 3d ed. London, H. M. Stationery Off., 1937.

Hetherington, H. B.: Note on the Health Organisation of the British Solomon Islands Protectorate. *In* League of Nations, Health Organisation, Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Geneva, 1937, pp. 79-102.

James, C.: Clinical Medicine in the Solomon Islands. M. Press, **205**: 231-234, 1941.

Lambert, S. M.: The Depopulation of Pacific Races. Honolulu, 1934. 42 pp. (Bernice P. Bishop Museum. Special Publ. 23.)

——: British Solomon Islands Health Surveys, 1933. J. Trop. Med., **37**:81, 100, 119, 134, 1934.

Lambert, S. M.: Medical Conditions in the South Pacific. M. J. Australia, **2**:362-378, 1928.

McCallum, F.: International Hygiene; a Review from the Australian Viewpoint of International Activities in the Field of Public Health. Glebe, N. S. Wales, Australasian Medical Publishing Company, 1935. (Australia Dept. Health. Service Publication No. 40.)

Manson, P.: Manson's Tropical Diseases. Ed. by P. Manson-Bahr. 11th ed., Baltimore, Williams & Wilkins Co., 1941.

Rutter, A. G.: The Incidence and Treatment of Yaws in the Western Solomon Islands. Tr. Roy. Soc. Trop. Med. & Hyg., **34**:429-444, 1941.

Statesman's Year-Book, 1943. London, Macmillan & Co., Ltd., 1943.

Stitt, E. R.: Stitt's Diagnosis, Prevention, and Treatment of Tropical Diseases. 6th ed. by R. P. Strong, Philadelphia, The Blakiston Co., 1942. 2 vols.

Taylor, F. H.: Intermediary Arthropod Hosts and Mechanical Carriers of Human Disease in the Australian Region. Health, Canberra, **16**:72-82, 1938.

33

Tokelau or Union Islands

GEOGRAPHY AND CLIMATE

The Tokelau, or Union, Islands, administered by the Dominion of New Zealand since 1926, are situated within the area designated by 171 and 173° of west longitude and 8 and 10° of south latitude. They consist of three islands—Fakaofu, Nukunono and Atafu—the total area of which is only 4 square miles. In 1942 it was estimated that the population was 1,300; the people are chiefly Polynesians closely related to those of the Ellice Islands. They speak a Samoan dialect.

Fakaofu Island is a small coralline atoll which has a village, Fakaofu, of about 450 or 500 natives. The island has nearly 50 islets along its shores. Atafu, another atoll, has a village of the same name as that of the island. Nukunono Island is composed of about 24 coralline islets arising from a coral reef. All the islands are similar; elevation is not much more than 10 feet. All are thickly covered with groves of coconut palms, low trees and shrubs. There are no important hydrographic features. The production of copra is the only industry.

The southeastern trade winds persist from March through April. During this period the temperature is not high, but March, April and May are the warmest months of the year. The mean monthly temperature varies from 72 and 82° F. (22.2 and 27.7° C.). Torrential downpours may occur during the hurricane season—end of November to March—but the annual precipitation is by no means constant. It is usually about 60 inches (1.5 meters), but may exceed 100 inches (2.5 meters).

PUBLIC HEALTH

Health Services

Organization. Only the most simple type of health organization is in force in the Tokelau Islands. The Secretary of Native Affairs of the Territory of Western Samoa is also district officer for Tokelau, which has no local Occidental officials or residents. Jurisdiction is exercised by local chiefs with the aid of native councilors. The group is visited once a year by a member of the Office of Native Affairs of the Territory of Western Samoa. There is one native medical practitioner who has headquarters at the small hospital at Atafu. This practitioner serves the entire group and provides the only skilled medical care available. A native of the Fiji Islands, he was trained at the native medical school at Suva.

In addition to the services of this practitioner, each village has a nurse and dresser trained by the Fijian physician at the Central Hospital at Funafuti in the Ellice Islands. Local women's committees have been organized in the villages to promote public health work. Their duties include the daily sanitary inspection of houses and their surroundings, assistance to the sick, promotion of child health, and assistance to the native medical practitioner and the dressers during their visits. These committees are given a supply of drugs, and are instructed in simple medical procedures.

Relative Effectiveness. The use of the native medical practitioners has been found to be highly successful throughout the Pacific Islands on which they have been used. Since all residents of the Tokelau Islands are natives, the practitioner is well suited to work among them. The use of native dressers and women's committees has been found effective among native groups. It has been stated that native medical practitioners are intelligent, ready students who do good work, but who need supervision. The reported incidence of disease is not high.

Water Supplies

The water supply for the islands is scant. Rain water is caught and stored in various containers; but water from wells, which during the dry season often is brackish, furnishes the principal supply for the islands. On Fakaofu, several fresh-water wells are reported. A cistern is filled with rain water from a church roof. Nukunono has one fresh-water well which dries up at times of drought, forcing the inhabitants, in the absence of rain, to resort to coconut milk. Milk from green coconuts is readily obtainable; that from older coconuts, although readily available, is usually mildly laxative. Atafu has three wells, but only one is available to the village; water is scarce. Rain water is collected from the trunks of leaning palm trees in which furrows are cut diagonally down the trunk to carry the water into artificial cavities near the base of the tree, where it is protected from the sun. Water is collected from the roofs and stored in concrete or iron cisterns. On similar islands outside this group some natives are afraid to use water collected from roofs of churches; this probably is true of the Tokelau natives. Most of the water collected in containers is unprotected; it soon becomes stagnant and provides ideal breeding places for mosquitoes. All water, regardless of source, must be considered unsafe and fit for use only after proper treatment.

Sewage Disposal

Customs as to disposal of body wastes are conditioned by the fact that the natives of the Tokelau Islands fear that harm will come to them if their feces, urine, hair and nail parings fall into the hands of others, especially their enemies; thus, these materials are deposited in places where they cannot be easily found. Defecation in the bush adjacent to the village is common. The beach below high-tide mark has been a favorite site for defecation because it ordinarily is not more than a few hundred yards from a village. Over-the-sea drop latrines have been built by the villagers, but they probably are not used commonly. The fecal material beneath the latrines is washed out to sea twice daily by the receding tide, but between tides it remains exposed to flies and other scavengers.

The propagation of flies, rodents and other carriers of disease is favored by the insanitary disposal of excreta and other wastes. The danger due to the disposal of excreta in the sea is enhanced by the fact that the natives, in many islands of this area, employ sea water for a beverage during periods of hard work and as a means of seasoning food.

Insects and Animals

Vectors of Disease. Mosquitoes. Mosquitoes are not abundant on the Tokelau Islands. Anopheline mosquitoes have not been reported from any of the islands, but the possibility of their introduction cannot be ignored. *Anopheles punctulatus moluccensis* has spread as far eastward as the Solomon Islands and the Condominium of New Hebrides. The larvae of this mosquito are among the most adaptable of all known, and might conceivably extend their range to the Tokelau Islands.

Aedes scutellaris pseudoscutellaris is found; it is the local vector of *Wuchereria bancrofti*. The breeding places of this mosquito are peculiar to the species and variety. It is not a domestic species; it breeds in small collections of fresh water containing decayed vegetable matter, such as water in husks and shells of coconuts, in crevices and holes in trees and in the artificial reservoirs hewn out of coconut trees for use as wells by the islanders. Larvae are found in holes in coconut pods gnawed out by the rats, and in bottles or tins which might be lying about in sheltered spots in the bush. Both larvae and pupae can exist for a long time at the bottom of these breeding places after the water has evaporated. This mosquito is extremely intolerant of sun and wind. It prefers the still, shady, thick bush around native villages. It bites strictly during the day. On Fakaofu and Nukunono islands, mosquitoes are reported not to be numerous, due to the light, airy bush on these large atolls which are swept by the southeastern trade and westerly winds. Conditions on Atafu, a small or closed-lagoon atoll, favor a greater abundance of mosquitoes. No other species of Aedes are reported from the islands. The possibility of the introduction of other forms must not be overlooked. *Aedes aegypti* is recorded in the Gilbert and Ellice Islands and in the Samoa Islands. In addition, *Aedes albopictus, A. samoana* and *A. vexans* are found in Samoa.

Species of Culex have not been reported from Tokelau. *Culex fatigans* has been reported from the Gilbert and Ellice Islands and from the Samoa Islands. In addition, *Culex annulirostris* and *C. samoaensis* are recorded in Samoa. The possibility of their importation into the Tokelau Islands must be kept in mind.

LICE. Data as to lice are lacking; their prevalence in other islands warrants the assumption that they are to be found in the Tokelau Islands.

FLIES. Flies are abundant, but the species are not recorded.

TICKS. No reports are available concerning the presence of ticks.

FLEAS. No data are available concerning the presence or absence of fleas in Tokelau.

MITES. *Sarcoptes scabiei,* the arthropod which causes scabies of human beings, is common in Samoa and the Gilbert and Ellice Islands and probably is present in Tokelau. No other mites of medical importance have been reported from Samoa.

RODENTS. *Rattus exulans* is the only species reported from the Tokelau Islands. This rat commonly opens coconuts and lives on the meat. Rats introduced in recent years to neighboring islands are the black rat, *R. rattus;* the roof rat, *R. alexandrinus;* and the brown rat, *R. norvegicus.*

Snakes and Other Dangerous Animals. Poisonous land snakes are not reported from the islands. Poisonous sea snakes of the family Hydrophidae have been found in other central Pacific waters, and may well be of importance in the waters around the Tokelau Islands. Spiders are reported to be present. The two most common species of scorpions in this area of the Pacific are *Isometrus europaeus* (*I. maculatus*) and *Hormurus australasiae. Scolopendra morsitans* and *S. subspinipes* are the most common species of centipedes. Undoubtedly other species are also present. Scorpions and centipedes frequently are found in thatched houses, under matting floors and in other damp places. They are most active at night and may crawl into shoes, clothing and luggage. Their bites, although extremely painful, are rarely fatal excepting among children. There are no large dangerous animals in the Tokelau Islands.

Pests. There are few pests on the islands besides those mosquitoes and flies already mentioned. Ants, beetles, dragon flies, crickets and crane flies were reported to be abundant on Fakaofu Island. Lizards also are reported, but are not known to be pests.

DANGEROUS MARINE LIFE

Poisoning by the eating of certain fish has been reported from the Samoa Islands and the Gilbert and Ellice Islands; the poisonous fish in question doubtless occur in the waters about the Tokelau Islands. Puffer fish, members of the genus Tetraodon, and porcupine fish or globefish, such as *Diodon hystrix* and *D. holacanthus,* have a thermostable poisonous principle which is contained in the ovaries or testes and exerts an effect somewhat like that of curare. These fish are poisonous if eaten at certain seasons, especially during spawning. Goatfish, members of the family Mullidae, are said to cause poisoning at certain periods.

Tropical eels or morays of the genus Muraena are common in crevices in the coral ledges or reefs of this region. These savage and voracious eels have well-developed hollow teeth through which they can inject a hemolytic toxin that can, in large amounts, produce immediate death. Stonefish, such as *Synancea horrida* and *S. verrucosa;* weevers of the genus Trachinus; and zebra fish, such as *Tephraeops zebra* and *Enoplosus armatus,* have dorsal and lateral spines through which a poison is injected when a spine inflicts a wound. Sting rays of the family Trygonidae are particularly feared. They lie in shallow water; if they are stepped upon they may inflict severe and dangerous wounds with the barbed tail and posterior spines. The giant clam, *Tridacna gigas,* often 2 feet (0.6 meter) or more in length, is found along coral reefs. This clam has severely injured native swimmers in waters of this region by snapping shut its formidable valves on a hand or foot carelessly or accidentally inserted between them. Sharks which probably will attack man are known to inhabit the waters about the Tokelau Islands.

Dangerous or Irritating Plants

The elephant ear, or *Alocasia macrorrhiza,* is a large plant that is dangerous unless it is cooked throughly with two or three changes of water. Papaya, or *Carica papaya,* is a tree that has yellow, melon-like fruit; immature fruit can be eaten safely if it is cooked thoroughly with several changes of water. Taro, or *Colocasia esculenta,* which has rootstocks much valued by the natives, occasionally causes difficulty if the rootstalks are not boiled and washed sufficiently to remove certain injurious crystals.

Copra dust is said to produce allergic reactions among those sensitive to it; some observers have said, however, that parasites or fungi in the copra are responsible for the reactions. Ragweeds which cause distress in other countries do not occur in the Tokelau Islands.

Food and Dairy Products

The dietary of people of the Tokelau Islands is similar to that of natives of the Gilbert Islands, but is more limited. There are no cows, sheep or goats on the islands. Fresh milk, butter or meat are not available. Practically no green vegetables are grown. The proteins of the diet include fish, shellfish, limited quantities of pig and fowl served only on special occasions, crabs, birds, jellyfish and octopus. Among the carbohydrates are coconuts, breadfruit, pandanus fruits, taro and bananas. Polynesian arrowroot is found, but is little used. Next to the coconut, the pandanus fruits are the most important plant food in the native diet on all atolls. Fish is the staple flesh food. Seabirds and their eggs are eaten, as are turtles. Supplies of food are fairly adequate. The most widely used food is the coconut; coconut milk is commonly fed to infants and used in cooking. The coconut yields the best substitute for drinking water available. The meat can be eaten at any stage of development. Copra is the chief export of the islands. Facilities for refrigeration do not exist.

