INDIAN HYGIENE AND PUBLIC HEALTH

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PREFACE.

Owing to the establishment of services of medical officers of health throughout India in municipal towns and districts, this handbook has been prepared from many voluminous books of reference on the subject to serve as a text book for candidates for the Diploma of Public Health and equivalent degrees granted by the examining bodies in the various provinces. It has, however, special reference to the United Provinces, particularly the chapter on Sanitary Law.

Knowledge of the subject matter contained in this book, together with that of its companion volume on public health laboratory work, which is shortly to be published, should ensure candidates being able to pass all such examinations as well as those for the Diploma of Public Health of any examining body in England, except that in the latter case the Sanitary Law of England would require to be studied in addition.

The book is also meant to serve as a handy manual for all medical officers of health in India to aid them in carrying out their duties.

Like many other manuals on Hygiene and Prevention of Disease, it cannot be altogether original and we do not claim originality, except in those portions which deal with Indian conditions in towns and villages with which both of us have a long and intimate experience. It has given us a great deal of work in its preparation in order that it may be in every way suitable for sanitarians in India and we can only hope that it will attain its object.

We are indebted to Lt.-Col. J. D. Graham, C.I.E., I.M.S., late Special Malaria Officer, U. P., and now Public Health Commissioner with the Government of India, for revising the chapter on malaria and for the diagrams on malarial survey work which he has permitted us to use. Major E. W. Oliver, M.R.C.V.S., late Superintendent, Civil Veterinary Department, U. P., has also kindly permitted us to use his lectures on meat inspection given to the Health Officers' class in Lucknow. We are also indebted to Lt.-Col. S. R. Christophers, C.I.E., O.B.E., I.M.S., of the Central Research Institute, Kasauli, for furnishing us with his latest classification of the anopheline mosquitoes of India and permitting the use of his diagrams, and to Dr. J. T. Cornelius, M.A., M.D., D.P.H., Lecturer on Hygiene, Provincial Hygiene Institute, U. P., for going over the proofs.

We acknowledge the permission of the Authors and Publishers to use numerous passages and illustrations from Parkes and Kenwood's Hygiene and Public Health, published by Messrs. H. K. Lewis & Co., Ltd., London, and of Messrs. Baird and Tatlock, London, for the use of some of their diagrams.

We are also indebted to our Publishers, Messrs. Butterworth & Co. (India), Ltd., Calcutta, for their unfailing courtesy.

C. L. D.
D. D. P.

Dedicated by permission

TO

HIS EXCELLENCY

SIR SPENCER HARCOURT BUTLER,

G.C.I.E., K.C.S.I., D.Litt., I.C.S.,

Governor of Burma,
late Governor of the United Provinces and Education Member of the Viceroy's Council,

whose keen interest in forwarding the cause of Public Health in India has been shown in practical form on many occasions.

ILLUSTRATIONS.

INDIAN HYGIENE AND PUBLIC HEALTH

PART I

CHAPTER I

WATER SUPPLY

The provision of pure drinking water is a matter which is of even greater importance in the tropics than in temperate climates, as water in hot climates is liable to be contaminated by a great many pathogenic organisms.

The sources of supply in the tropics are similar to those in temperate climates, viz., rain-water, wells, springs, rivers, lakes and reservoirs for the storage of upland surface water.

In comparatively rainless regions, wells may have to be dug to great depths to reach water or the water may have to be brought from rivers in canals or aqueducts. In other places salt water has to be distilled in order to obtain a pure fresh water supply.

In the plains of India the chief supply is from wells. There appears to be in many parts of India an inexhaustible supply of underground water, the level of which varies with the locality. This supply is replenished yearly during the monsoon rains by percolation into the ground. In the dry areas, such as parts of Rajputana and the south-west Punjab, the ground water is far below the surface and in many places in this region no water can be reached.

Parts of these areas are now thickly populated owing to the great system of canals which have been constructed and annually new arid areas are being brought under cultivation and populated.

Rain-water.—In many parts of the tropics the rain-water which falls on the roofs of houses is collected and stored in all sorts of receptacles for use during dry periods. Rain-water when falling is pure, except in large towns where it picks up many impurities from the air. If there has not been rain for some time, the roof of a house gets very dirty from dust, birds' droppings and rotting leaves, and other matter of this description. Rain-water should, therefore, not be stored until the roof has been thoroughly washed by the first rain. To effect this there are various types of rain-water separators on the market, such as Roberts' and Gibbs' (fig.1). Simpson recommends Sir William Macgregor's arrangement as introduced in Lagos. In the rain-water pipe from the roof there is a pipe leading to the storage reservoir at a sharp angle. The bottom of the straight pipe can be plugged after the first rain has washed the roof. The water then rises in this pipe to the level of the branch pipe after which it flows into the reservoir. The top of the rain-water pipe and the branch are protected by wire mesh to exclude roof debris and insects.

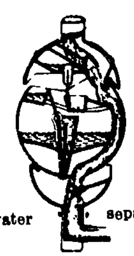


FIG. I.
Roberts' & Gibbs' apparatus
(Knight's Diagrammettes).

The reservoir should be properly constructed of galvanised iron, or impermeable brick or stone work lined with concrete and cement. It should be covered with wire mesh to prevent the access of insects to the water and should also have a close-fitting lid which can be removed for cleaning and inspection. In the tropics where malaria is prevalent, no receptacle for the storage of water should be left uncovered as mosquitos lay eggs in the water. The domestic habits of such mosquitos as N. Rossi and N. Stephensi are well known, and the latter is a well known carrier of the malarial parasite in nature. In regions where this source of water supply is much used the health authorities should be given extended powers to compel owners and occupiers of houses to provide proper receptacles for the storage of water otherwise the health of the community will suffer.

Rain-water is also collected by paving a sloping area leading to a tank with impermeable material such as concrete or slate. Here also arrangements should be made to divert the first rain by a channel round the tank and for covering the top of the tank.

Wells.—Wells are usually divided into three classes, *shallow wells, deep wells* and *artesian wells* as shown in fig. 2.

Shallow wells tap the underground water which is held up by the nearest impervious stratum to the surface. A shallow well therefore is not necessarily shallow, but may be any depth from 2 or 3 feet to 200 feet or more. In the south-west Punjab, before the introduction of irrigation, water was sometimes not reached for a depth of 400 feet, and there were no impervious strata met with.

Deep wells are wells which have been sunk through the first impervious stratum or several impervious strata and draw their water from the strata in between them.

Artesian wells are deep wells which tap water-bearing strata from which the water rises by hydrostatic pressure to the surface.

All wells drain an area surrounding them which varies with the kind of soil they are sunk in. This is called the *circle of drainage* of the well. Underground water is always moving in the direction of the general drainage of the country to some river or lake or to the sea.

When a well is sunk into the water-bearing stratum, the water drains to the well in all directions in the *circle of drainage.*

Sources of Pollution.—This underground water is liable to pollution, especially if the ground water is near the surface

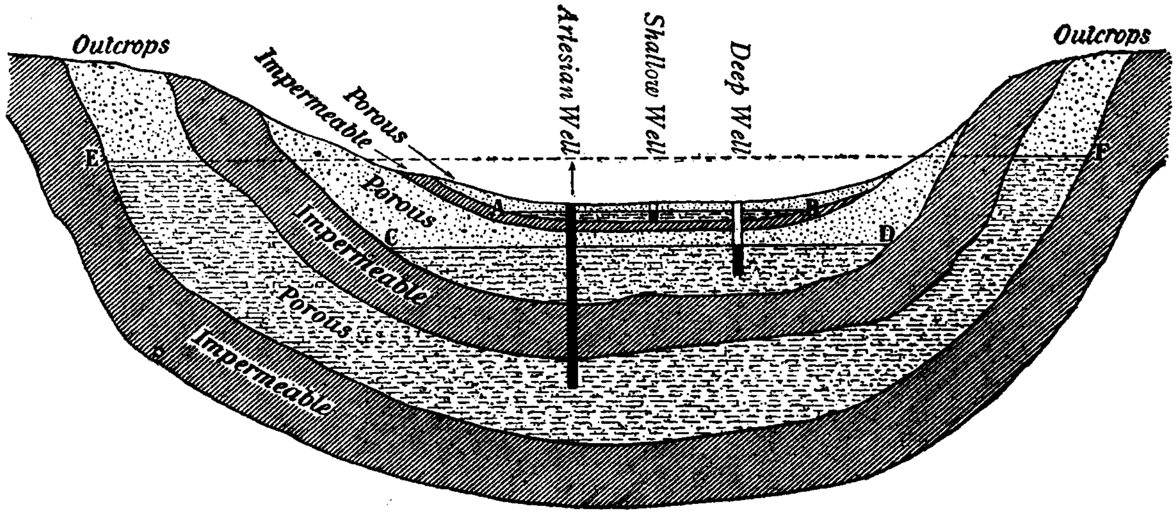


FIG. 2.—Diagrammatic Representation of Strata ; showing Shallow, Deep and Artesian Wells. A, B, subterranean water level in surface strata ; C, D, subterranean water level in deep strata ; E, F, subterranean water level in water-bearing strata supplying artesian well.
(*Parkes & Kenwood's Hygiene & Public Health*).

or if there are cracks or fissures in the soil coming within the circle of drainage and communicating with a source of pollution. In the plains of India, in thickly populated areas which derive their water supply from wells, the ground water varies as a rule between 5 and 50 feet from the surface. These wells are sunk all over the inhabited area, in houses and in their compounds. The inhabited area is also usually covered with cesspools, manure heaps, privies and other contaminating agencies, so that nearly all these shallow wells are liable to pollution with excremental matter. So it may be stated with safety that 90 per cent. of the population of India habitually drink polluted water.

In Benares, as the sewerage system is extended, the inhabitants have frequently remarked that wells which could not be used owing to the water being unpalatable, now contain water of excellent flavour. This is due to the fact that persistent soil pollution was stopped.