MEDICAL FACILITIES

Hospitals

The only hospital reported is a small one on Atafu Island, conducted by the native medical practitioner. All equipment and supplies are imported.

Medical Personnel

Physicians. The native medical practitioner, a graduate of the native medical school at Suva in the Fiji Islands, serves all the islands.

Dentists. There are no dentists.

Nurses. Native nurses and dressers are located in each village. They have been trained at the hospital at Funafuti in the Ellice Islands.

Others. Members of the women's committees have been trained to assist the native medical practitioner and the nurses. They can treat the simple diseases and are instructed in basic therapeutic procedures.

DISEASES

Diseases Spread Chiefly through Intestinal Tract

Dysentery. Dysentery and the common diarrheas are widespread throughout this region. Bacillary dysentery is endemic in the Tokelau Islands, where serious outbreaks have occurred. These have been traced to *Shigella dysenteriae;* milder outbreaks have been caused by the Flexner type of *S. paradysenteriae.* One observer in the Tokelau Islands found intestinal protozoa in only three cases, *Endamoeba coli, Trichomonas hominis* and a species of Enteromonas, each being found on one occasion only.

Typhoid Fever. Typhoid fever and paratyphoid fevers have not been reported from the Tokelau Islands.

Cholera. Cholera is not reported from the Tokelau Islands.

Helminthiasis. It is said that virtually all the people have ancylostomiasis. Infection with *Necator americanus* occurs; but infection with *Ancylostoma duodenale* and *Ascaris lumbricoides* is not reported. Trichuriasis has been reported.

Diseases Spread Chiefly through Respiratory Tract

Tuberculosis. Tuberculosis is not unduly prevalent. One observer reported two cases of far-advanced tuberculosis in 1926 on Atafu Island, where this disease was found more often than on the other islands. Eight cases of tuberculosis of the cervical nodes and two of Pott's disease were noted. All tuberculous patients from Atafu Island were segregated on neighboring islets. Natives sleep together, share mosquito nets, and spit under floor mats; these are common practices which may be of importance in dissemination of tuberculosis.

Diseases Spread Chiefly through Contact

Venereal Diseases. It is believed that syphilis does not occur in the Tokelau Islands. No specific data are available about prevalence of other venereal diseases.

Prostitution does not exist in the Tokelau Islands. Although restriction is placed on sexual intimacy with blood relatives, this is the only restriction on unmarried people. License exists mainly among the unmarried group; adultery is regarded as a serious crime.

Yaws. One observer in 1926 saw sixty patients with yaws in the Tokelau Islands. The type found was mostly "crab" yaws of the late secondary stage. One primary sore, one mild secondary rash, two "saber" tibias, two instances of tenosynovitis of the wrist that might have been caused by yaws, and ten tertiary ulcers also were noted. Although in 1934 few patients with a serious stage of yaws were seen, it was reported that few children escaped an attack.

Leprosy. Leprosy has not been reported from the Tokelau Islands.

Diseases of the Skin. Tinea imbricata, a fungous infection known locally as "Tokelau ringworm," was recognized clinically in the islands many years ago. It is still prevalent. Forty-eight cases of tinea imbricata and 152 cases of tinea corporis, less conspicuous but more prevalent than the former, were noted in 1926. Tinea alba also is prevalent, but it causes almost no symptoms. No other fungous diseases are definitely reported from the Tokelau Islands.

Diseases Spread by Arthropods

Malaria. Malaria does not occur in the Tokelau Islands; anopheline mosquitoes are absent.

Filariasis. Filariasis occurs on the Tokelau Islands. No recent data are available. In 1920 and 1921, of 245 natives examined, 94 or 36 per cent were found to be infected.

In 1924 on Atafu Island 11 of 54 natives examined had microfilariae; on Fakaofu

Island 10 of 53 natives examined were infected. Five of the natives of Atafu Island had elephantiasis; none of the natives of Fakaofu Island had the condition. In 1923, of 85 children of both sexes less than 15 years of age, seven had microfilariae in the blood.

Aedes scutellaris pseudoscutellaris probably is the only vector of filariasis in the Tokelau Islands. The organism found is *Wuchereria bancrofti* of the nonperiodic type. The strain causing the nonperiodic type of filariasis occasionally is spoken of as *W. pacifica*. The range of nonperiodic filariae is co-extensive with that of the intermediate host, *Aedes scutellaris pseudoscutellaris*, in the Pacific. This mosquito abounds in the bush around native habitations.

Typhus Fever. Typhus fevers have not been reported from the Tokelau Islands. Although no definite records are available, lice parasitic on human beings probably are prevalent. Fleas, ticks and mites, capable of acting as vectors of typhus fever, also may be present.

Plague. Plague is endemic in the Hawaiian Islands, New Caledonia, the Netherlands East Indies and other regions in the Pacific. Rats are present in the Tokelau Islands; once introduced, plague might spread readily.

Dengue Fever. Dengue fever has not been reported nor have its vectors been described in the Tokelau Islands, but the introduction of both vector and disease is possible in the event of increased communication with other Pacific areas.

Miscellaneous

Injuries Caused by Heat. Prickly heat, heat cramps, heat stroke and heat exhaustion are rare among the natives, but might occur among persons accustomed to temperate climate.

SUMMARY

The most simple form of medical organization is found in the Tokelau Islands; one small hospital, a native medical practitioner, village dressers and women's committees carry on a limited program of sanitation and treatment. The organization has proved satisfactory among similar island populations and probably is adequate for the Tokelau Islands. Rain and limited supplies of well water furnish the only fresh water available on the islands; at times of drought coconuts may be the only source of a substitute for water. The disposal of sewage is primitive; defecation on beaches and in the bush is common. A few over-the-sea type of latrines are in use. Supplies of food are limited to coconuts, seafood and very limited amounts of breadfruit, pandanus fruits, taro and bananas. There are limited quantities of pigs and fowl, sea birds and their eggs, and turtles.

The only known insect of medical importance is the mosquito, *Aedes scutellaris pseudoscutellaris*, which is the vector of filariasis on the islands. There are no poisonous land snakes or dangerous animals, and no poisonous plants of serious importance. The North American ragweeds are absent.

The incidence of disease, so far as is known, is not high. Filariasis, yaws, and infections with tinea and hookworm are the major problems. Tuberculosis is present, but is not unduly prevalent. Venereal diseases are not common. Enteric diseases occur. Typhus fever, plague, cholera, malaria and dengue fever are absent.

BIBLIOGRAPHY

Allard, H. A.: The North American Ragweeds and Their Occurrence in Other Parts of the World. Science, **98**:292-294 (Oct. 1) 1943.

Bryan, E. H.: American Polynesia; Coral Islands of the Central Pacific. Honolulu, Tongg Publ. Co., 1941.

Buxton, P. A.: Researches in Polynesia and Melanesia. Parts V-VII (Relating to Human Diseases and Welfare). London, The London School of Hygiene and Tropical Medicine, 1928. (Memoir Ser. No. 2.)

——, and Hopkins, G. H. E.: Researches in Polynesia and Melanesia. Parts I-IV (Relating Principally to Medical Entomology). London, The London School of Hygiene and Tropical Medicine, 1927. (Memoir Ser. No. 1.)

Clunie, T., and McGusty, V. W. T.: The Native Medical Practitioner in the Western Pacific and the Central Medical School in Suva, Fiji. Trop. Dis. Bull., **33**:826-833 (Nov.) 1936.

Fa'atiga, T.: Medical Work in Western Samoa. Native M. Pract., Suva, **3**:424-425, 1939.

Fiji. Central Medical School: Annual Report, 1938. Suva, Fiji, 1939.

Hicking, A.: Foodstuffs in the Gilbert Islands. Native M. Pract., Suva, **3**:432-437 (March) 1939.

Lambert, S. M.: Medical Conditions in the South Pacific. M. J. Australia, **2**:362-378 (Sept. 22) 1928.

McCarthy, L.: Tropical Mycoses. J.A.M.A., **123**: 449-454 (Oct. 23) 1943.

MacGregor, G.: Ethnology of Tokelau Islands. Honolulu, Hawaii, The Museum, 1937. (Bernice P. Bishop Museum Bull. 146.)

Manson, P.: Manson's Tropical Diseases. Ed. by P. Manson-Bahr. 11th ed. Baltimore, Williams & Wilkins Co., 1941.

Mumford, E. P.: Mosquitoes, Malaria and the War in the Pacific. J. Trop. Med. & Hyg., **45**: 74-75 (May 15) 1942.

O'Connor, J. W.: Some Results of Medical Researches in the Western Pacific. Tr. Roy. Soc. Trop. Med. & Hyg., **16**:28-56 (Mar.-May) 1922.

Pacific Islands Year Book, 1942. Sydney, Australia, Pacific Publications, 1942.

Tate, G. H. H.: Rodents of the Genera Rattus and Mus from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. Bull. Am. Mus. Nat. Hist., **68**: 145-178 (Feb. 11) 1935.

U. S. War Dept.: Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. Washington, U. S. Govt. Print. Off., 1943. (Technical Manual TM 10-420.)

34

Tonga or Friendly Islands

GEOGRAPHY AND CLIMATE

The British Protectorate of Tonga, or the Friendly Islands, consists of an independent kingdom of from 150 to 180 * islands, the main groups of which lie between 15 and 24° of south latitude and 173 and 177° of west longitude. The chief land bodies of this archipelago have been classified into three parts: Vavau to the extreme north, Haabai in the central portion, and Tongatabu to the south. Haabai actually is a small archipelago in itself. Tongatabu and Vavau are composed, in each case, of a large island and several smaller ones.

It is thought that the Tonga Islands have an area of about 256 square miles. The largest island, Tongatabu, is the site of the capital of the archipelago, the town of Nukualofa. This town is about 1,100 miles from Auckland in New Zealand and 2,000 miles from Sydney, Australia. The population of the archipelago is thought to be 35,000 persons of Polynesian origin with some admixture of Fijian strains. European elements are so few as to be negligible. Some 15,000 of the Tongans are concentrated on the island of Tongatabu. Only 36 of the entire group of islands are known to be inhabited.

The physical features of the Tonga Islands are those of most land bodies of volcanic and coralline origin. In general, the islands extend from north to south in two parallel chains; the western chain is volcanic and the eastern chain is largely coralline. The islands of the Tongatabu and Haabai groups are low-lying and of coralline origin; those of the Vavau group are of volcanic origin and are characterized by elevations of from 300 to 600 feet.

Hydrographic features of the Tonga Islands are not impressive. Rivers and smaller streams exist only in some mountainous regions in a few islands. Tofua, Niuafoo and Vavau have relatively large lakes, and a large, shallow lagoon is situated in the center of Tongatabu. The island of Eau has several creeks which arise from springs in the hillsides.

The climate of the Tonga Islands is semitropical. Relative humidity is high, especially in the rainy season. The temperature during seven months of the year, or from May through November, rarely exceeds 84° F. (28.8° C.), and does not often recede to less than 70° F. (21.1° C.). At the height of the hot season a temperature of more than 90° F. (32.2° C.) is unusual. Rainfall is fairly heavy. The islands are swept by cool and strong southeastern trade winds from April to December, and during the rest of the year the winds are west-by-northwest and north. Disastrous hurricanes have occurred in the northern part of the islands, particularly in the vicinity of Niuafoo; they do not, apparently, visit the general neighborhood of Tongatabu. The salient climatic features of three places in the Tonga Islands, expressed in annual figures, are seen in Table 32.

PUBLIC HEALTH

Health Services

Organization. Both public health work and medical care are under the same administration in the Kingdom of Tonga. The Chief Medical Officer is public health officer

* The stated number varies in different reports.

TABLE 32

Salient Climatic Data, Annual Figures, Certain Places in the Tonga Islands

Place	Temperature, ° F. Extreme maximal	Extreme minimal	Mean	Precip., inches *	Humidity, relative, per cent	Wind direction, freq., %	Elev., feet
Alofi	97	54	77	80	82	E, 31	120
Nukualofa	90	51	75	64	78	SE, ?	10
Vavau	91	58	78	78	77	E, ?	...

* Rainfall is exceptionally variable in the Tonga Islands. At Nukualofa in February it has ranged from a half inch (1.25 cm.) to 19 inches (0.48 meter).

for all the islands, quarantine officer for the port of Nukualofa, and director of the hospital and dispensaries on Tongatabu Island. There is a board of health for all the islands, and local boards in two of the larger districts. These boards are composed of a medical officer and laymen, both Tongans and non-natives. The boards make recommendations to the government concerning health problems which arise within their areas.

The functions of the health and medical services are the following: (1) provision of medical, surgical and dental treatment and hospitalization free to Tongans and, for fees, to Occidentals; (2) administration of preventive measures, such as vaccination for typhoid fever and smallpox, prenatal care and programs to promote infant welfare; (3) supervision of environmental sanitation; (4) training of native assistants, such as nurses, dispensers and dressers; and (5) health education.

Relative Effectiveness. There are many public health problems in Tonga which are readily amenable to control. Epidemics of water-borne diseases, a high death rate from tuberculosis, a high infant mortality rate, and the frequent occurrence of deficiency diseases reflect the state of development of public health in the Tonga Islands. There is evidence, however, on the basis of scattered reports over the last 20 years that progress has been made and that public health work is being planned and carried out in a way appropriate for the local situation. In connection with the hospital at Nukualofa there is a dispensary where treatments and immunizations are given. There are six other dispensaries in the outlying areas, two in the rural parts of Tongatabu, and one each at Niuafoo, Niuatobutabu, Nomuka and Eau islands. A major portion of the work consists of minor surgical procedures and of treatment for yaws. This treatment is readily sought by the Tongans. Women are encouraged to come to the hospital for delivery of children and to accept medical care in their homes. Although at the time of the last available report (1937) only about 20 per cent of the births were attended, this percentage was larger than in earlier years. The number of women taking advantage of the prenatal and infant welfare services is also increasing. Inspection of water supplies, of meat offered for sale, and of latrines is carried out by Tongan sanitary inspectors trained and supervised by the Chief Medical Officer. A shortage of adequately educated personnel is a major factor in the continuation of unfavorable health conditions which are locally recognized.

Water Supplies

There are few rivers or streams in Tonga, and the people depend largely on rain water, which is collected and stored in concrete tanks and cisterns, for their water supply. These tanks or cisterns are owned by private persons and by the government. The storage capacity of the privately owned cisterns usually is small, but some of the government tanks hold between 10,000 and 20,000 gallons. Wells are of only minor importance as sources of water on Tongatabu Island. The deep wells vary in depth from 30 to 120 feet (9 to 36 meters). Even though ground water is abundant and of good quality in the interior of the island, relatively few wells have been sunk. Water obtained from wells has been limited largely to external use by the natives, whereas rain water which is gathered from roofs of houses has been used almost exclusively for drinking purposes. On most of the islands rain is the principal source of water, but on Tofua and Kao water is taken from small surface pools, and on Vavau collections of rain are supplemented by well water. In situations in which water is not available the natives use the milk of fresh young coconuts to quench their thirst.

In general, the actual and potential supplies of water are sufficient to meet the local demand, and are capable of considerable development. Until a few years ago, native tabus with regard to the collection and use of rain water from the roofs of many churches in Tonga created a problem of finding enough catchment areas to supply an adequate amount of water for drinking purposes. During periods of light rainfall the failure to use these collecting surfaces caused considerable inconvenience. In an effort to correct this undesirable situation the co-operation and assistance of the Queen of the Kingdom was obtained, and the tabu was broken. It is probable that with the development of the available supplies of water, the natives' reluctance to use well water also will be overcome.

The Tongans drink the water without purification, in spite of the fact that most well water examined has been found to be contaminated by both surface and subsurface drainage. The bacterial count usually was low (sometimes as low as 10 to 20 colonies per cubic centimeter), but the organisms were chiefly *Escherichia coli.* Insanitary methods of taking water for individual supplies from storage tanks offer other opportunities for the spread of waterborne infections.

Sewage Disposal

There are no central systems for the collection or disposal of sewage. Some of the British houses have septic tanks from which the effluent drains into the soil. A law requires owners of Tongan houses to maintain pit latrines, which are inspected by the health department. Most of these latrines in the Nukualofa region are made of cement, are well protected and maintained in a sanitary condition. In other parts of Tonga progress in securing the universal construction and use of these latrines has been slower. Some are not well protected, and provide breeding places for flies and cockroaches. Indiscriminate disposal of sewage on the ground is apparently not common. The continual presence of water-borne diseases and intestinal parasitism indicates, however, that much remains to be done in the improvement of methods of disposal of human wastes. Refuse is either buried or burned.

Insects and Animals

Vectors of Disease. Mosquitoes. Results of repeated surveys have failed to reveal anopheline mosquitoes in the Tonga Islands. Six species of Aedes mosquitoes have been reported from Tonga and are numerous there. *Aedes kochi* and *A. samoana,* vectors of filariasis (*Wuchereria bancrofti*), bite at night and breed in the leaf axils of taro and other similar plants. (Taro, a plant of the arum family, is cultivated for food. It usually grows to a height of 3 or 4 feet [90 or 120 cm.]. It is similar to the jack-in-the-pulpit, elephant ear, and calla lily of the United States.) The species of Aedes which bite during the day are *A. aegypti, A. scutellaris pseudoscutellaris, A. scutellaris tongae* and *A. vexans. Aedes aegypti,* an important vector of dengue fever, usually breeds in or near dwellings in any collection of clean water such as that in gutters or roofs, open cisterns, barrels, cans and the like. Tongan methods of collection of water are admirably adapted to the propagation of this mosquito. *A. scutellaris pseudoscutellaris*, probably the most important vector of filariasis in Tonga, breeds in small collections of water in tree holes, coconut shells and cans. A characteristic of this mosquito which has contributed to its wide distribution is the resistance of the eggs to drying. *A. scutellaris tongae*, a probable vector of filariasis, also breeds in water collected in tree holes, coconut husks and cans. *A. vexans*, although it has not been established as a vector of disease in this area, is a common pest. It is a long-lived mosquito with a wide range of flight, and breeds in shallow pools. The species of Culex which bite at night are *C. fatigans* (*quinquefasciatus*) and *C. sitiens*. *C. annulirostris* bites during both night and day. All three are vectors of filariasis. The larvae of *C. fatigans* are more often found in artificial receptacles, but also occur in shallow pools at some distance from habitations. *C. sitiens* breeds in swamps and small holes, and usually but not always prefers brackish water. The larvae of *C. annulirostris* occur in a variety of types of pools, usually in those containing filamentous algae.

Flies. *Musca sorbens* and *M. vicina*, the common houseflies of this area, are very abundant in some places. Their breeding habits are similar to those of the common housefly of the United States (*Musca domestica*). *Musca sorbens* is known to be a mechanical transmitter of dysentery and is suspected of transmitting yaws and leprosy. *Musca vicina* does not regularly feed on human sores or breed in human feces. Cow dung is its favorite place for depositing eggs. The following flesh flies, which can give rise to myiases and which are sometimes mechanical transmitters of enteric infections and of infections of the skin, are reported: *Chrysomyia rufifacies, C. megacephala, Microcalliphora varipes* and *Sarcophaga froggatti*. Other species of flesh and blow flies probably occur. *Chrysomyia rufifacies*, a green blow fly, breeds in carrion and sometimes feeds on human feces and festered sores. *Chrysomyia megacephala* usually breeds in carrion, but also is a common producer of myiasis in wounds of man and animals. It feeds on human feces and sores, but is also attracted to sweets.

Fleas. *Ctenocephalus felis* and *Pulex irritans* are reported from Tonga. *Ctenocephalus felis* actively bites man, dogs and cats and is capable of transmitting plague. Although *Pulex irritans*, commonly known as the flea of human beings, has not been demonstrated to transmit plague in nature, it can do so under laboratory conditions.

Rodents. Although the usual ship-borne rodents, *Mus musculus, Rattus norvegicus, Rattus rattus* and *Rattus alexandrinus* are not specifically reported from the Tonga Islands, it is likely that some of these rats have colonized there. *Rattus exulans* is the native rat in most of the Pacific islands and has been reported in Tonga.

Snakes and Other Dangerous Animals. There are no land snakes in Tonga. Some poisonous sea snakes, Hydrophidae, called locally "coral snakes," are reported. No cases of snake bite have been recorded in recent years. These snakes are not inclined to bite except when forcibly restrained or disturbed, and are said never to attack bathers in the water. Although the venom of the Hydrophidae is extremely toxic, the danger from it is minimized by the fact that the head of the snake is small and its fangs are short.

Pests. Two scorpions, *Hormurus australasiae* and *Isometrus maculatus*, are found in the islands. Blister beetles of the genus Sessinia occur in Tonga. Whether or not the Tongan species are capable of severe blistering of the skin is not established. Wasps, *Polistes olivaceus*, are very numerous and are capable of delivering a severe sting.

Food and Dairy Products

Very little milk is produced on the islands. There are no facilities for pasteurization. Facilities for cold storage are found only in Nukualofa, but even at that place the facilities are not nearly enough to insure adequate storage of perishable foods. Meats are inspected in some instances, but inspection is not universal and is not thorough enough to be relied upon. Some fish which are normally edible are reported to become poisonous during the spawning season. In the Tonga Islands as well as elsewhere in the Pacific, poisoning by the eating of fish in most cases is caused by fish which belong to the Tetraodontidae and which commonly are known as "puffer fish" or "balloon fish." The eggs of several species of Tetraodon are always poisonous, even when immature. The common belief that the bile and liver of this fish are poisonous is usually, but not always, true. The symptoms of Tetraodon poisoning are vertigo, headache, vomiting, diarrhea, paralysis and sudden death.

Tongans suffer from a deficiency of vitamins A and D, calcium, iron and iodine. They do not like milk, eggs, fruit and green vegetables. Some fish is eaten but not in a quantity large enough to supply the requirements of iodine. Foods necessary for an adequate diet could be produced in quantities sufficient to meet local needs, but habits of long standing in respect to choice of foods on the part of the natives make changes very difficult.

MEDICAL FACILITIES

Hospitals

Number of Beds. The government hospital at Nukualofa, called Vaiola Hospital, is housed in several buildings, the first of which was erected in 1923. Additions were completed in 1938. The maximal bed capacity is 50. This represents a bed capacity of 3.3 beds per 1,000 of population. At Vavau and at Haabai there are small government hospitals which serve also as dispensaries. Information concerning the bed capacity of these hospitals is not available, but it is probable that they are little more than first-aid stations. Hospital facilities in these groups of islands are grossly inadequate. There is a separate unit with cubicles for Occidentals.

Equipment. Vaiola Hospital has no kitchen, and food for patients must be brought in. Although there is a fairly well-equipped laboratory, little laboratory work is done because of the lack of a trained technician. The small operating room is equipped for minor and abdominal surgery. The room has overhead acetylene lights which are inadequate. There is a portable x-ray unit.

Medical Personnel

Physicians. The staff of the hospital at Nukualofa consisted in 1942 of five Tongan physicians under the direction of the Chief Medical Officer of the islands. In addition, six Tongan physicians are distributed among the other islands.

Nurses. In 1942 the hospital at Nukualofa had six nurses who were under the direction of the Chief Medical Officer of the islands.

Others. An Occidental dentist is located at Nukualofa. Dental care is free for Tongans.

Medical Institutions

It has been the policy of the government health service for more than 20 years to encourage the training of native medical practitioners. Promising students are sent to the Central Medical School at Suva in the Fiji Islands, where the course of training extends over four years. Graduates receive a diploma entitling them to practice medicine and surgery in the areas from which students are sent to the school. Emphasis is laid by the medical school on preserving the native character of its graduates, and thus to insure their acceptance in the native social system. The native medical practitioners are valuable adjuncts to the medical service, in that they are well trained, speak English, and are thoroughly acquainted with the natives' beliefs and customs.

Social Services. There are no social services organized specifically for the purpose. Certain social services are carried on in an individual way by the mission schools, but the need to provide organized care of the aged, orphans and others unable to assume responsibility for themselves is not so great as it is in a more complex society because the social customs of the Tongans are such that the more obvious problems of social dependency are met promptly by relatives and neighbors of those who need assistance.

DISEASES

General Considerations. Since less than half the deaths and probably an even smaller proportion of illnesses in the Tonga Islands are attended by physicians, statistical analyses of morbidity and mortality reports are of limited usefulness. An estimate of the relative importance of certain causes of sickness and death for the whole of the Tonga Islands can be made on the basis of the records of those patients who are attended. The chief causes of deaths for which a definite diagnosis had been made in 1937 were as follows: enteric diseases, 28 per cent; tuberculosis, 25 per cent; cardiac diseases, 10 per cent; septicemia, 6 per cent; malignant conditions, 6 per cent; pneumonia, 5 per cent; tetanus, 2 per cent; meningitis, 2 per cent; all other causes, 16 per cent.

The reported morbidity rates per 1,000 of population in 1937 were as follows: yaws, 24; dysentery, 15; conjunctivitis, 14; typhoid fever, 7; trachoma, 6; tuberculosis, 4; pneumonia, 2; tetanus, 0.6. The actual incidence of most, if not all, of these diseases was unquestionably much higher than the rates computed from reported cases would indicate. The rates indicate, however, the relative importance of the diseases, excepting tuberculosis. Malaria, yellow fever, plague, typhus fever, cholera and leptospirosis have not been reported.

Diseases Spread Chiefly through Intestinal Tract

Typhoid fever, paratyphoid fevers and dysentery, both amebic and bacillary, are important causes of illness and death among the Tongans. The incompletely controlled individual water supplies and methods of disposal of sewage are important factors in the continuation of the enteric infections. There are undoubtedly many carriers of some of these intestinal diseases. Amebic dysentery is not so important as are the types of bacillary dysentery caused by the Shiga and Flexner strains. From 1933 to 1936 an average of about 60 cases of dysentery were reported annually. In 1937 a total of 459 cases was reported. Up to 1942 there had been no recurrences in epidemic proportion. Typhoid fever is decreasing as the result of improved sanitation, isolation of patients and increased immunization. In 1937 there were 250 reported cases, and in 1940 only 21 cases. In 12 of these 21 cases the disease occurred on Tongatabu.