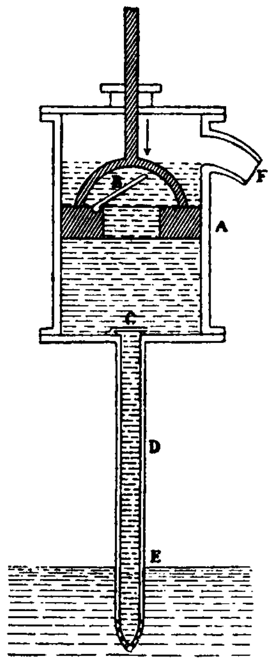
If wells are properly constructed with impermeable material and the mouths of the wells are properly protected, the passage of the polluted water through 20 or 30 feet of soil in the absence of cracks and fissures has a great purifying effect on it and such water, though not an ideal supply, is fairly safe for drinking purposes. Wells of this description are however unfortunately few and far between. The great majority of the wells in Indian towns and villages are faulty in construction and are unprotected at their mouths, and are thus habitually polluted by the users.

Indian public health officers have before them a heavy task in impressing public bodies and private owners of wells with the necessity of maintaining their wells in a good state of repair and protecting their mouths.

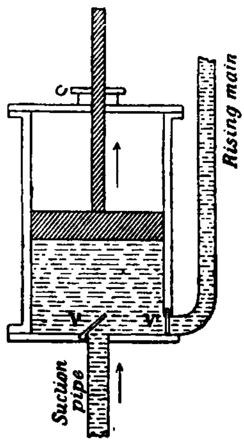
Protection of Well Water Supplies.—The best method of protecting a well mouth from pollution is to close the mouth of the well altogether and pump the water out of the well by means of a pump suitable to the requirements of the users of the wells and to the depth of the water in the well. This pump should not be directly over the well but situated at a distance of 15 to 20 feet from the well mouth. The pump should deliver water over a circular platform of which the pump spout forms the centre. The platform should be of some impermeable material such as bricks laid in cement or of concrete. It should slope away from the centre and have a circular drain round the edge connected with an effluent drain, which serves to lead away overflow and waste water to the nearest surface drain of the locality if any, or one of the natural drainage ditches of the area. By adopting this plan the surface of the ground in the vicinity of the well is protected from continual pollution, which may soak into the well. The covering to the well should be impermeable, a dome of brickwork, the summit of which is two or three feet above the surface of the ground, is the best. The tube of the pump should run down one side of the well and emerge by a right-angled bend below the springing of the arch of the dome and lead from there to the pump. The brickwork of the well should be surrounded on the outside by puddled clay. An inspection manhole may be constructed in the summit of the well by which entrance can be gained for repair, but a well of this description would require practically no repair for years, if originally properly constructed.

Pumps.—Atmospheric pressure is theoretically able to support a column of water 34 feet in height. *Suction pumps* make use of this fact, but in practice it is found that a suction pump will only act up to a depth of 25 feet.

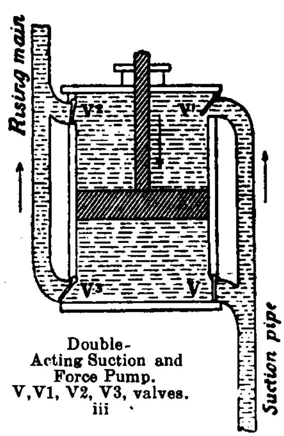
Suction Pumps (fig. 3-i).—These act by exhausting the air inside a cylinder by means of the upward stroke of a piston. The tube connecting the cylinder with the ground water supply is supplied with a valve at the bottom of the cylinder which opens upwards. There is a similar valve in the



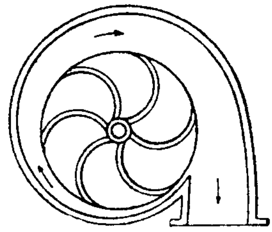
Suction Pump—A, Piston ; B. Piston valve ;
C, Suction or clack valve ; D, Suction Pipe ;
E, Water ; F, Spout.
i



Single-Acting
Suction and Force Pump.
V, V1, Valves.
ii



Double-
Acting Suction and
Force Pump.
V, V1, V2, V3, valves.
iii



Centrifugal Pump.
iv

FIG. 3.—(*Parkes* & *Kenwood's Hygiene* & *Public Health*).

piston which allows water to pass up through it. The upward stroke of the piston creates a vacuum in the cylinder which draws water up the tube to fill it. After a few strokes the water rises up the tube and fills the cylinder. The downward stroke closes the valve at the bottom of the cylinder, the water forces the valve in the piston open and rises above the piston. The next stroke delivers the water along the pipe to the spout, and with each stroke this action is continued.

Force Pumps.—To raise water to a greater height than 25 feet a force pump must be used. A force pump raises the water by suction by its upstroke to a height of 25 feet as in the previous pump, but the down stroke forces the water up a rising main to the spout. Such pumps are single or double-acting and are very efficient (figs. 3-ii and iii).

Centrifugal Pumps.—These pumps are very useful for raising large quantities of fluid and driving them along a rising main. Such a pump consists of fans revolving at a rapid rate, this causes a vacuum by means of which the water is drawn into the centre of the rotary wheel and delivered. They are driven by engine power (fig. 3-iv).

Chain Pumps.—The water is raised by means of an endless chain working in a tube. The chain is provided with washers of the same size as the internal diamater of the tube and the water is lifted in the tube by these washers. They can be worked by hand, animal or engine power.

The Persian wheels in use in many parts of India are primitive chain pumps.

Pulsometers.—The pump is a double vessel with a ball valve. Steam is forced alternately into the chambers and forces the water up a rising main. The steam by condensing on the cold side of the chamber causes a partial vacuum and draws the water by suction into the chambers alternately.

Waterwheels.—This system is well known in the tropics and is used in many parts of the country for irrigation.

Hydraulic Rams.—If water descending a large pipe is suddenly stopped, there is a great increase of pressure in the interior of the pipe. This can be used to deliver a portion of the water up a rising main to a higher level. This principle is used in constructing hydraulic rams (fig. 4). The water descends a large pipe to a chamber which is provided with a valve. The momentum of the water overcomes the weight of the valve and closes it. The water then rises in the chamber which connects with another chamber by an opening provided with a ball valve which allows the rising water to pass through. In this chamber the water comes in contact with an air cushion which steadily drives the water up a rising main. When the pressure is reduced the valve in the first chamber falls and allows of the escape of water. When the pressure in the pipe again rises sufficiently, the process is repeated and a continuous supply is maintained.

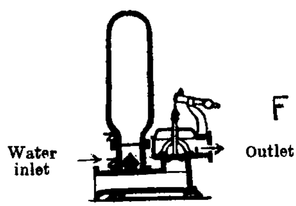


FIG. 4,
Hydraulic Ram.
(Keith's)
(Knight's Diagrammettes).

Tube Wells.—The use of small hand-worked tube wells in the tropics is strongly recommended where the ground water is less than 25 feet from the surface. They meet the requirements of small villages and isolated houses at a very small initial cost in a way that no other kind of well does. The situation in which the well is sunk can be carefully chosen, away from possible sources of contamination, and a good supply of underground water can be maintained.

A tube well consists of several lengths of tubing of 1 to 4 inches diameter, which can be accurately joined to each other. The lowest segment is provided at the tip with a sharp boring point and is perforated above this for some distance to admit the water. The various lengths are driven into the ground to the required distances by a weight hanging from a tripod. A suction pump is fixed to the top of the tube and will raise water from depths up to 25 feet. The water delivered at first is loaded with silt, but this soon clears up and clean pure water is delivered. These wells cannot be polluted from the surface as open-mouthed wells can, and before the war they only cost about Rs. 60 including the sinking into position.

Such a pump with 1½ inches diameter will easily deliver 5 gallons a minute and should the supply fail its location can quickly be changed. A pump with 4 inches diameter will deliver in most parts of the plains of India 2,000 to 4,000 gallons an hour.

Tube wells can also be used to supply large quantities of pure water to urban communities. These wells are of larger bore and are sunk to great depths, the water being raised by force pumps worked by oil or steam engines. Many such are in use in Northern India such as Miller-Brownlie's Convoluted Tube Wells made by the Empire Engineering Company, Cawnpore (fig. 5). These tubes are made in various sizes according to the delivery of water required, a 9-inch tube being capable of delivering 45,000 gallons an hour. They are sunk deep into the large sandy water-bearing strata such as exist in most parts of the Punjab and the United Provinces. There is one working in Amritsar in the Punjab which has been sunk to a depth of 125 feet. The water gains access to the tube through the perforations in the 3 or 4 lowest lengths of pipe and these perforations are protected by fine mesh copper wire which prevents the entrance of the sand particles to the tube.

Deep tube wells of this description are in use at Muttra, Allahabad and other places in the United Provinces.

The water delivered from such tube wells is of the purest description and provides an enormous supply of pure water for drinking purposes which requires no further treatment. There is probably a great future for this type of well in the tropics to provide a pure water supply for both large and small communities. The water can be pumped into reservoirs and supplied to the users in pipes. The sanitarian in the

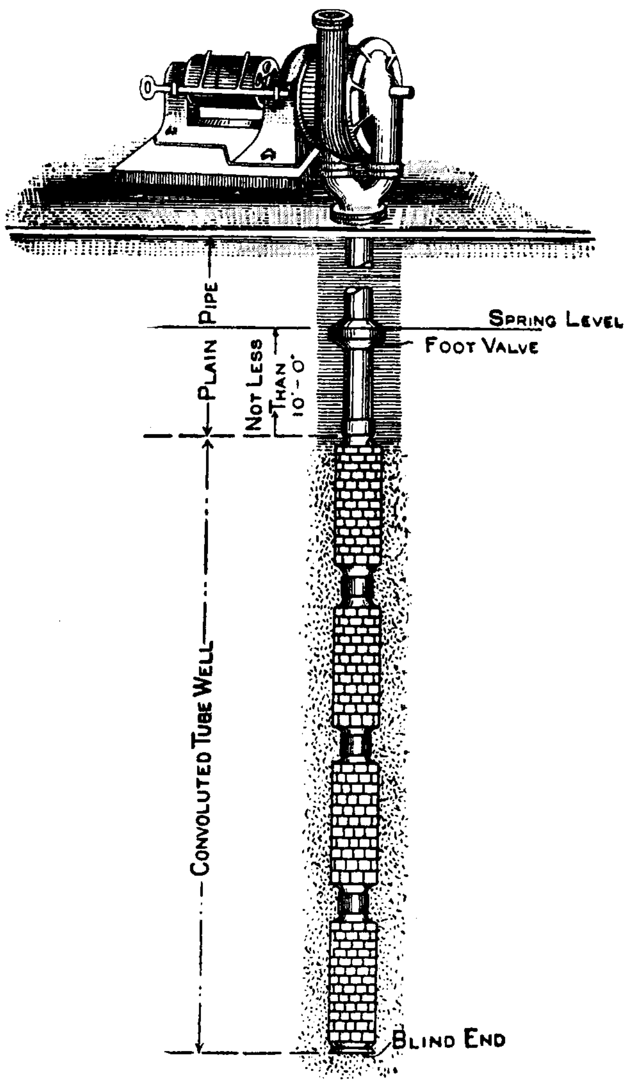


Fig. 5.
Brownlie's Convoluted Tube Well with Pump. Direct Pumping from Tube Well.

tropics should impress on the local authorities the advantages of using tube wells and covered wells supplied with pumps (fig. 6) for the drinking water supply of all small communities and advise the closing of all other well water supplies.