Intestinal Parasitism. About 25 per cent of the Tongans are estimated to be infected with intestinal parasites. Hookworm (*Necator americanus*) was the most common helminth found in a sample study made over a period of several years prior to 1928. Of the persons examined at that time, 46 per cent were found to be infected. Later reports indicate that although the infection is widespread, infection with hookworm is no longer a serious problem and that the number of worms per person is seldom large. In the same early study, about half of the persons studied were found to be infected with *Trichuris trichiura* and about 5 per cent with *Enterobius vermicularis*. Ascariasis is common in the Vavau group of the Tonga Islands, but is rare in Tongatabu.

Diseases Spread Chiefly through Respiratory Tract

Acute Respiratory Infections. Influenza, pneumonia, colds, bronchitis, measles, mumps, whooping cough and chickenpox occur with about the same frequency as in temperate climates, but chickenpox and measles sometimes reach epidemic proportions. It should be noted, however, that a large proportion of the native population, particularly those natives who have little contact with civilization, are very susceptible to respiratory diseases. When these diseases have been introduced among them the diseases frequently assume epidemic proportions. In 1936 a third of the population was reported to be affected with measles. Medical observers believed the incidence was much higher. This epidemic of measles, in which complications and sequelae were severe, was a cause of great alarm among the Tongans.

Tuberculosis. Although tuberculosis is reported to be decreasing in incidence, the death rate is still very high. As previously said, less than 50 per cent of the deaths in Tonga are certified by physicians. On this particular basis, the death rate from tuberlosis in 1937 was close to 300 per 100,000 of population, or roughly six times greater than the death rate from this cause in the United States. Not only pulmonary tuberculosis but other forms, notably that of the skin and bones, are common. Facilities for hospitalization, isolation and treatment are not available.

Smallpox. Smallpox has not been reported in recent years, although vaccination is not widely practiced.

Diseases Spread Chiefly by Contact

Venereal Diseases. Gonorrhea is fairly prevalent. There were 44 new cases reported to the health services in 1940, but the patients were mostly persons who had complications. Numerous observers have emphasized, on the one hand, their failure to discover syphilis and, on the other, the prevalence of yaws. Chancroid is seen occasionally. There is no organized prostitution. By American standards the morals of the Tongans are lax. Their habits of promiscuous sexual relations are conducive to the ready dissemination of venereal diseases. About 25 per cent of the births are illegitimate. In the United States this percentage is about 4.

Yaws. Yaws was once the greatest single cause of morbidity and has been reported as an important cause of infant mortality in Tonga. The disease has been actively combated by the government health service for many years, and the Tongans present themselves readily for treatment. In 1940 only 202 cases were known to the government health service. Most of the patients were children, but a few patients who had chronic yaws of long duration were under observation and were receiving treatment.

Diseases of the Skin. Mycotic infections, phagedenic ulcers and scabies afflict a large number of Tongans. Of the mycotic infections, epidermophytosis, tinea cruris, tinea imbricata and other ringworm infections of the skin are particularly troublesome to white men. Secondary infection of cuts and abrasions occurs with considerable frequency. Chronic ulcers of the skin, including phagedenic ulcers, are the causes of considerable morbidity among the native inhabitants.

Leprosy. Leprosy is detected among a few persons each year. Lepers are removed to the British leprosarium on Makogai Island, near Viti Levu in the Fiji Islands.

Diseases of the Eyes. Conjunctivitis of unspecified etiology is one of the most frequent infections reported. On the basis of the information that is available, there is reason to believe that the "conjunctivitis" which occurs in the Tonga Islands is similar to that which occurs on Niue Island. It is possible that the Tongan conjunctivitis may be related to the severe and highly disabling "epidemic conjunctivitis" of Samoa. A type of ophthalmia is referred to which clinically is similar to gonorrheal ophthalmia. Some of the diseases of the eyes that occur may be associated with, or related to, malnutrition and specific vitamin deficiencies. The extent of blindness is not reported.

Trachoma is endemic; 63 cases were reported in 1940.

Leptospirosis. Leptospirosis has not been reported among either rats or human beings in the Tonga Islands. It is possible, however, that leptospirosis might be introduced from British Samoa, where a form of "malignant jaundice" is endemic. The etiology of the Samoan "malignant jaundice" is not entirely clear. Some authorities are of the opinion that it is caused by a virulent strain of *Leptospira icterohaemorrhagiae,* but other equally competent observers believe that the clinical manifestations are the results of an acute toxic type of atrophy of the liver of undetermined etiology. Recently, however, evidence has been presented which indicates that the disease is transmitted from animals, and especially rats, pigs and dogs, to man. Spirochetes of the genus Leptospira have been isolated from the blood of some patients, and it is currently believed by physicians who are resident in British Samoa that *Leptospira icterohaemorrhagiae* is the etiologic agent.

Tetanus. Tetanus is reported regularly. Seventeen cases were recorded in 1937.

Diseases Spread by Arthropods

Malaria. Malaria and anopheline mosquitoes were not known to be present in Tonga in 1942. With the advent of rapid transportation by sea and air from heavily malarious areas in the southwest Pacific, constant vigilance is required to prevent the introduction of vectors of malaria into the Tonga Islands.

Filariasis. Infection with *Wuchereria bancrofti* is common, but manifestations of elephantiasis develop in less than 1 per cent of the affected Tongans. Mosquito vectors of filariasis, chiefly *Culex fatigans, Aedes scutellaris pseudoscutellaris, A. kochi* and *A. samoana,* are numerous. *Aedes aegypti* also is a probable vector. During the 1920's it was estimated that about a third of the Tongans were infected with *W. bancrofti.* There is no reason to suppose that the incidence has diminished in recent years.

Dengue Fever. Outbreaks of dengue occur from time to time. Mosquitoes capable of transmitting dengue fever, chiefly *Aedes aegypti,* are numerous.

Nutritional Diseases

Deficiency Diseases. Although the soil is rich and most of the essential protective foods could be produced, many Tongans suffer from malnutrition and vitamin deficiencies. Precise studies have not been made, but the Tongan government health service reported in 1937 that considerable anemia, diseases of the eyes, "septic conditions" and goiter result from improper diet.

SUMMARY

All preventive health measures and medical care are under the jurisdiction of the Tongan Health Department. All physicians, trained native medical practitioners and nurses are in the government health services. Although public health, hospital and medical facilities are inadequate to meet the needs of the people, these services are better than is usual in small southern Pacific islands.

Some water is obtained from wells, but catchment basins for rain water are the more important sources. Water in the Tonga Islands is usually contaminated. Use of pit latrines is required by law, but pollution of the soil is practiced to some degree. There is no disposal system in which sewage is water-carried. Many mosquitoes capable of carrying dengue fever, yellow fever and filariasis occur in the Tonga Islands. Flies are very abundant in some places. Rats and rat fleas, capable of transmitting plague, also are found. Poisonous sea snakes are present, but snake bite is not common. Wasps and scorpions are common pests but are not dangerous.

The diseases which will be of greatest importance to unacclimated persons in the

Tonga Islands are enteric diseases (typhoid fever, paratyphoid fevers, amebic dysentery and bacillary dysentery); dengue fever; diseases of the skin and venereal diseases, especially gonorrhea. Although malaria and its vectors are not known to exist on the island, the danger of introduction of the disease or its vectors from the islands in the southwest Pacific, where both are common, is a constant threat. Strict inspection and disinfection of incoming ships and aircraft are especially important. Filariasis is likely to affect a large proportion of the people who are stationed in the Tonga Islands for a long period unless measures for the control of mosquitoes are employed. Most of the other diseases which cause high morbidity among Tongans can be avoided by unacclimated persons by means of good personal hygiene. In addition to the diseases mentioned above, the following diseases are of special importance to the native population: yaws, tuberculosis, diseases of the skin, intestinal parasitism, conjunctivitis and trachoma. Whenever the common acute communicable diseases are introduced, they become epidemic among the native inhabitants.

BIBLIOGRAPHY

Beaglehole, E.: Psychic Stress in a Tongan Village. Proc. Pacific Sc. Congr. 1939, 6. Congr., **4**:43-52, 1940.

Blacklock, D. B.: Epitome of the Prevention of Certain Diseases and Infections Occurring in Man. J. Roy. Nav. M. Serv., **28**:262-284 (July) 1942.

Bull, L. J. F.: Medical Service of Tonga. New Zealand M. J., **35**:396-400 (Dec.) 1936.

Buxton, P. A., and Hopkins, G. H. E.: Researches in Polynesia and Melanesia. Parts I-IV (Relating Principally to Medical Entomology). London, The London School of Hygiene and Tropical Medicine, 1927. (Memoir Ser. No. 2.)

Carrick, F. R.: Epidemic of Measles in the Kingdom of Tonga, 1936. Native Medical Practitioner (Fiji Islands), **3**:426-428 (March) 1939.

Central Medical School, Suva, Fiji. J. Trop. Med., **44**:52 (Apr. 15) 1941.

Craig, C. F., and Faust, E. C.: Clinical Parasitology, 2d ed. Philadelphia, Lea & Febiger, 1940.

Eva, A.: Surgical Experience in the Tongan Group. Native Medical Practitioner (Fiji Islands), **3**:479-483 (March) 1940.

Gt. Brit. Colonial Office: Information as to the Conditions and Cost of Living in the Colonial Empire, 3d ed. London, H. M. Stationery Off., 1937.

—— Colonial Office: Tongan Islands Protectorate, 1937. London, H. M. Stationery Off., 1937. (Colonial Reports Annual No. 1869.)

Lambert, S. M.: Medical Conditions in the South Pacific. M. J. Australia, **2**:362-378 (Sept. 22) 1928.

——: Yaws Incidence in the South Pacific. J. Trop. Med., **34**:117-122 (May 1) 1931.

League of Nations. Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene, 8. Report for Tonga. Geneva, 1937, pp. 115-125.

Mumford, E. P.: Native Rats and Plague in the Pacific. American Scientist, **30(3)**:213-217, 1942.

Mumford, G. D.: Present Status of Knowledge of Polynesian Fresh-Water Fauna. Proc. Pacific Sc. Congr. 1939, 6. Congr., **4**:249-252, 1940.

Some Aspects of the Public Health Work in Fiji and the Western Pacific Islands, 1937. J. Trop. Med., **42**:334-339 (Nov. 1) 1939.

Stitt, E. R.: Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. 6th ed. by R. P. Strong. Philadelphia, The Blakiston Co., 1942.

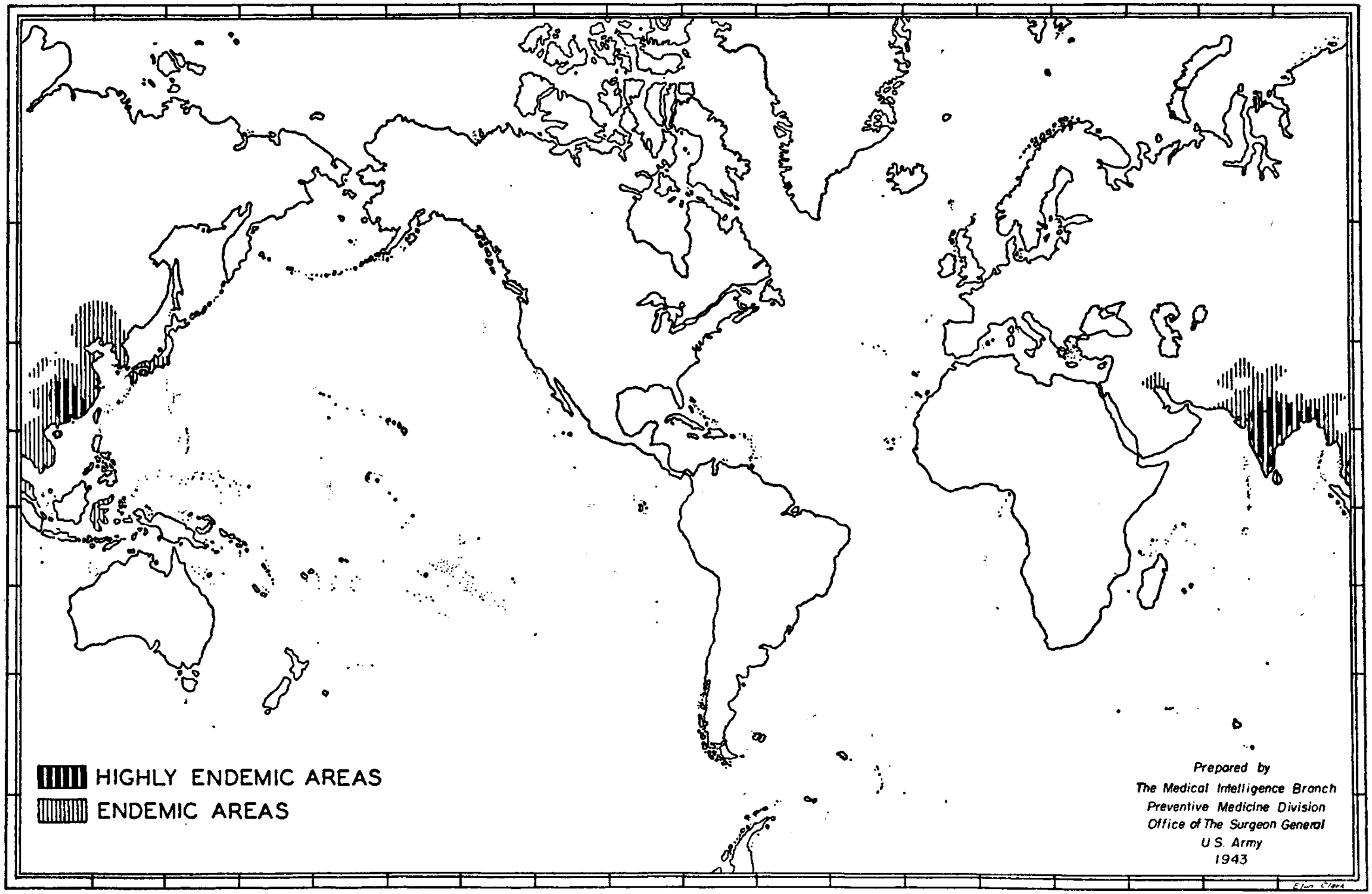
Tate, G. H. H.: Rodents of the Genera Rattus and Mus from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. Bull. Am. Mus. Nat. Hist., **68**:145-178 (Feb. 11) 1935.

Taylor, F. H.: Intermediary Arthropod Hosts and Mechanical Carriers of Human Disease in the Australian Region. Health, the Journal of the Commonwealth Dept. of Health, Australia, **16**:72-82 (Aug.) 1938.

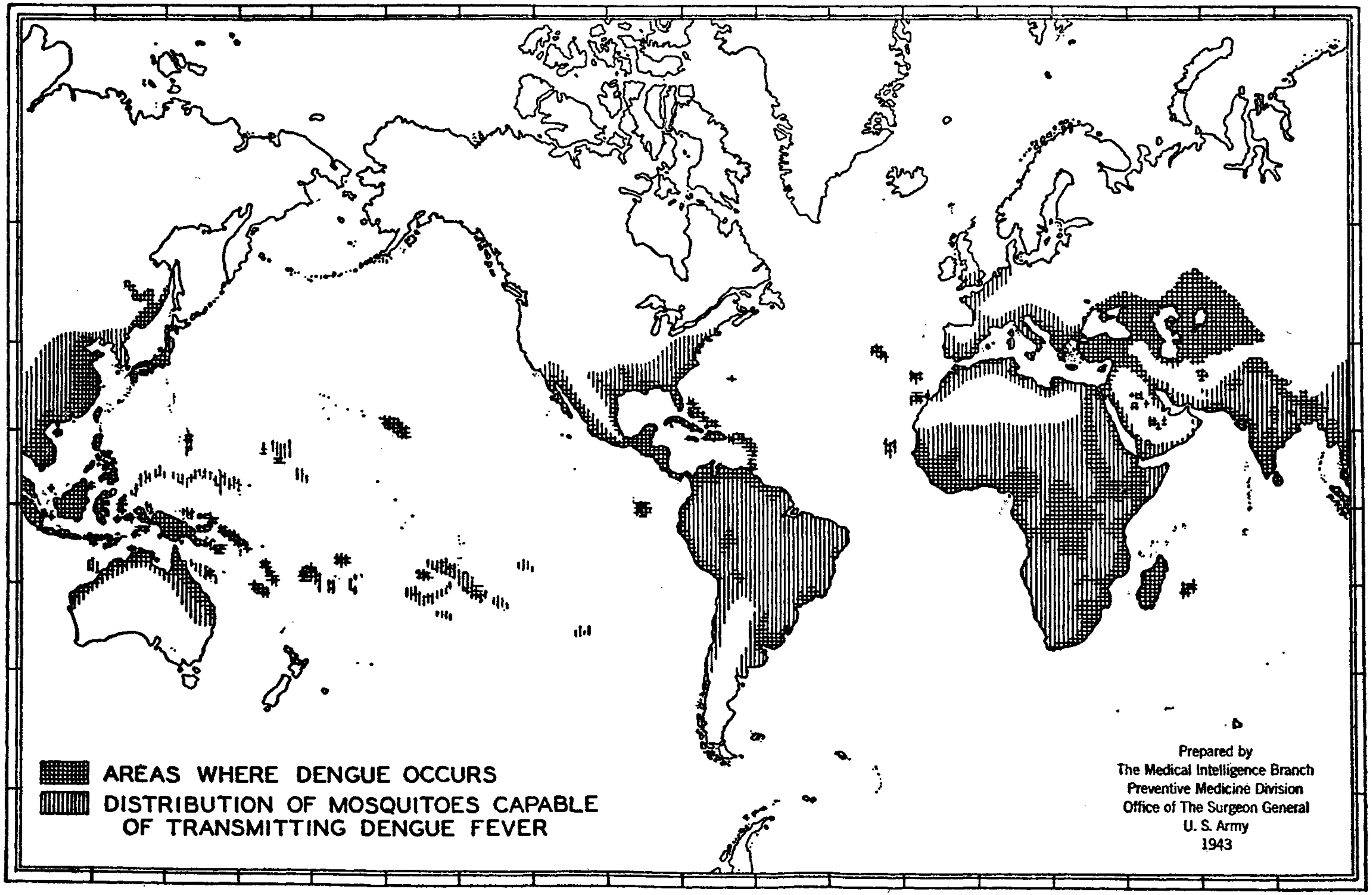
U. S. Bureau of Foreign and Domestic Commerce (Dept. of Commerce): World Trade in Dental and Surgical Goods. Washington, Govt. Print. Off., 1942.

Weckler, J. E., Jr.: Polynesians, Explorers of the Pacific. Washington, Smithsonian Institution, 1943. (Smithsonian Institution, War Background Studies No. 6.)

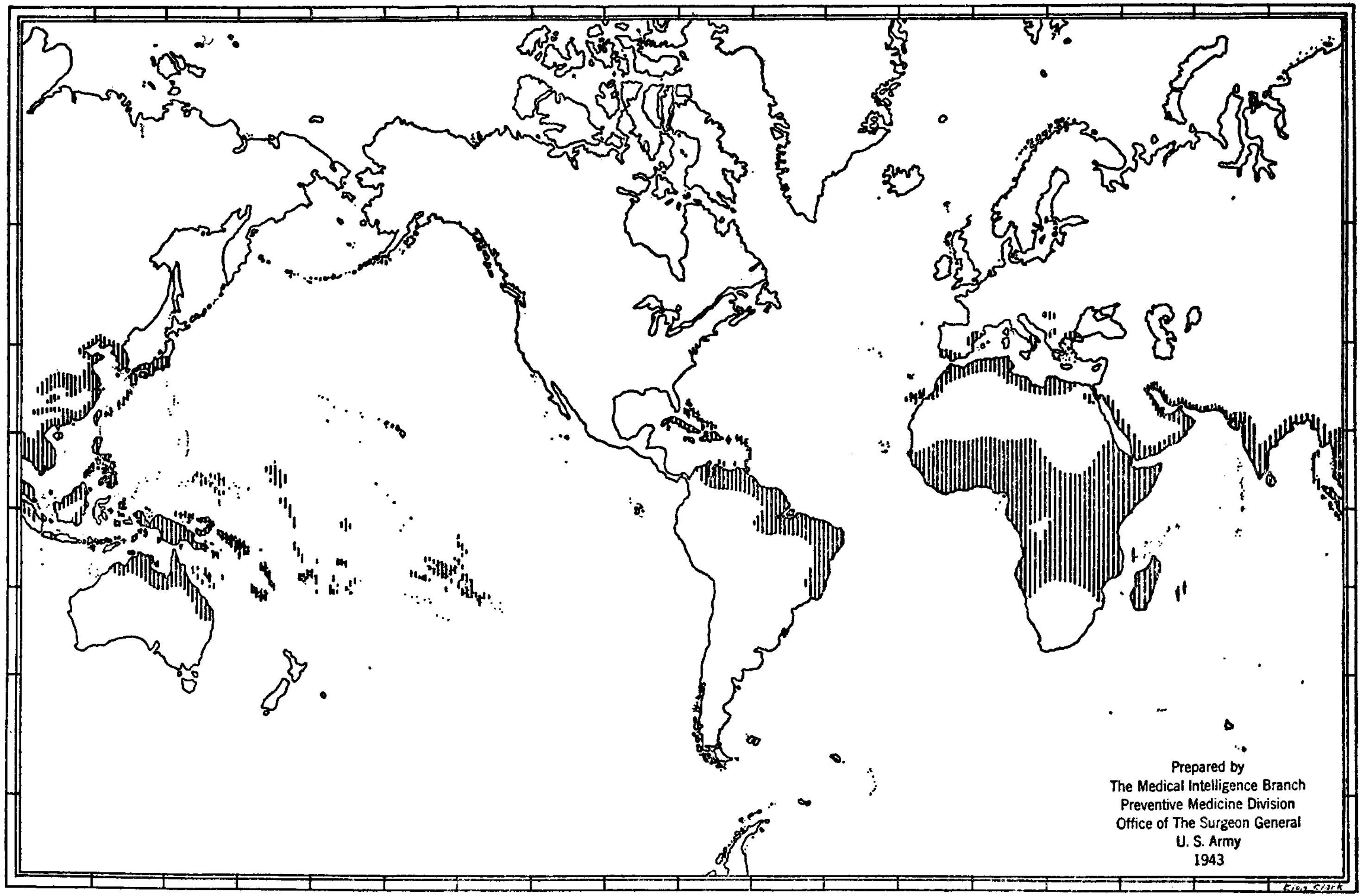
Maps Showing World Distribution of the Principal Tropical Diseases