Protection of Well Mouths.—It is probable, however, that a long period will elapse before this ideal is reached and in the meantime, together with the gradual introduction of these very desirable improvements, our energies should be directed to ensure the proper protection of the mouths of open wells, which are in use all over the tropics for drinking water supplies.

Open well mouths should be protected by a parapet at least 2½ feet high ; the coping of which should be built at a sharp angle of not less than 45° to prevent users placing their receptacles on the top of the parapet. This coping should be protected by some unbreakable material such as galvanized iron sheets otherwise users will break off the coping in order to rest their receptacles on the edge.

The water should be drawn from the well by chains working over pulleys fixed on iron girders above the well mouth and the receptacles for drawing water should be galvanized iron buckets attached to these chains. Users should not be allowed to drop their own receptacles into the wells. The well mouths should be protected by a roof of galvanized iron sheets to prevent pollution from the droppings of birds and other organic matter carried by the wind.

The well should be surrounded by an impermeable platform of the type described before in connection with pumps attached to wells and similarly provided with an effluent drain.

All leaky wells and wells in special danger of pollution from the surrounding surface area should be filled up. In Indian towns and villages there are usually many old and unused wells which serve no useful purpose and which might very well be filled up. Many of these are "blind" wells which are a source of danger to human beings and animals ; a large number of accidents occur annually through the presence of these wells. In most Indian towns there are many wells in private houses and yards, which being in close proximity to cesspools and privies are constantly polluted. Local bodies should be given powers to require these wells to be filled up, when a sufficient and adequate pure water supply has been otherwise provided. At present local bodies have no powers to enforce the closure or disuse of any private wells which they consider a danger to health. In Bombay there are numbers of these wells which Dr. C. A. Bentley proved to be the breeding ground of countless anopheline mosquitos and steps have been taken by the corporation to acquire powers to have them filled up. They are not necessary for the water supply of the inhabitants as Bombay enjoys an excellent and adequate pure water supply in pipes from the adjacent hills.

In Cawnpore, in spite of the fact that the town is supplied with excellent filtered water from the Ganges, there are over 2,000 wells in the town the majority of which are private wells and the municipal board have no power to order their closure, although many of them must be grossly polluted from their position and construction.

Deep Wells.—The supply from deep wells is usually pure unless the outcrop of the water-bearing stratum is liable to serious pollution. Wherever a deep well water supply is available, the water should be obtained from this source in preference to shallow wells. There are many parts of India in which a deep well water supply is available.

Artesian Wells.—Where these wells are found the users of the water can be certain of receiving an exceedingly pure water supply. There are few places in India where Artesian wells are to be found. Simpson mentions one in Pondicherry which gives a very pure supply of water. Many have been sunk in South Africa, Australia and Java. They are often sunk to a depth of 2,000 to 3,000 feet.

Examination of Suspected Sources of Pollution.—Many methods have been used for this purpose. A chemical in solution is added in large quantities to the suspected source of pollution which can be detected if it appears in the well. The chlorides of sodium, lithium or ammonium have been used for this purpose and amounts of these found in the water by chemical analysis above the normal would show that the well water was being polluted from the suspected source. *Fluorescein* is better than any of the above. It is an orange dye which produces a distinct green fluorescence even when present in water in the most minute quantities. Fluorescein is capable of producing visible fluorescence if present in water to the extent of 1 part in 100 million parts of water. Fluorescein gives no colour in acid water, so if the water to be tested is acid owing to the presence of peaty acids, etc., it should be made alkaline with caustic potash. In the absence of any special test, the presence of excess of chlorine in a water which is not contaminated by passing through salty strata or by sea-water, is very suspicious of urine contamination, as is also the presence of abnormal quantities of either free or albuminoid ammonia. Such water, however, although originally polluted, may be quite potable as the bacterial content may be very small owing to filtration through the soil, which does not remove chemical substances in solution like chlorine.

A more comparable test is to add 500 c.c. of a 48 hours broth culture of B. prodigiosus to the suspected source and periodically make agar slope cultures of the water to be tested. If the B. prodigiosus gain access to the water a characteristic red growth will appear on the agar slopes in 3 or 4 days. If this occurs it is a sure sign that fæcal bacteria can also gain access to the water from that source.

Spring water.—Spring waters are either perennial or intermittent. The latter are produced by a depression in the surface of the land above the water-bearing stratum in which water appears only when the ground water is high.

The discharge on the surface of underground water is caused by an impermeable stratum which holds it up, cropping out at a lower level. If the ground water level is always above this outcrop the spring is then a permanent one.

The water from springs which derive their supply from considerable depths is usually pure, but they may be contaminated through cracks and fissures connecting them with a source of contamination.

All ranges of hills which receive a good annual rainfall have many constant and intermittent springs. Springs far away from ranges of hills are very uncommon or absent.

The outcrop of springs which are used for water supplies should be protected by building a closed reservoir over the outcrop and passing the supply pipes through the walls. By inspection of the area above such springs it should be ascertained whether the whole course of the stream supplying the spring is underground, as springs are often supplied with water from a stream which rises to the surface in various places and then again disappears underground. These outcrops should also be protected from pollution before such springs are used as water supplies.

Rivers, Streams and Lakes.—All rivers and streams which run through inhabited areas are bound to receive a considerable amount of pollution.

The water supply of many communities is obtained by damming up a stream or series of streams and thus forming artificial lakes or reservoirs.

Collecting Areas for Reservoirs.—The collecting area for such reservoirs should be uninhabited and fenced in. It should, if possible, be well wooded as well wooded areas retard the flow of water and act as an additional reserve of water during heavy rain which, in their absence, would quickly fill the reservoir and the surplus would have to be run to waste.

In addition to this, wooded gathering grounds prevent torrents of water from rushing down towards the reservoirs carrying with them large quantities of silt and decaying vegetable matter which would pollute the water. A steady flow is thus ensured in the direction of the reservoir.

The area for about 100 yards round the reservoir should be free from trees so that their leaves may not gain access to the water.

There should be no peaty areas in the gathering grounds as, if peaty acids gain access to the water, they give the water a plumbo-solvent action which is deleterious to the health of the users if the water comes in contact with lead pipes.

The water supply of Glasgow is from Loch Katrine and contains certain amount of peaty water, but this is evidently so diluted that no complaints have been received of its plumbo-solvency.

There should be no cultivated fields in the collecting area.

Water supplies from lakes, rivers and streams in inhabited areas should never be used for drinking water supplies without previous purification, but apart from this, stringent regulations are necessary to prevent the pollution of such sources of water supply by the population living on the banks above the intake of the drinking water supply of a community living below them.

Lakes.—Lakes have a great power of self-purification owing to the storage of the water. Dr. Houston has proved that if large numbers of typhoid bacilli be added to water which is then stored for a month, they will have almost completely disappeared in this time ; the total bacterial content of Thames water was enormously reduced by storage for this period.

Rivers.—River water also has great powers of self-purification, but never sufficient to render the raw water potable in rivers which pass through long stretches of inhabited country. After heavy rain when the river is filled with surface washings, the bacterial content is very high while, after long dry periods, the bacterial content is correspondingly low, unless it is being constantly polluted.

In the tropics the greater heat of the waters in rivers is conducive to a high bacterial content, but in the case of large rivers such as those of India, this is greatly counteracted by the enormous dilution which polluting matters receive.

Smaller streams in the tropics with towns and villages on their banks are usually very pollute.

Tanks.—In India, in the plains, a very common source of water supply is from tanks. These may be constructed with impermeable sides or may simply be dug out of the level plain. In and around most Indian towns and villages there are numbers of these tanks. Some of them are irregular in shapes and were originally dug for the purpose of obtaining clay for the making of bricks to build houses. Being filled up with rain in the monsoon they are not only used as bathing ghats, washing places and for the watering of cattle, but in many places the inhabitants of the town or village also drink the water.

Others again are well built with brick steps and walls, constructed by public benefactors, or in memory of some holy man ; consequently they have become places of pilgrimage, and the pilgrims drink the water. Such tanks are common sources of the outbreak of severe epidemics of cholera and other diseases as the water often becomes grossly polluted with the germs of epidemic disease. These tanks are also excellent breeding grounds for anopheline mosquitos and render the town and villages, in or near where they are situated, very malarious. Tanks as a source of water supply are thus out of the question and it is hoped that the spread of sanitary knowledge will lead to the greatly diminished use of such water for drinking purposes.

All tanks which are unnecessary to the public economy should be filled up and only sufficient allowed to remain to supply the needs of the people for washing, bathing and watering cattle. The banks should be properly sloped and built of brick. They should be capable of being emptied and cleansed periodically. The best kind of tank is one which is filled from an irrigation canal so that a constant supply of fresh water is ensured.

Storage of Drinking Water in the Tropics.—Water is usually drawn from wells or taken from streams in earthenware or brass receptacles and taken to the houses where it is stored in large porous earthen ware jars. These, by allowing of the evaporation of the water from the surface of the jar, cool the water and make it more palatable for drinking purposes.

Mahommedan communities usually collect their water in skins called "mashaks." They are made from the untanned skins of goats or cattle and are extremely unsuitable for the transport or storage of water as they get very foul and cannot be kept clean. Hindoos usually keep their metal receptacles very clean and polish them with sand.

Diseases Due to Impure Water.—In the tropics many diseases are disseminated by water supplies, but the chief of these are cholera, enteric fever and dysentery ; the methods of detecting the presence of the specific organisms of these diseases will be described in the chapter dealing with them in detail.