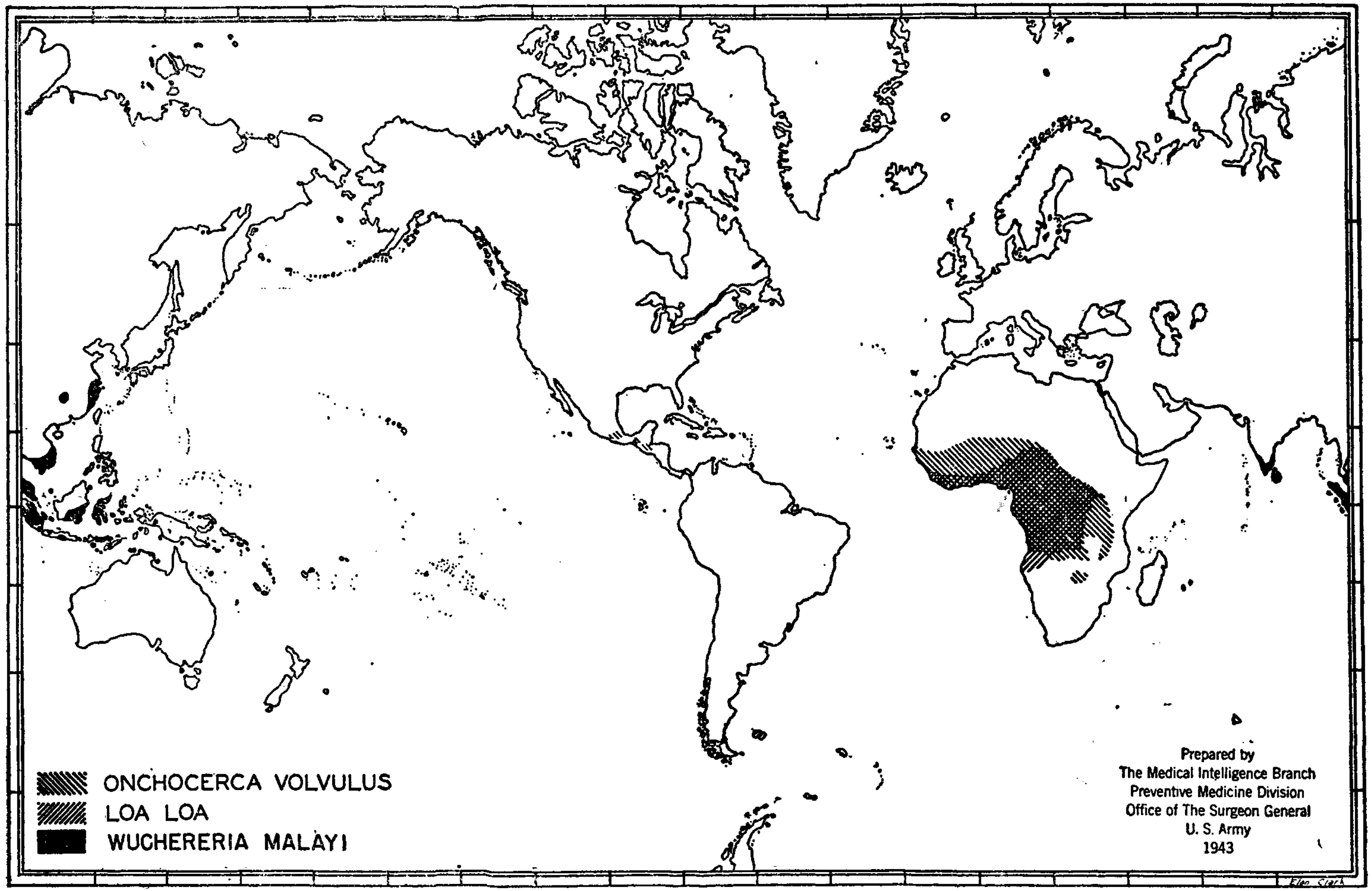
World Distribution of Cholera



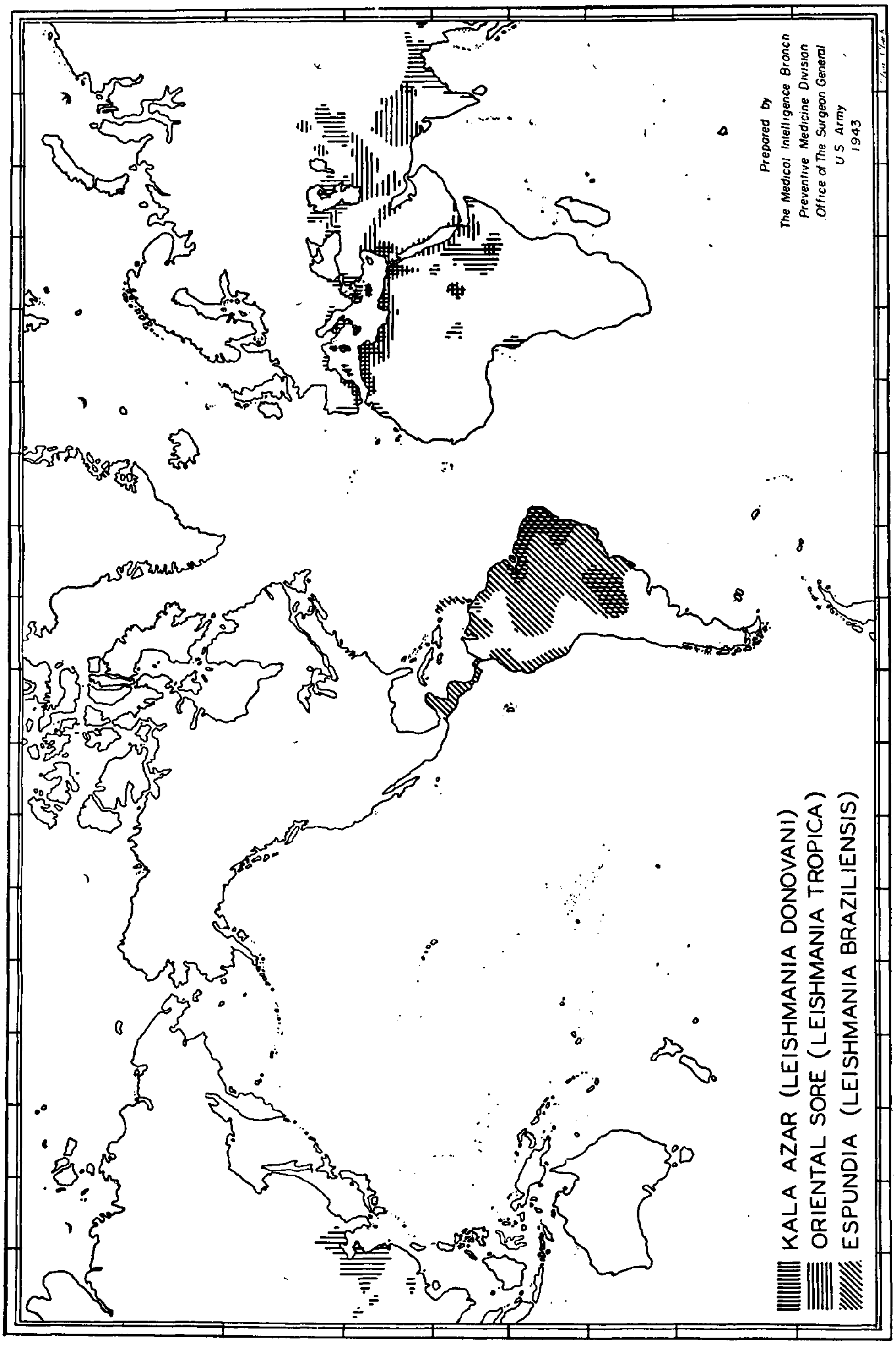
World Distribution of Dengue



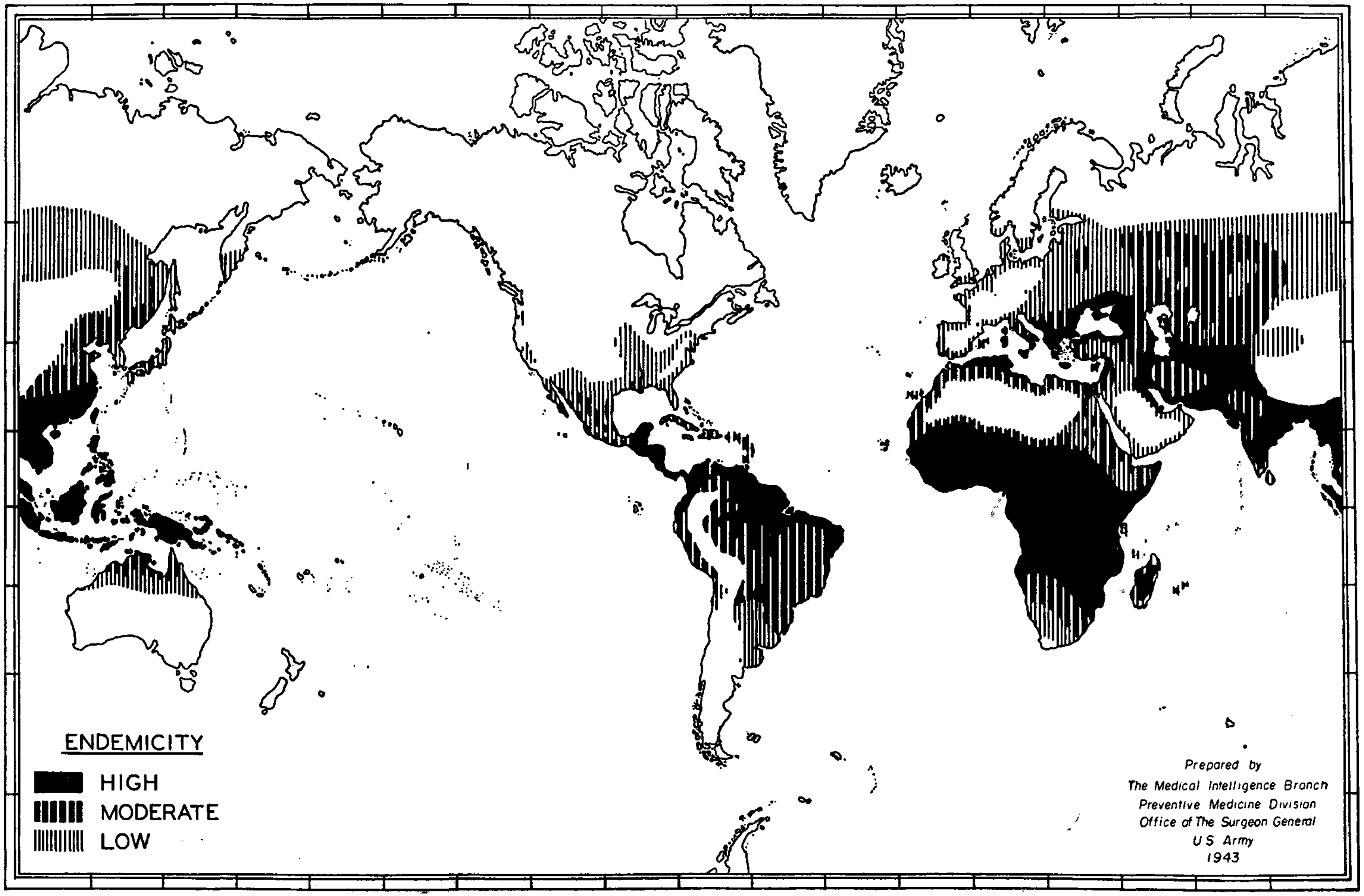
World Distribution of Filariasis (Wuchereria Bancrofti)



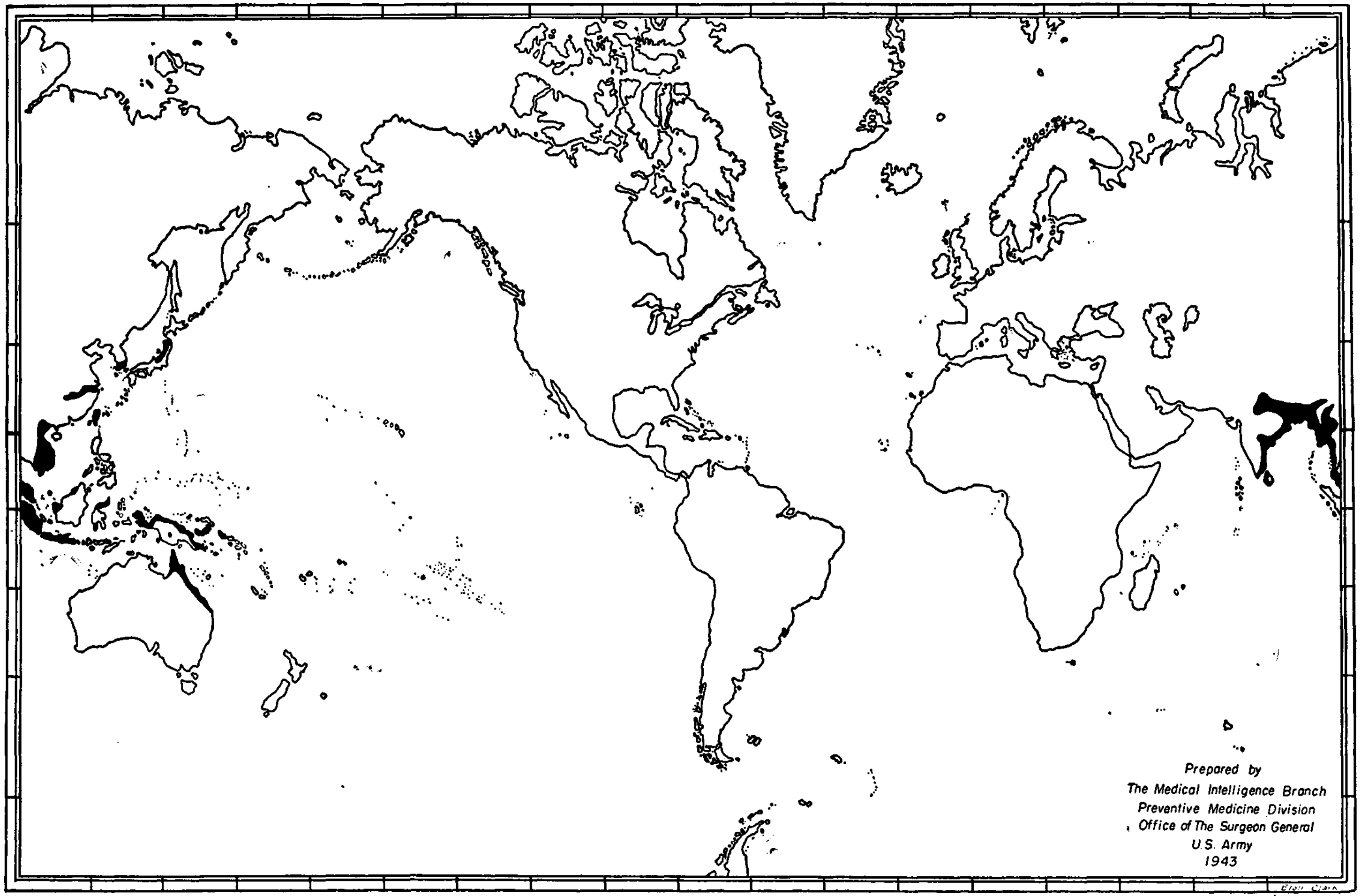
World Distribution of Filariasis (Other Than Bancroftian)



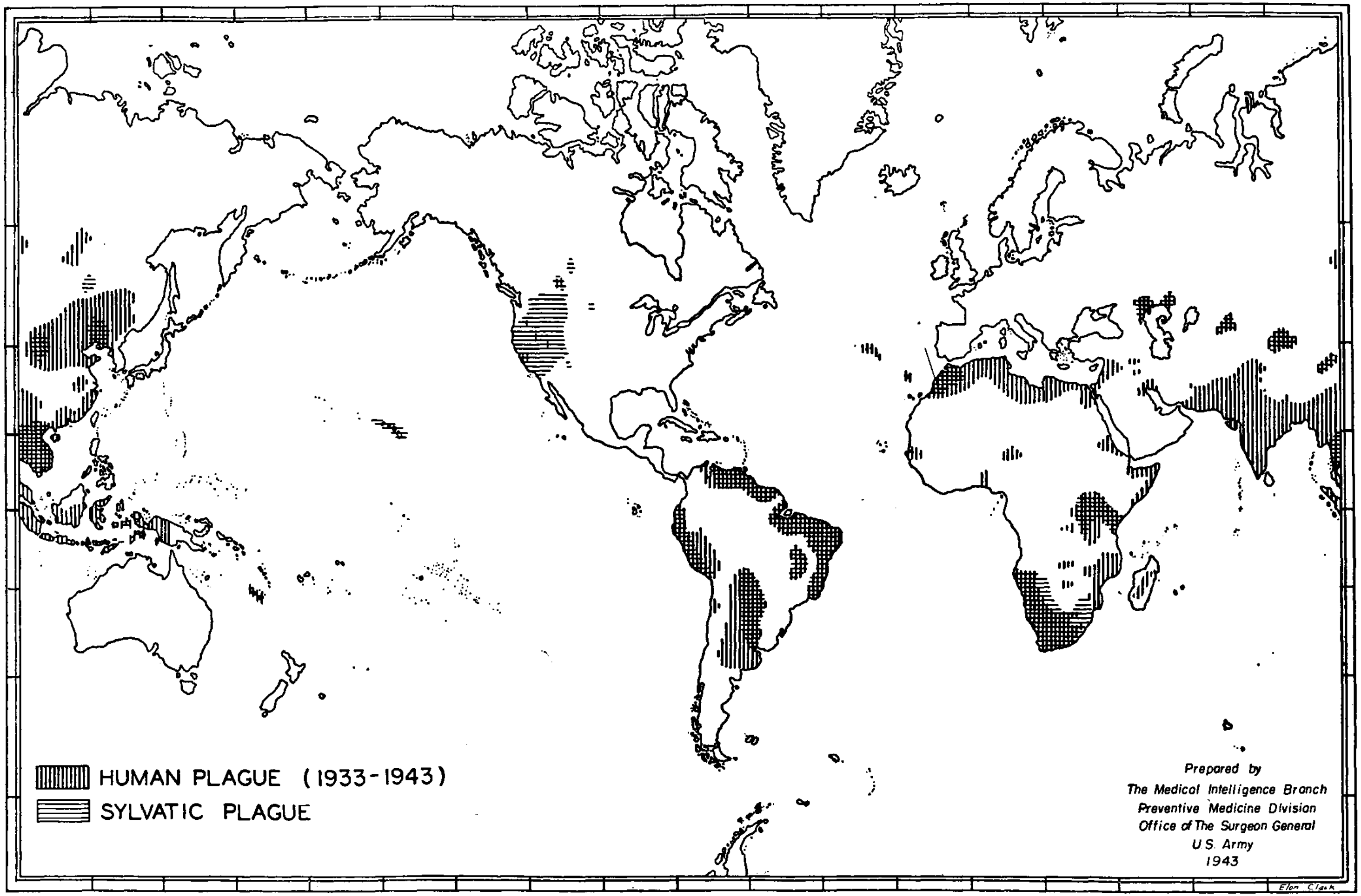
World Distribution of Leishmaniasis



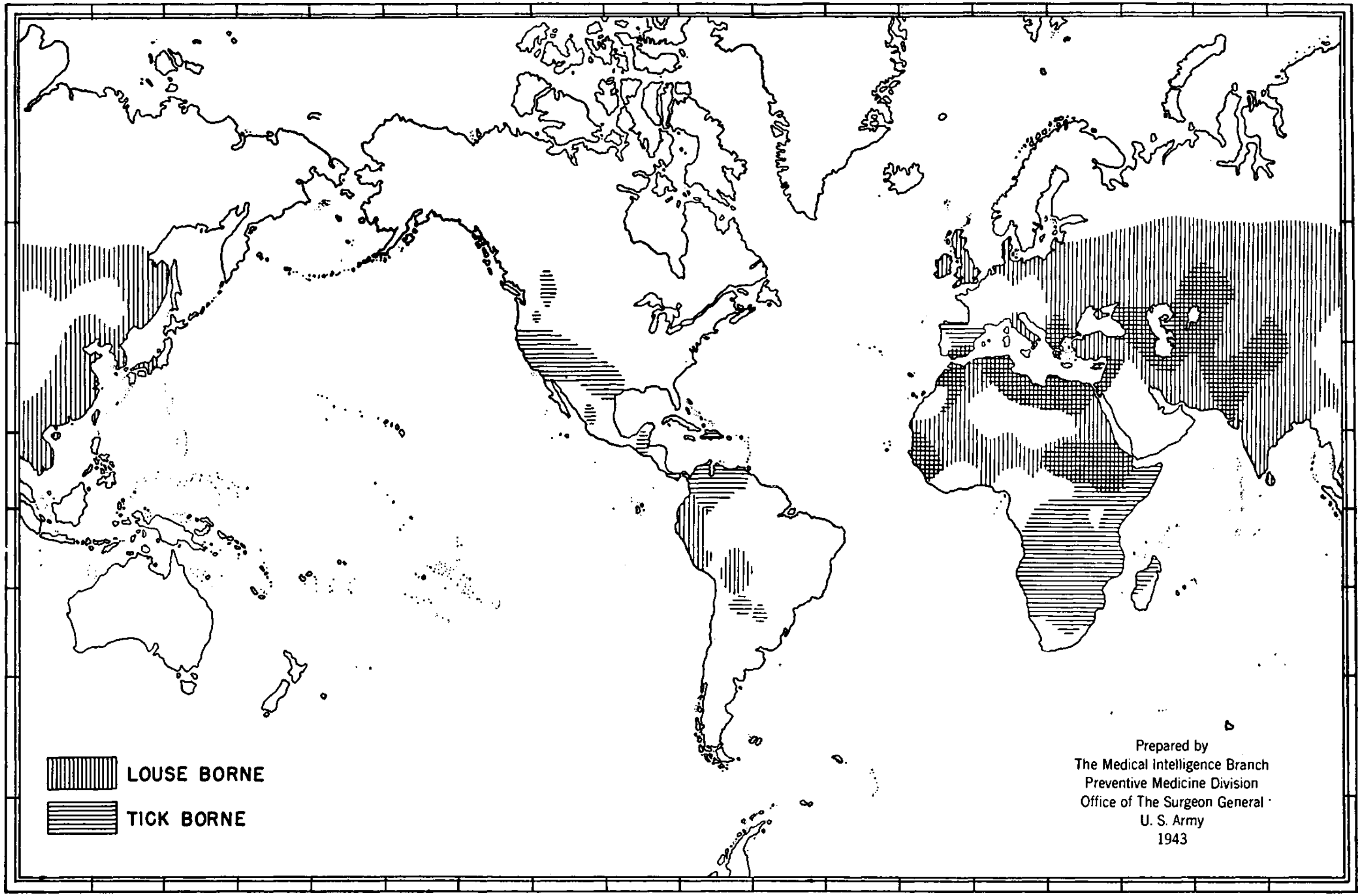
World Distribution of Malaria



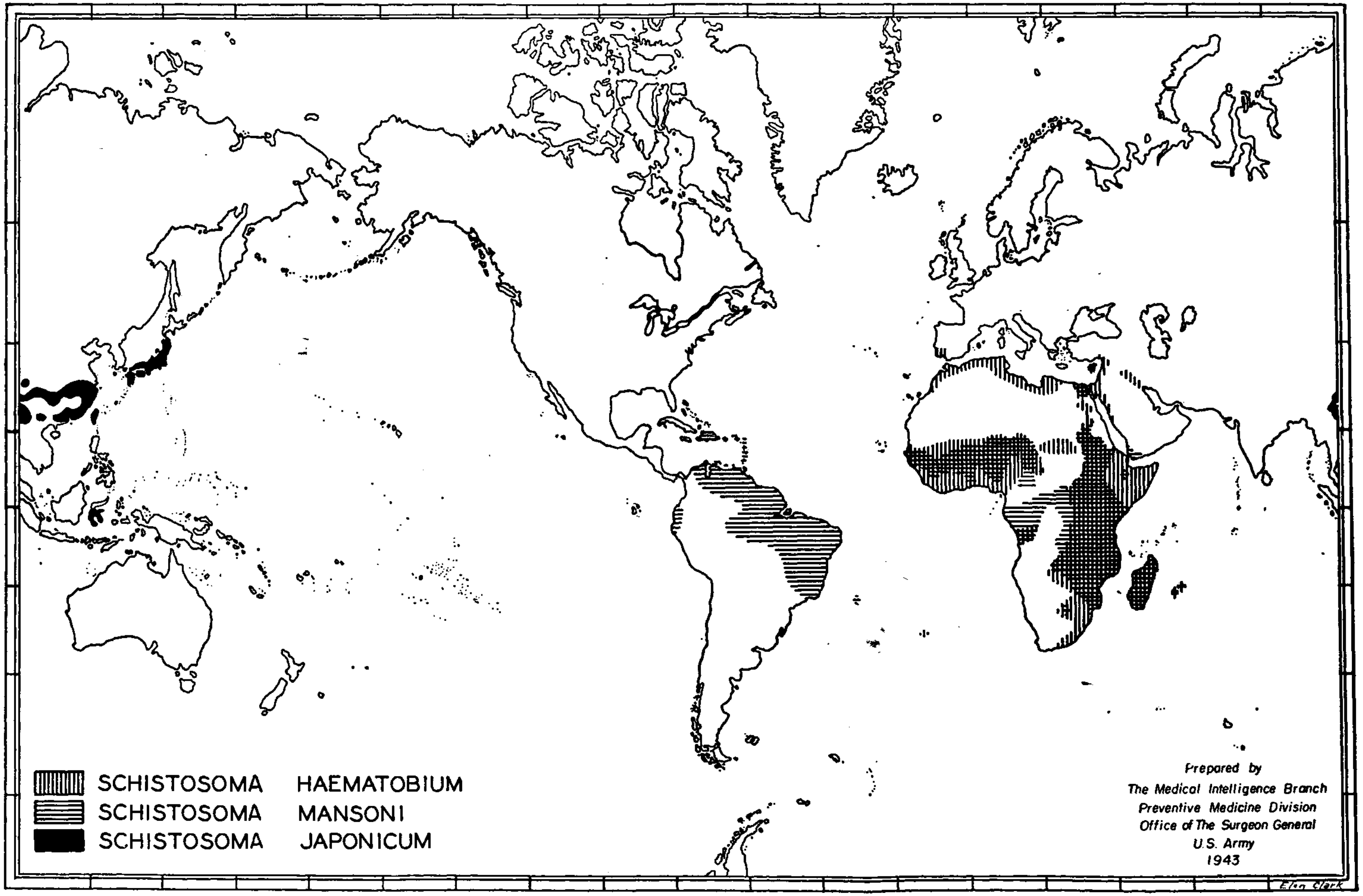
World Distribution of Mite Typhus



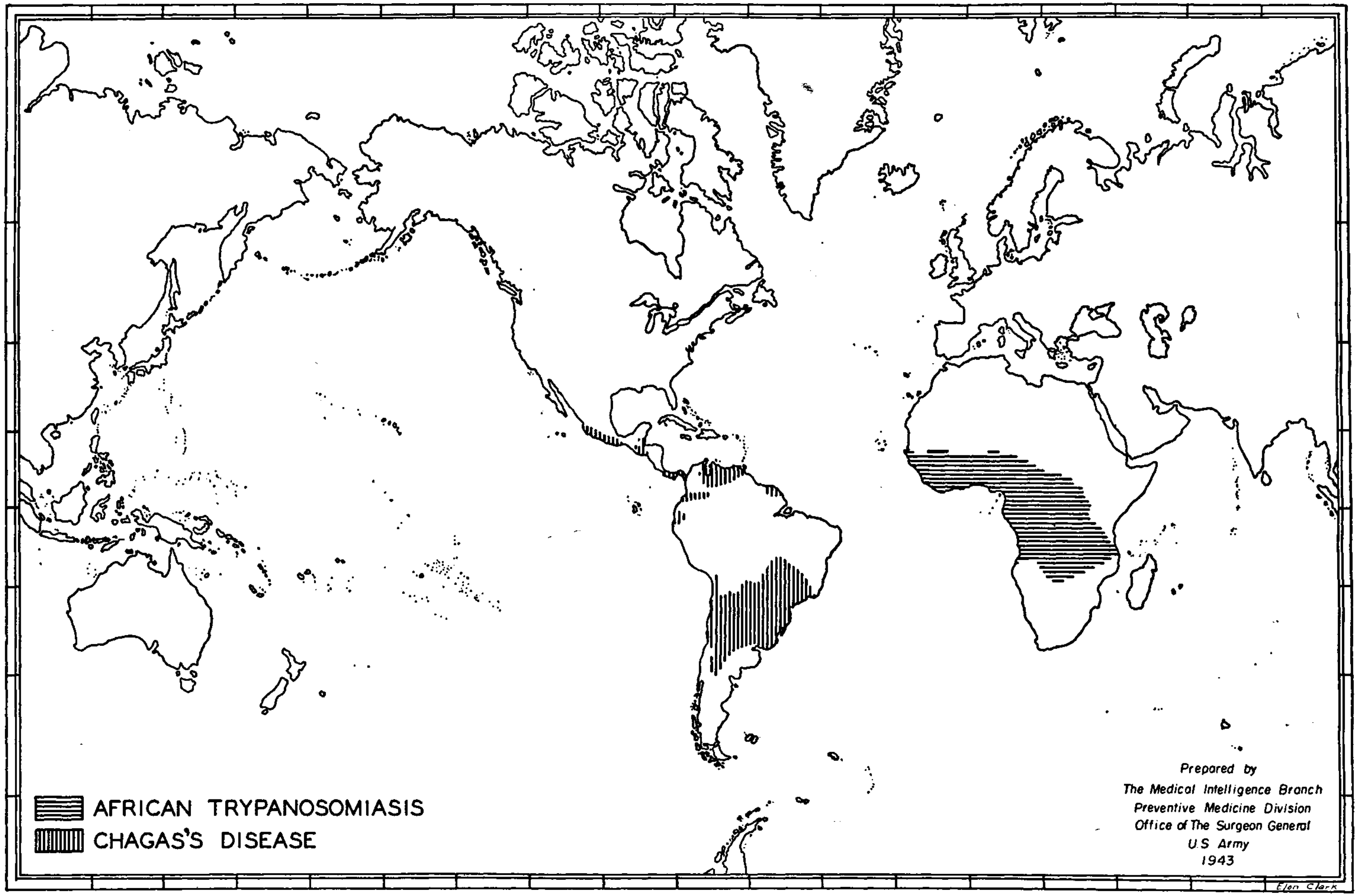
World Distribution of Plague



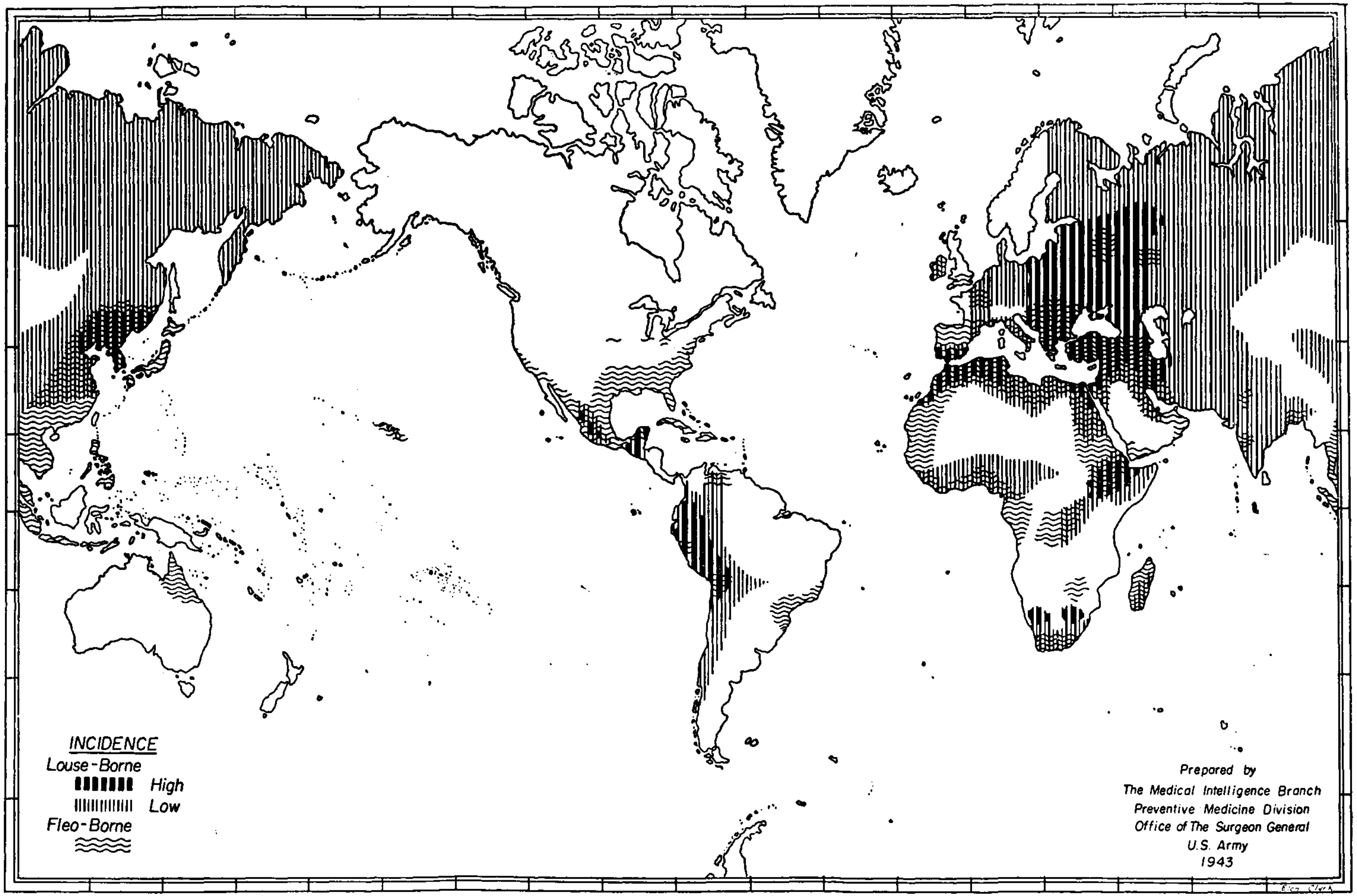