The eggs and larvæ of many worms and protozoa are also found in water and such parasites as, *Ankylostomum duodenale, Schistosomum hœmatobium, Dracunculus medinensis*, etc., gain entrance to the body in water

Other diseases such as dyspepsia and diarrhœa are caused by drinking muddy water with large quantities of silt or sand in it, and lead and copper poisoning are often caused by the presence of these metals in water in solution.

Distribution of Water.—In communities where the local authorities are going to establish a public water supply, they must take into consideration the following points :—

1. The quantity which is required for the immediate and future needs of the community.
2. The source and cost of the supply.
3. The method of distribution.

1. Quantity.

In England it is generally found that 30 to 50 gallons per head of the population is sufficient for all purposes.

Water is required for drinking, cooking, bathing, washing and flushing water-closets in the houses, and in the streets for drinking, public baths, public washing places, flushing and cleaning drains, watering streets and extinguishing fires. 25 to 30 gallons per head daily are sufficient for all these purposes.

In addition 10 to 20 gallons per animal is required for the drinking supply of horses and cows, so that 50 gallons per head would be an adequate and abundant supply.

In India, if all the population of the area supplied use water from the public supply only, probably 50 gallons per head would be amply sufficient for both public standposts and private houses. At present, however, most towns do not supply anything like this quantity because the public supply is supplemented by private supplies from wells.

No public body should therefore endeavour to enforce the closure of private supplies unless they are prepared to replace them by adding to the public supply.

It is desirable therefore, in installing a new public supply, to aim at an amount of 50 gallons per head of the population and make arrangements for the subsequent increase of this supply in areas with a growing population.

The following are the amounts supplied at present in gallons per head of the population in the principal cities of India :—

	Population.		Supply per head.
Bombay	1,172,953	(1921)	39·00
Calcutta (excluding neighbouring municipalities)	907,851	(„)	40·00
Madras	526,000	(„)	27·50
Rangoon	338,222	(„)	54·00
Delhi	246,987	(„)	22·30
Lahore	279,000	(„)	11·35
Amritsar	157,031	(„)	13·60
Lucknow	217,167	(„)	15·50
Benares	195,101	(„)	32·20
Cawnpore	195,085	(„)	34·70
Agra	163,750	(„)	20·00
Allahabad	145,605	(„)	22·70
Meerut	77,711	(„)	12·20
Mirzapur	54,994	(„)	8·00
Muttra	42,615	(„)	14·20
Dehra Dun	33,500	(„)	6·20
Naini Tal	10,393	(„)	13·60
Mussoorie	8,201	(„)	31·50

2. The Source and Cost of the Supply.

In large communities situated close to a river, it is usual to pump up the water from the river and supply it to the community in pipes after efficient purification, and if the treated effluent comes up to the standard of purity required by the public health department, this system is a good one and is probably the least expensive.

In small communities, however, and in towns situated at considerable distances from a river, the expense of procuring an adequate purified supply from a river is often prohibitive.

A small community on a river bank may be able to afford pumps to raise the raw water to the required level but may not be able to afford the initial expenditure of a purification plant.

A large community at a distance from a river may not be able to afford the construction of an aqueduct to bring the water to the town for distribution.

In such communities if there is an adjacent supply of underground water, the installation of a series of deep tube wells calculated to give them the required quantity of water per head would be more convenient and less costly. Such water usually would not require purification.

In other small communities all that is probably necessary is to see that there are enough public wells provided with covered mouths and pumps to supply the needs of the inhabitants who can draw their own water.

This applies especially to small villages and isolated houses. All towns and communities in which there is local taxation should be provided with a pure public water supply, the initial and recurring cost of which can be recovered by a water-rate.

An adequate supply at a cheap rate can always be obtained by raising water from wells or tube wells by pumping engines of the required power and distributing it in pipes by gravitation to houses and public standposts.

The installation of such a supply should be accompanied by the closure of the previous inadequate and polluted supply, in order to benefit the public health and ensure the abolition of water-borne epidemic diseases.

Whatever source of supply is chosen it should be pure, if it is to be supplied in an untreated condition, and measures should be taken to protect it from pollution, if such pollution is likely.

Even if the water is to be treated, as pure a source as possible, commensurate with the cost of obtaining it, should be chosen for the supply.

If there is a choice of more than one source of supply, naturally the supply in which the initial and recurring cost is least, other things being equal, should be chosen.

It is better, however, to instal a supply with a small recurring cost, even if the initial expenditure is large.

3. Distribution.

In public supplies in large towns, especially in sewered towns, in which the water-carriage system of sewage disposal is in force, it will be necessary to supply water in pipes to all houses connected, or which in the future are expected to be connected, with the sewers. In smaller communities without sewers it may often be necessary to supply a series of public standposts, public washing and bathing places, and flushing tanks for the surface drains.

The distribution should always be by gravity if possible, and the head of water should be sufficient to command all the houses destined to be supplied, the upper as well as the lower stories.

The water should be led away from the pure water storage reservoir in iron pipes laid underground. Cast iron mains are subject to rusty erosion but this can be prevented by dipping the pipes, heated to a high temperature, in a hot varnish of coal tar pitch, resin and linseed oil. This is known as Angus Smith's Solution. Water mains should have impervious joints turned and bored and pointed with the best Portland cement. They should be laid at least 3 feet under ground to protect them from the sun, which in pipes near the surface heats the water to a high temperature and renders it unpalatable for drinking. The mains, of course, will vary in size with the amount of water they are meant to convey. House connections should be of galvanized iron, but house service pipes are usually of lead, because they are easily bent and can be accommodated to the curves they have to take in a house to reach the various connections, and because they do not rust.

Soft water usually has plumbo-solvent properties, and if this property is present to an extent to be deleterious to the health of the users, lime should be added to the water. The inside of the pipes thus quickly becomes coated with insoluble basic carbonate of lead and further solvent action is stopped.

"**Erosion**" is caused by the action of the dissolved oxygen in the water on the lead, an insoluble oxyhydrate of lead being formed, which may not adhere to the pipe, so that progressive action is possible.

Polluted shallow well waters have been known to possess a high degree of plumbo-solvency. This is probably due to carbonic acid, which dissolves the lead carbonate coating in the pipes.

If lead poisoning is to be feared, galvanized iron pipes should be employed.

The presence of lime in any quantity in water destroys its plumbo-solvency and silica even in small quantities is said to prevent this action.

The supply of water may be *intermittent* or *constant*.

A constant supply is much better on the whole than an intermittent supply. In the latter case, users in houses store water in cisterns and receptacles, which are often not kept clean, so that the supply is contaminated in the houses before it is drunk. Storage cisterns are necessary in every house and the sinks, slop closets and taps should be supplied by pipes connected with this cistern. For drinking water it is better to have a tap connected direct with the supplying main. In the constant system cisterns are unnecessary, but houses are usually provided with them all the same, so that the occupiers may have a store of water to fall back on in the event of the supply being cut off for unavoidable reasons. Cisterns should be of galvanized iron and should be periodically cleaned out. They should be properly covered.

The heat of the water supplied in pipes in hot weather in the tropics is a great objection to its use as drinking water, as the water of wells is usually much cooler. In the tropics therefore storage reservoirs should be covered to keep the rays of the sun off the water. The pipes should be more deeply laid than in temperate climates. If balancing tanks are required in the installation to command certain areas of distribution, these, which are usually built of cast iron, should be as far as possible insulated against the sun's rays. House cisterns should also be well protected from the sun.

The water in the tropics supplied in pipes is usually at a temperature of about 90° F. in the hot season, and the natives of India adduce this as a strong reason for keeping their private wells as a source of drinking water. Efforts therefore should be made to put in force every reasonable means of preventing this heating of the water in providing public supplies.

Owing to the great rise in the cost of iron pipes, firms are now producing reinforced concrete pipes for use as water mains. They are cheaper and their durability is probably greater than iron pipes. They are at present on trial and so an authoritative opinion on their utility is not at present possible.

CHAPTER II

THE PURIFICATION OF WATER SUPPLIES

To any one who has spent any length of time in the tropics and has seen the hundreds of ways in which the teeming millions who inhabit those regions allow their water supplies to become polluted, the urgency of ensuring the potability of public and private water supplies becomes increasingly evident. All kinds of refuse, garbage and also dead bodies are thrown into the rivers, and children and adults habitually defæcate on the banks of rivers, lakes and streams. One may frequently see people taking drinking water from the banks of a stream a few yards below a place where other people are washing clothes or bathing.

In India, where the Hindoos are so particular about personal cleanliness and clean food, it is strange that they make little effort to obtain pure water. If the water is clear and palatable it is sufficient for the most fastidious taste.

The only efforts at purification which are made in some parts of the country are the addition of alum (phitkari) to muddy waters which are allowed to settle and the clear water is decanted, and the use in other parts of *Strychnos potatorum,* the cleaning nut, which has a clarifying effect on the water.

The result of this attitude of the people is that water-borne diseases are wide-spread in India and the tropics in general. Few adult natives of India can say that they have not suffered from some form of dysentery and the ravages of cholera in the past is a matter of history. There are many methods which have been introduced for the purpose of purifying water, both on a large scale for public water supplies, and on a small scale for private houses, and the choice of a method depends very much on the source of the crude water, the quantity to be supplied, the locality or the area to be supplied, and the cost of supply.

METHODS OF PURIFICATION.

Chemical.—These methods may aim at clarifying the water, destroying the bacteria in it, or both.

On a Large Scale.

Clark's process consists in adding one ounce of quick-lime to every 700 gallons of water for each degree of temporary hardness. Temporary hardness is due to chalk which is held in solution by the carbonic acid dissolved in the water. The carbonate is formed and the chalk is precipitated. By this means all the temporary hardness is removed, the falling precipitate clears the water and removes a large proportion of the suspended mineral and organic matter and the bacteria.

Uncombined lime should not be allowed to pass out with the effluent, so that excess of lime should not be added. The quicklime is slaked with water and the lime water is added in the exact proportions required and thoroughly mixed with the water. There are several machines on the market for effecting this mixing and exactly measuring the proportion of lime added. Excess of lime can be detected by adding nitrate of silver to the water when a brown colour is produced if un-combined lime is present.

The Porter-Clark's Process.—This process is similar to the above only the suspended matter is removed by filtration through a series of linen cloths under high pressure. Recently this system has been put through a series of tests in England to determine its capabilities not only of removing impurities by precipitation but by using the actual bactericidal effect of free lime in excess. It has been found that 7 parts of free lime per 100,000 is sufficient to kill B. coli in less than 24 hours and that the water can be practically freed from all bacteria. The lime can then be neutralized by adding carbonates or by filtering it out as mentioned above.