World Distribution of Relapsing Fever



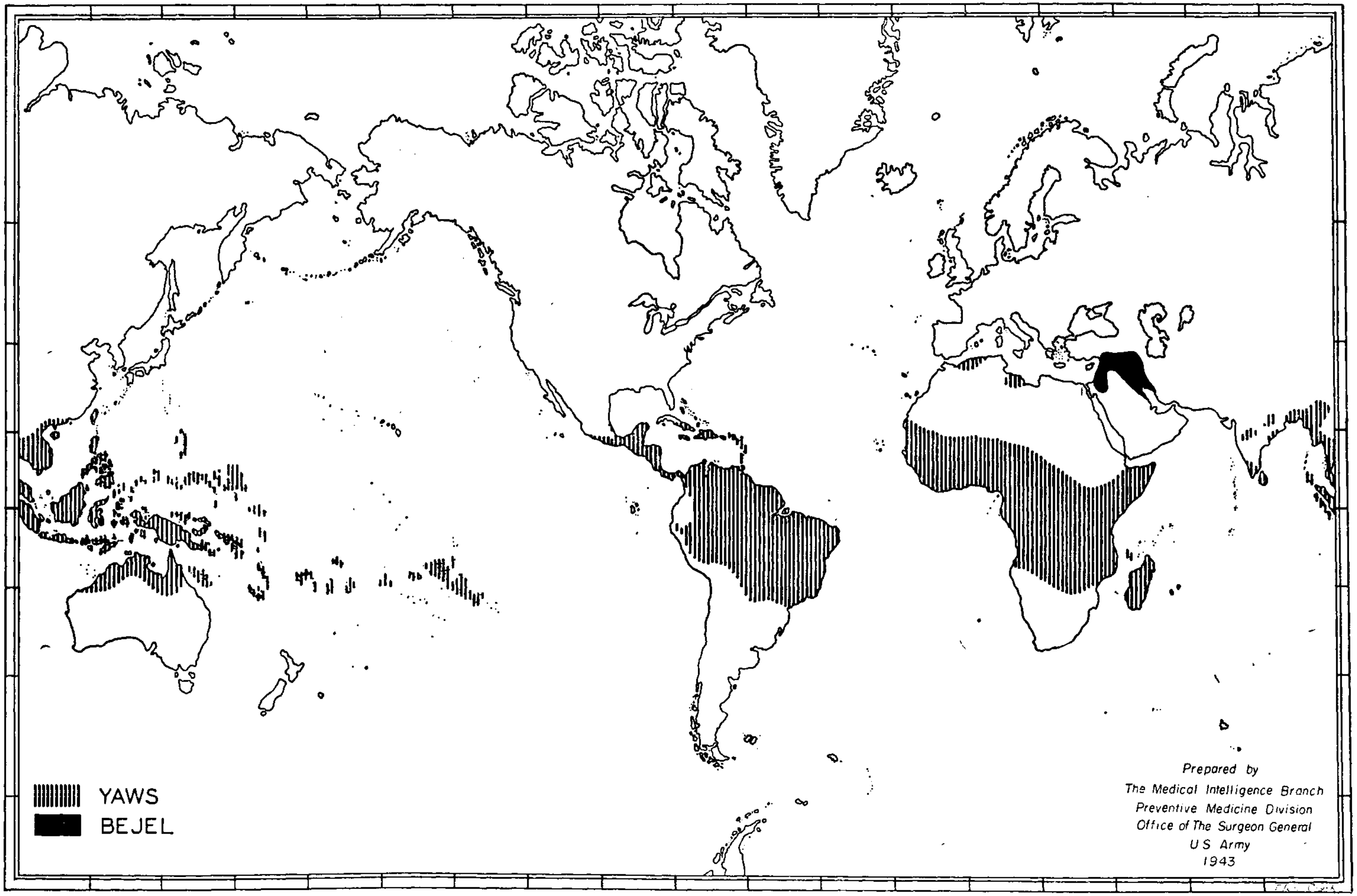
World Distribution of Schistosomiasis



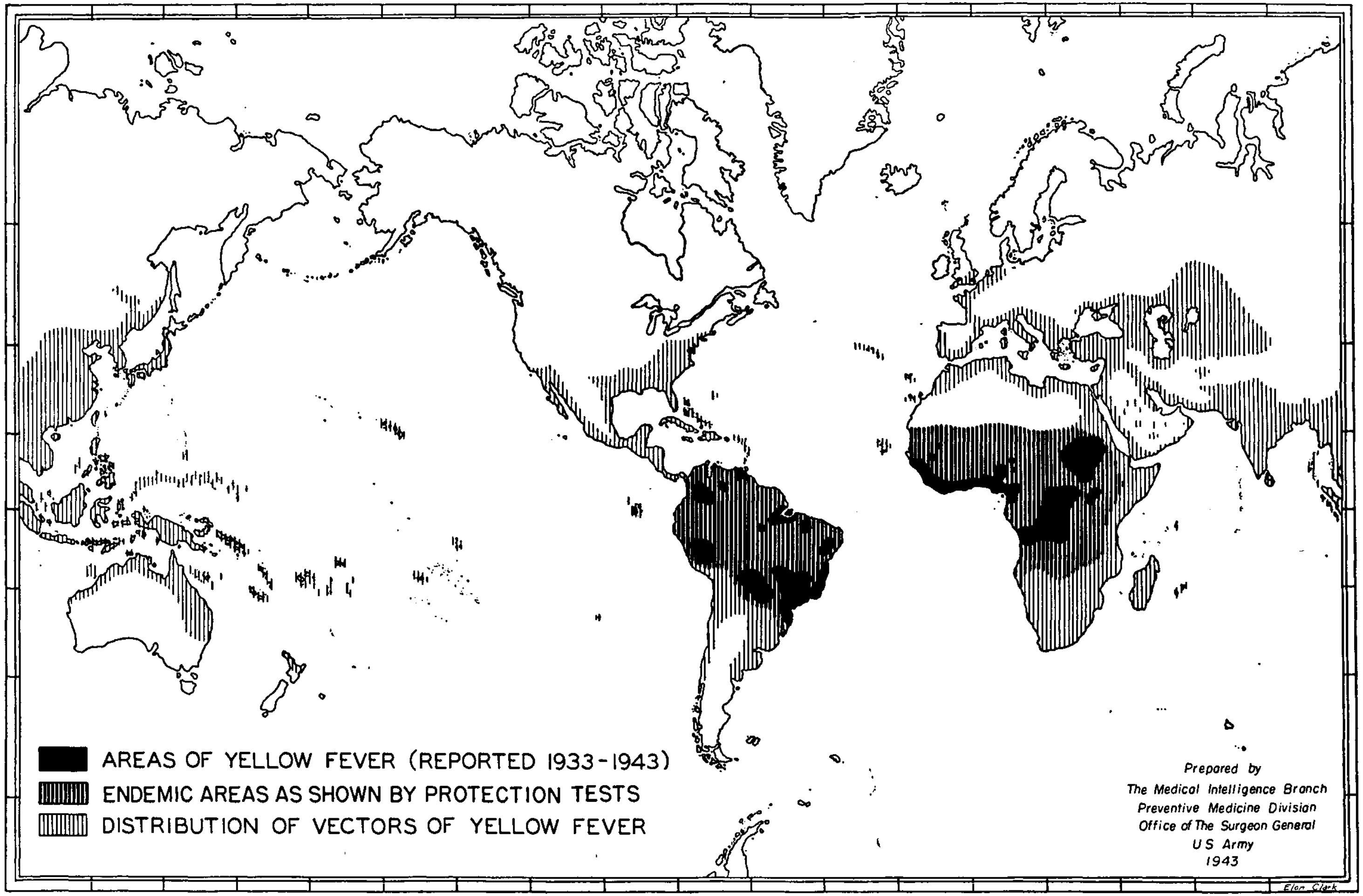
World Distribution of Trypanosomiasis



World Distribution of Typhus Fever



World Distribution of Yaws and Bejel



World Distribution of Yellow Fever

Index

I

Q

R

S

U