Houston's excess lime method is the same as the above except that the excess lime is neutralized by adding to 75 per cent. of treated water 25 per cent. of untreated water, the result being, when Thames water is used, a perfectly potable water.

The Stanhope System endeavours to reduce both the temporary and permanent hardness by adding lime and also soda.

In the Maignen System lime, soda and alum are added.

Spongy iron and **magnetic carbide** of iron are chemical purifiers as well as filters. They remove lead from the water and yield to it a little iron which can be removed by filtration through sand. The spongy iron has to be renewed periodically.

Polarite is also an excellent filtering material which does not need renewal. This material and magnetic carbide of iron purify the water by their oxidizing properties ; the filtration must be intermittent to allow of æration. Spongy iron cakes on exposure to the air, so in this case the filtration should be continuous.

Anderson's Process.—The water is passed through a long horizontal cylinder provided with curved shelves on which scrap iron is placed. When the cylinder is made to revolve a continuous shower of scrap iron is passing through the water. Iron is taken up by the water which is subsequently ærated by passing along troughs and over cascades. The oxygen in the air combines with the iron and forms a precipitate of ferric oxide. This precipitate settles down carrying the organic matter with it and is removed by filtration through sand.

In the above methods direct chemical action and precipitation are usually combined with filtration and most methods combine these principles in order to get a satisfactory effluent.

If the water contains no sediment or suspended matter such as deep spring and well water, but is nevertheless liable to pollution, chemical sterilization without filtration is sufficient.

Schumberg's Process consists in adding ·06 grain of bromine dissolved in potassium bromide to each litre of water and removing the excess bromine by sodium sulphite.

Chlorine Process.—Chlorine is added in the form of a hypochlorite. 1 part per 1,000,000 of available chlorine is sufficient for sterilization, excess chlorine can be removed by adding bisulphite of soda. For this purpose bleaching powder is usually used or sodium hypochlorite.

The sterilization of water by chlorine has practically superseded all other chemical methods in India.

Several firms supply excellent plants for automatically regulating the addition of chlorine solution to raw water in the required proportions.

Copper Sulphate in the proportion of 1 part per 1,000,000 will sterilize a water supply and in addition has an excellent effect in killing algæ.

Ozone method.—In this method the ozone is prepared and admitted to the bottom of a tower filled with large-sized filtering material. The water to be sterilized is conveyed to the top of the tower and allowed to filter down through this material. The ozone meeting the water sterilizes it to a great extent. The ozone is made by passing air through ozonisers supplied with electricity. Simpson gives full description of Siemens and Halske's ozoniser plant in his book, which should be consulted for further details about this system. The sterilization effected by this method is very high. The largest plant at present working is one at Wiesbaden where about half a million gallons can be sterilized per day.

It is doubtful whether this method will ever be much used in India for large water supplies of 10 to 20 million gallons a day, but for the water supply of hill stations it is probable that it would be very effective, as the plant is compact and efficient, which is an essential consideration in the case of water supplies in the hills.

Ultra-Violet Rays.—Considerable volumes of water can be completely sterilized by bringing the water into contact with with ultra-violet rays and the result on the water is very effective as practically all the bacteria are killed by a well designed plant.

Other methods such as boiling, heat under pressure and steam sterilization have been utilized in the Lawrence, Waterhouse-Forbes and Griffiths' systems, and fairly large volumes of water can be sterilized by these systems, but they are not meant to deal with large public supplies of water and are not likely to be adopted in India, even for small systems, as the cost of maintenance is high.

On a Small Scale.

Maignen's alum, lime and soda method can be used on a small scale and a small plant is made suitable for use in a dwelling house.

Nesfield's Method.—A 2-grain tablet of iodide-iodate of soda is added to 4 gallons of water together with a 2-grain tablet of citric acid. These have the effect of killing coliform bacilli in a few minutes. A 2-grain tablet of sodium hyposulphite is then added and the free iodine thus eliminated.

Schumberg's Method and the *Chlorine process* can also be used on a small scale.

Other Methods of Purifying Water on a Small Scale.

Boiling.—This is undoubtedly the best method of render-

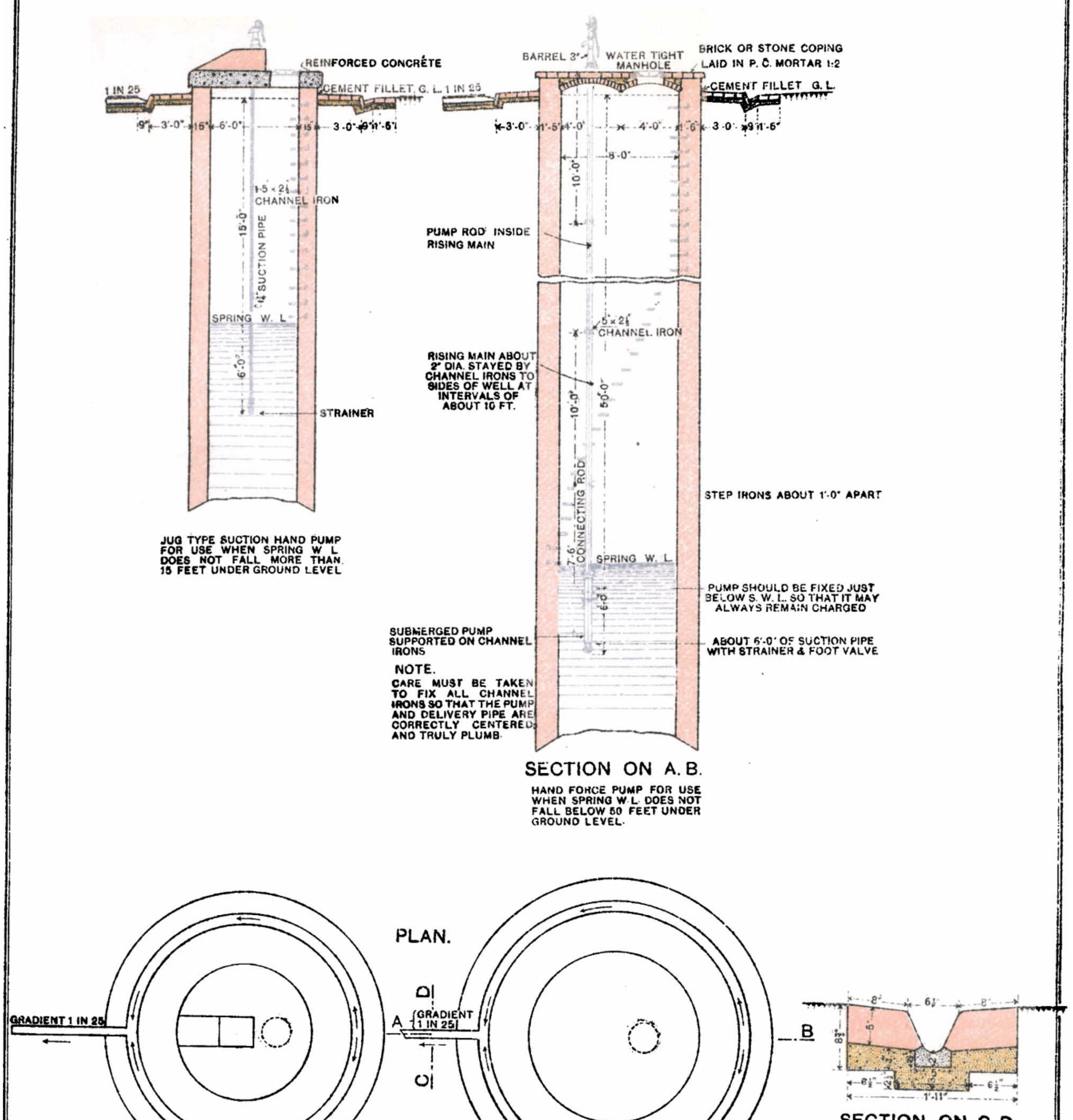


Fig 6.
TYPE DESIGN
OF
HAND-PUMPED WELL SUPPLIES.

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ing impure water fit for drinking in houses. Boiling not only kills all pathogenic germs but it also eliminates the temporary hardness. Boiled water, however, is flat and insipid to the taste owing to its lack of æration. Water, however, can be boiled in any house and the public health authorities in India, by widely distributing pamphlets and by personal advice, endeavour to get the inhabitants of infected areas to boil their water during cholera epidemics.

Distilling.—This method also has the effect of sterilizing water but stills are not available in most houses.

Small domestic filters of various kinds have been in use such as charcoal filters, filters of spongy iron, magnetic carbide of iron and polarite. These filters afford little protection against infection by water-borne disease as most organisms are only partly arrested in these filters and may wash through for several days after the original infected supply was received. They therefore rather increase than diminish the risk of infection.

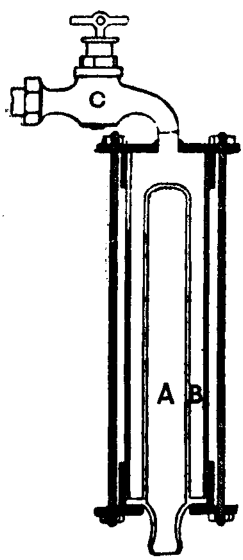

FIG. 7.

Pasteur—Chamberland Filter comprising: A—Bougie or Cylinder of unglazed porcelain; B—metal case; C—Bibcock connected with water supply.

Pressure must be used to obtain practical results. Sterilization by boiling necessary once a week.
(Knight's Diagrammettes).

The **Pasteur-Chamberland** (fig. 7) and **Berkefeld** filters will arrest typhoid bacilli in the water. The former is a porous porcelain filter whose pores are small enough to arrest bacilli and their spores. The filtered water is therefore sterilized. It is therefore an ideal filter.

The filter is attached to a tap on the main and the water is forced through under pressure.

The **Berkefeld filter** is on the same principle, the filtering candle being made of infusorial earth. Colonel Sir William Horrocks, A. M. S., has shown that typhoid bacilli can pass through this filter in 4-11 days so that it is not so efficient as the Pasteur-Chamberland, through which typhoid bacilli cannot pass.

The Berkefeld filter would therefore have to be boiled every third day to effect complete sterilization. The candle of this filter is easily broken.

Both the above filter candles have to be cleaned periodically as the pores become clogged and the rate of filtration gradually diminishes.

FILTRATION METHODS ON A LARGE SCALE.

Slow Sand Filtration.—This system of water purfication is in use in a large number of towns both in temperate and tropical regions. The crude water is first passed into large sedimentation reservoirs to allow the solids in suspension to settle down.

This process is often aided by the addition of alum or alumino-ferric to the incoming water, the flocculent hydrates of iron and alum in precipitation entangle the organic matter and bacteria and carry them to the bottom of the reservoir.

The supernatant water is then run on to sand filter-beds. These usually consist of a surface layer of pure white sand from 15 inches to 3 feet in thickness, a second layer of course sand of a depth of 1 to 2 feet and a bottom layer of gravel of 6 inches. Below the coarse gravel are the open mouths of the outlet pipes which lead the purified water to the filtered water reservoirs. The rate of filtration through these sand filters depends on the depth or head of water on the filter-beds. It has been found that a head of 2 feet of water on the filter-beds will result in an average rate of filtration of 36 gallons per square foot of surface in 24 hours, or 1½ gallons per hour, or about 1½ million gallons per acre in 24 hours (fig. 8-i).

The purifying action of this system is produced by the formation on the surface of the sand of a gelatinous layer of bacteria, protozoa, infusoria, algæ, sediment, etc., present in water, so that the filter does not become efficient until this layer is formed. This layer appears to be sufficiently formed two or three days after the filter has been put in use to produce a high degree of efficiency when dealing with fairly clear waters. After this layer has been formed a reduction of the water bacteria of about 98 per cent. is to be expected if there are no flaws in the filter.

FIG. 8—i. SECTION of a SAND FILTER (After Knight's Diagrammettes).

As time goes on, the rate of filtration becomes slower owing to the clogging of the top of the fine layer of sand with sediment, algæ, bacteria, etc., and to keep up the rate the head of water on the filter-beds must be increased.

There is a filtered water well beside each filter and the height of the water in this well compared with the height of the water on the filter-bed is an indication of the state of the filter. Floats are put in each and the rise and fall of each float is measured by pointers working on a graduated scale marked out in feet and inches. When the filter is first put in use with a 2 feet head of water on the filter-bed, the purified water in the filtered water well will gradually rise to the same height, or nearly the same height, as the water on the filter-bed. When the level of the purified water is below that of the crude water, the difference is called loss of head. As time goes on the loss of head increases owing to the choking of the filter until the time would come when water would not pass through at all. A filter-bed can be worked until the loss of head reaches 3½ to 4 feet after which it must be cleaned. This is done by letting all the water run through, and scraping half an inch of sand off the top of the filter, after which it is again put into use.

In London, with Thames water, each filter has to be scraped about once in a month. In India, in the dry weather, using Ganges or Jumna water each filter will run about 3 to 4 weeks in the dry season but in the monsoon when the rivers are full of silt, they as an average have to be scraped once in 10 days.

In Cawnpore the filters, in the month of May or five weeks before the monsoon, were choked with algæ to such an extent that the filters had to be scraped as often as once in two or three days. For this reason, the Cawnpore municipal board have had to instal a system of preliminary treatment before allowing the water to run on to the filter-beds. The sand thus scraped off the filters has to be washed in sand-washing tanks, after which it can be used again. When by successive scrapings, the thickness of fine sand is reduced to a foot, the filter must be thrown out of use and fresh sand to a thickness of 3 feet altogether laid on the filter.

The Massachusetts Board of Health carried out a series of experiments on sand filtration and obtained the following results :—

1. One foot of sand appears to filter just as efficiently as five at rates of filtration up to 2,000,000 gallons per acre in 24 hours.

2. 55 per cent. of the organisms removed from the water are found in the upper ¼ inch of the sand and 80 per cent. in the upper inch.

3. Filters do not regain their highest efficiency until 3 days after scraping.

4. The bacterial efficiency varies directly with the fineness of the sand employed, *i.e.*, the finer the sand the greater the efficiency.

5. The bacterial efficiency varies inversely as the rate of filtration *i.e.*, the slower the rate the greater the efficiency.

In India it has been found that an effluent can be usually obtained, containing less than 100 organisms per c. c. that will grow on agar at 37°C. and no coliform organism in 10 c. c., at rates up to 40 gallons per square foot in 24 hours and such a water is passed by the sanitary authorities. If over 100 bacteria of this kind are found in the water, the filter should be thrown out of action and examined for faults.

This standard is unsatisfactory. A water which contains 100 organisms which can grow on agar at 37°C. will probably contain 1,000 that will grow on gelatin at 22°C. and a water which on an average shows the presence of organisms in 10 c. c. which can produce acid and gas in McConkey's medium should be looked on with grave suspicion. There is no doubt that the bacterial flora of waters in India are different from the waters of more temperate climates and that the relative amount of the different classes of organisms varies considerably. It is therefore necessary that a bacterial standard of purity for water in India be established. At present it may be stated that a pure water after filtration should not contain on an **average** more than 10 to 20 colonies per c. c. that grow on agar at 37°C. and absence of fermentation in McConkey's medium in 40 c. c. of the water. These conditions are frequently obtained in India and should be possible to fulfil in all cases.

It is essential that the filtering film on the surface of a sand filter should be maintained intact as any flaws in this film will allow large numbers of bacteria to pass through until the film reforms. The water to a filter-bed should therefore be supplied in such a way that it will not break the surface film. It is usually supplied from a raised fountain in the middle of the bed, which allows the water to flow out quietly and evenly on to the surface of the water in the filter.

The clogging of a filter with algæ can be prevented by treating the water in the sedimentation tanks with 1 part of copper sulphate per million. This kills the algæ and their spores so that growth in the filter-beds is prevented. Only certain kinds of algæ cause clogging of filter-beds. Such algæ as *desmids, diatoms,* etc., have little effect but long branching forms such as *oscillaria, spirogyra* etc., flatten out on the surface of the filter when dead and rapidly stop the filtering action.

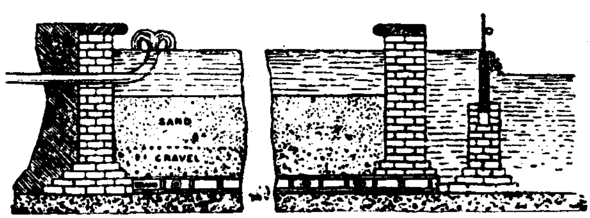

FIG. 8·ii. SECTION OF FILTER-BED AS ARRANGED BY LONDON WATER COMPANIES.

The black line on surface of sand represents the film of bacteria and organic matters.

(*Knight's Diagrammettes*).

Some algæ, such as *crenothrix, cladothrix* and *beggiatoa,* after decay, give the water an offensive fishy odour after filtration. *Beggiatoa alba* is usually only present in highly polluted water. It requires sulphur for its growth.

An excessive growth of algæ is probably favoured in the hot weather in the tropics by the high temperature to which the water sometimes attains.

The disadvantages of slow sand filtration are :—

(*a*) The filtered water ought to be run to waste till the full efficiency of the filter is established ; this cannot be done owing to the great waste of water entailed and the necessity for many spare filter-beds.

(*b*) The choking of the filter with algæ and with sediment, which necessitates frequent scraping and maintenance of a large staff.

(*c*) The danger of damage to the filtering film owing to the development of insect larvæ, which may injure the film, and from other causes.

(*d*) The danger of pollution during scraping by hand labour.

(*e*) The large area required for filter-beds and sedimentation tanks.

(*f*) The waste of water in sand-washing with the filtered water.

If a slow sand filter is well managed it is, however, highly efficient as it produces a very pure potable water.

ROUGHING FILTERS.

The water which is supplied to slow sand filters is often passed through roughing filters in addition to being allowed to stand in sedimentation tanks.

These roughing filters of coarse sand, by effecting a certain amount of purification by removing most of the suspended matters, allow a comparatively pure water to flow on to the fine sand filters and thus the life of these filters between scrapings is lengthened, with the result that the amount of wash water required is reduced and the cost of labour decreased The cost of roughing filters has to be taken into

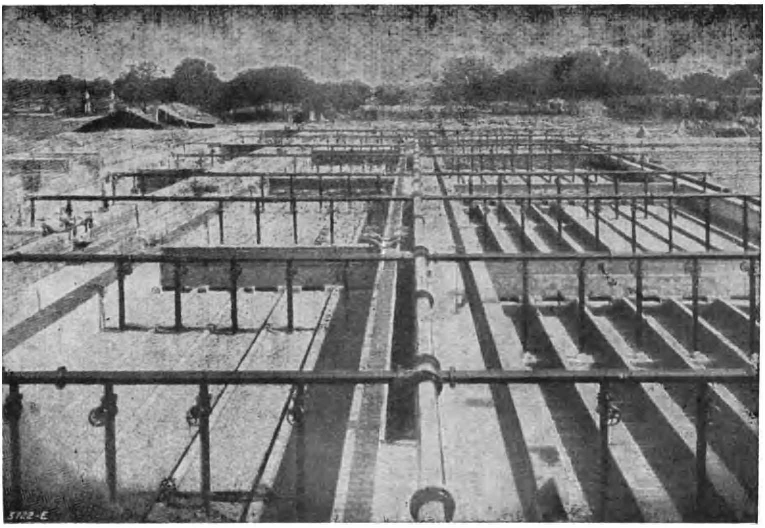

Fig. 9 (i).—Degrossisseurs and Collecting Canals.

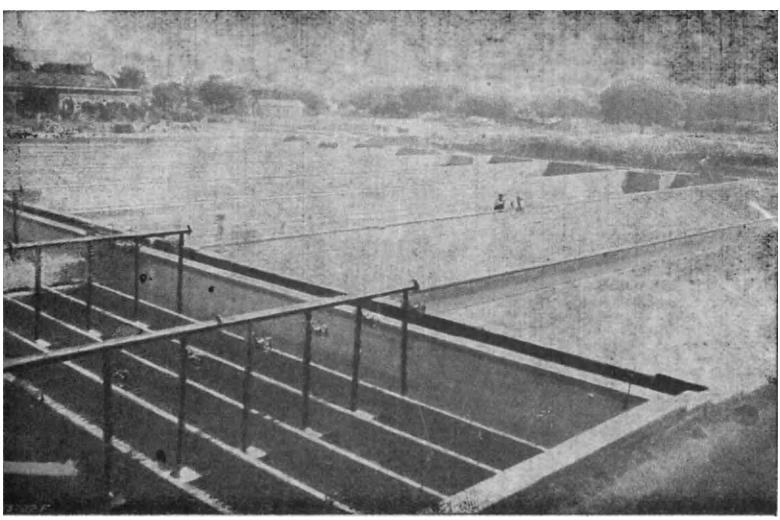

Fig. 9 (ii).—Pre-Filters at Cawnpore Water Works.

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account and the labour of scraping them periodically but there is no doubt a total saving in recurring expenditure if roughing filters are in use.

In upper India the price of fine sand is about Rs. 3 per hundred cubic feet and of coarse red sand about Rs. 15 per hundred cubic feet.

In the *Puech-Chabal* system which has been installed at Cawnpore (figs. 9 and 10) the raw water is treated by being passed though roughing filters. It is first passed through 3 series of degrossisseurs of graded gravel, the third being of the finest grade, for the purpose of removing the suspended solids. It is then run on to roughing filters of coarse red sand, through which the water is passed at a rate of 250 gallons per square foot in 24 hours after which it is passed on to the fine sand filters. The degrossisseurs are cleaned daily by passing air up through the gravel from below upwards and allowing the wash water to run to waste. The air is driven through pipes by an oil engine. The designers of the plant claim that :

(1) The greater part of the sediment will be removed in the degrossisseurs and practically all the remainder, nearly all the spores of algæ and the majority of the bacteria, in the roughing pre-filters, so that a fairly pure effluent reaches the fine sand filters

(2) This partially purified effluent can then be run through the final filters at an average rate of 52 gallons per square foot in 24 hours without the bacterial efficiency being lower than that of the old slow sand filtration plant.

(3) The life of the fine sand filters would be so prolonged that they would only need to be scraped twice a year and thus enormously reduce the cost of labour in sand scraping and the loss of wash water in washing sand.

(4) No chemicals would be required, so that the cost of alumno-ferric used in the old sedimentation tanks would be

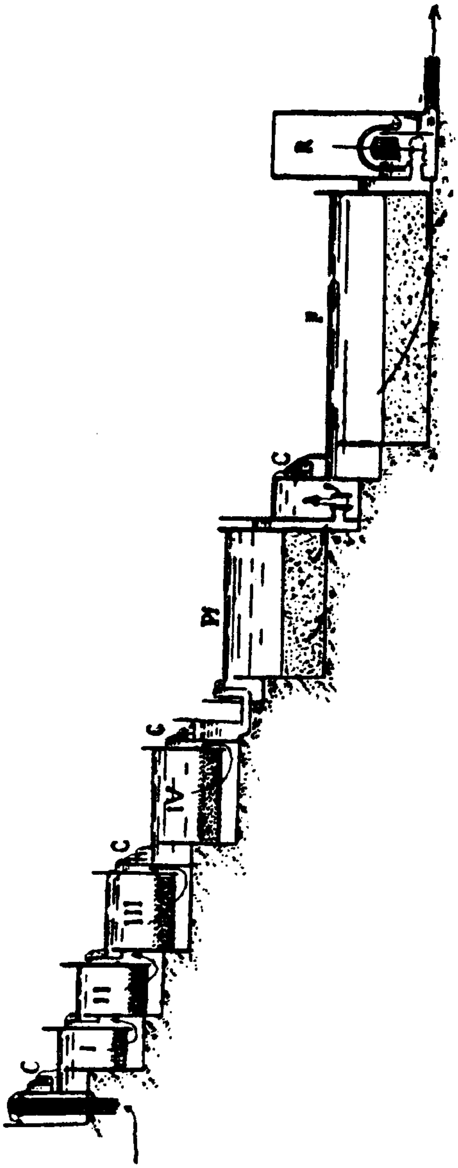

FIG. 10.—DIAGRAMMATIC SECTION OF PUECH-CHABAL SYSTEM.
I—IV, degrossisseurs ; C, cascades ; Pf. prefilter ; R, siphon regulator, (Didelon) ; F, finishing filter.
(*By permission of Messrs. Chabal & Co.*).

saved. From the series of tests carried out during 1912 and 1913 at Cawnpore it would appear that they have fulfilled their guarantees in all respects except that the final filters require to be cleaned about 6 times a year instead of only twice.

In the slow sand filtration plant the number of scrapings per filter per annum was usually about 25 to 30.

The plant suffers from the enormous growth of algæ which appear in the pre-filters and final filters and these may have to be dealt with in settling tanks with copper sulphate. If this is done, there will be a large diminution of the cost of labour and the life of the filters will probably be considerably increased.

In spite of this multiple filtration a certain amount of very fine silt still reaches the top of the final filters and this is a great factor in causing the early choking of these filters during the monsoon.

Rapid Filtration.—Rapid filtration can be effected by gravity or under pressure, and is usually carried out in sand filters of limited size. This kind of filtration is also called *mechanical filtration.* It is greatly used in America to deal with muddy waters and many filters of this type are giving excellent results in India, when dealing with silty river water.

In these filters an artificial filtering film is obtained by adding sulphate of alum in the proportions of 1 to 2 grains per gallon to the crude water. This coagulant forms a film of colloid material round the fine grains of sand in the upper part of the filter, which acts in the same way as the bacterial layer in the case of slow sand filtration.

High rates of filtration up to as much as 2,000 gallons per square foot per day can be attained and at these rates 98 to 99 per cent. of the bacteria can be removed. It is doubtful, however, whether this type of filter is very efficient in removing bacteria from a clear water with practically no suspended solids which is polluted with fæcal matter by surface contamination. There are several efficient filters of this description on the market such as the Paterson (figs. 11-i and ii) Mather & Platt, Candy, Jewell, etc. In some kinds, cleaning is effected by reversing the current of water from below upwards, and by revolving rakes or by passing air through the sand from below upwards. Both gravity and pressure filters are made by all these firms. They also supply plants with the filters for adding lime, soda and other chemicals to the water in the right proportions to eliminate hardness, iron, lead and other impurities.

It is claimed for these filters that :

(1) The initial cost is very much less than a slow sand filtration plant.

(2) All impurities can be removed by suitable automatically worked chemical treatment.

(3) They are not liable to contamination from the air or by workmen.

(4) They are quickly cleaned and very little wash water is required.

(5) The area required for the whole plant is about one fiftieth of that required for a slow sand filtration plant supplying the same amount of water.

(6) The staff required to work such a plant is very small.

(7) The bacterial efficiency is as high as that obtained by slow sand filtration.

Several such filters working with Hooghly water have been carefully tested and have shown a very high degree of bacterial efficiency, and most firms guarantee that the effluent from their filter will be free from bile salt bacilli in 60 c.c. In the hills, however, when dealing with a water containing no sediment, but which is polluted, the results obtained have been found unsatisfactory as little or no filtering film appears to be formed.

The Candy firm supply a filter in which free chlorine is added to the incoming water in the required proportion

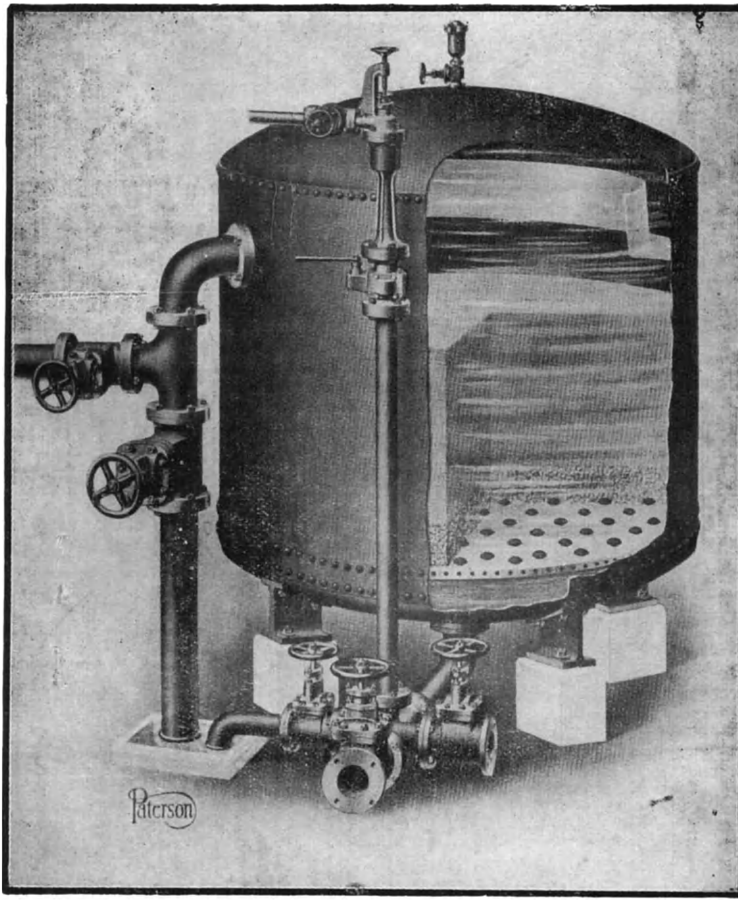

Fig. 11—i.—Paterson Pressure Filter.
(Cleansed by Compressed Air).

SPECIFICATION :

Paterson Air Cleansed Pressure Type Quartz Sand Filter with rivetted mild steel shell ; annular waste trough and strainer plate ; cast iron stools ; inlet, outlet, wash-water, bye-pass-to-waste valves ; air relief valve ; steam air-injector with air valve and steam valve ; all inter-communicating piping ; manifold strainer system ; quartz sand filtering medium.

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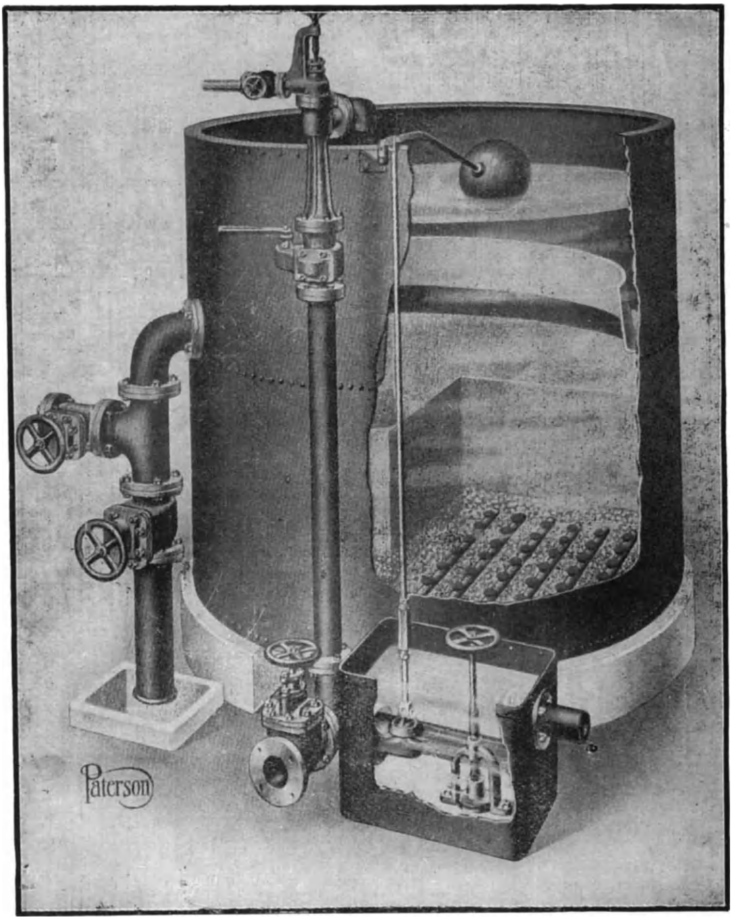

Fig. 11—ii.—Paterson Gravity Filter.
(Cleansed by Compressed Air).

SPECIFICATION :

Paterson Air Cleansed Gravity Type Quartz Sand Filter with rivetted mild steel shell and annular waste trough ; inlet, wash-water, bye-pass-to-waste and waste valves ; steam air-injector with steam and air valves ; automatic outlet controller ; inspection box ; all intercommunicating piping ; manifold strainer pipe system, fitted with gun-metal strainers ; quartz sand filtering medium.

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so that the effluent is practically sterile, and the excess chlorine is subsequently eliminated.

In choosing a plant to instal for the purification of a water supply the sanitarian must take into consideration the source of the crude water to be treated, the impurities to be eliminated, the matters in suspension to be dealt with, the quantity to be supplied and the space available for storage tanks, filter-beds, reservoirs, etc., the initial and recurring cost of the plant and the quality of the effluent obtained.

Dr. Houston's excess lime method has given excellent results, but a large area is required for the storage of the treated and untreated water.

Simple Storage also requires sufficient storage reservoirs to contain at least one month's supply of water. *A well managed slow sand filtration plant* will, with many waters, give as good a result as can be desired, but when taken from rivers is liable to give great trouble in times of flood, when the water is laden with silt.

Probably the best results will be obtained in India, where the crude water is taken from rivers, from slow sand filtration with previous treatment of the water by some of the methods of removing silt such as *roughing pre-filters* combined with treatment in settling tanks to prevent the growth of algæ.

In places where the space is limited, *gravity mechanical filters* will probably give the best results, especially where chemical treatment of the water to remove the hardness is necessary.

In the hills where the crude water is usually fairly free from sediment, but is in places liable to pollution from surface washings gaining access to the supply through cracks and fissures as it rises to the surface or from percolation, one of the *chemical methods of sterilization* with or without subsequent filtration through mechanical filters is likely to be the most efficient method of purification.

In order that as pure a raw water supply as possible may be obtained, deep tube wells should be sunk in those areas which are situated over a permanent water-bearing stratum of large capacity such as the Gangetic plain in India. In most places this will give an inexhaustible supply of water for communities of all sizes, and it will probably be found that in most cases the water will require no treatment whatever before being distributed to the users.

The system has the advantage of being cheap in its initial cost, the recurring expenditure is very small and the plant is easily managed by a small staff.

As we believe that for obvious reasons deep tube wells are likely to be an important source of water supply in this country in the near future, it will not be out of place to refer briefly to the Air Lift System of Pumping introduced a few years ago in North America.

This system of pumping is based on the principle that when the specific gravity of a column of water in a pipe immersed in water is reduced by mixing air with it, the water outside forces the lighter column of water within the pipe upward and induces it to rise.

So, in a tube well compressed air is employed which is admitted from the Air Receiver by means of pipe-lines. It is possible in working this system to link up any number of wells by properly designed and installed pipes to a central Air Compressor at the main pumping station.

Among its many advantages it is stated that this system increases the yield of wells, the water being ærated under pressure becomes clearer and more palatable and prevents the growth of vegetable matter and micro-organisms.

That this system of pumping is economical is seen by the fact that a community may obtain, according to pre-war prices, fresh pure wholesome water at the rate of ten pies per 1,000 gallons.

CHAPTER III

AIR AND VENTILATION

The provision of pure air is, in tropical as well as in temperate zones, important from the public health point of view.

In the open country the outer air is generally pure, but in the larger towns, owing to the large number of people living in a small area and the addition of noxious gases owing to manufacturing processes, its purity is greatly impaired.

Effects of Impure Air.—Impure air has a direct effect on the physique of the human race. It is well known that in most countries the physique of the inhabitants of villages is better than that of the town dwellers, and that the death rate in towns is greater than the death rate in villages in the same age-periods of life. In villages in parts of tropical and subtropical regions, in which the winter temperatures are much lower than the summer, the people are in the habit of living in small ill-ventilated houses. In the summer, when they spend most of the day and night in the open air, this has little effect on their health ; but, in the winter, the whole family sleep in these small houses and close every aperture which allows of the ingress of pure air, in order to keep out the cold. For this reason phthisis and other respiratory diseases are prevalent in villages as well as in the towns. It is therefore the duty of the sanitarian in the tropics to inculcate the principles of proper housing and ventilation both in towns and villages.

Composition of Air.—Pure, dry atmospheric air has the following volumetric composition :—

Oxygen	20·94
Nitrogen	78·09
Argon	·94
Carbonic Acid	·03
	100·0

The amount of aqueous vapour varies, and there are also traces of such gases as neon, krypton, xenon, helium and hydrogen.

Pollution of Air.—In towns the air does not exhibit this purity. It contains traces of organic matter, ammonia, sulphurous acid, sulphuric acid, hydrogen and an increased amount of carbonic acid gas. Carbonic acid gas is exhaled by human beings and animals day and night, and by plants during the night only. In the daytime the green parts of plants absorb carbonic acid and set free oxygen ; in this process much more purification is caused during the day than pollution during the night.

Ozone is supposed to be found in air in mountainous regions and near the sea, but recent investigations have tended to throw considerable doubt on the question whether this gas exists in a free state in air at all. It is suggested that the reactions supposed to be produced by ozone are really produced by nitrous oxide, N_2O.

Recent researches by Sir James Dewar prove that all animal and plant life are hydrogen producers and that the average man produces as much as 100 c.c. of hydrogen in 24 hours. This accounts for the traces of hydrogen in the air, of which the majority probably combines with oxygen to form water vapour.

In India, owing to the long, dry periods without rain, the air is polluted by large amounts of organic and mineral matter in the form of dust, as much as 180,000 dust particles per cubic centimetre having been found in the air of Cawnpore in the dry time of the year. An analysis of this dust showed that it consisted mostly of particles of organic matter. During a dust-storm, however, over 96 per cent. of the dust in the air is mineral matter, which subsides rapidly, owing to its greater weight.

Carbonic Acid Gas and Respiration.—It used to be thought that the symptoms caused by the breathing of the vitiated air of crowded rooms was due to the excess of carbonic acid present. It has been proved, however, by Haldane that the CO_2 in the air may be increased to 3 per cent. before any effect is produced on the respiration, and that 10 per cent. is required before any poisonous effect is observed This is provided that the humidity and temperature of the air is kept low. It, therefore, appears that physical and not chemical changes produce the symptoms experienced by breathing the air of overcrowded rooms.

Air, on being inspired by a male adult at rest, loses 4 per cent. of its oxygen and gains about 4 per cent. carbonic acid. It is raised to a temperature of 98·4°F., and on being expired contains 5 per cent. aqueous vapour. It is this gain in aqueous vapour and rise in temperature which produces the oppressiveness caused by breathing air vitiated by respiration. As, during each respiration 500 c.c. or 30 cubic inches of air passes in and out of the lungs, and the average number of respirations is 17 per minute, it is easy to calculate that a male adult at rest adds ·72 of a cubic foot of CO_2 to the air in one hour.

Although CO_2 has been proved not to be the cause of the symptoms produced by breathing foul air, it is, however, a convenient indication of the added impurity. It has been found that these oppressive symptoms begin when the quantity of CO_2 in a room reaches ·06 per cent.; ·04 per cent. is taken as the average amount present in a room which is filled with pure air, so that the *respiratory impurity* is ·02 per cent. or 2 parts per 10,000.

Personal emanations have a much greater effect on the purity of the air in the tropics than in temperate zones, owing to the greater activity of the sweat glands in hot climates, and there is no doubt that these emanations are responsible for much of the unpleasant odour of the air of crowded rooms.

Putrefaction.—The rapid putrefaction of vegetable and animal matter in hot climates is responsible for the foul odours which are noticeable in nearly all villages and towns in the tropics in which the arrangements for the removal of refuse are defective or absent.

Pathogenic micro-organisms are not present in air as a rule, except in close proximity to patients whose expired air is charged with them and in air which is laden with septic dust and organic matter.

It does not seem probable that the addition of a small percentage of CO_2, moisture and heat, and the removal of a little oxygen from pure air, can be responsible for the definite symptoms which the respiration of vitiated air produces. Respiration, therefore, appears to either add some constituent, which has not yet been identified, to air, which renders it injurious, or the air is deprived of some vital element.

The long continued respiration of foul air produces lack of vitality and decreased resistance to attacks of acute disease ; it is, therefore, necessary for the sanitarian to see that proper provision is made for the frequent changing of the air in houses and the dilution of the air outside houses by the provision of wide streets and open spaces, to allow of free percolation of pure air round the houses.

Vitiation by the Products of Combustion.—Another cause of the vitiation of the air is the combustion of coal, wood, oil, gas, etc., and other materials to produce heat for cooking and warming rooms, and for the provision of light In the tropics, very few towns and no villages are provided with a gas supply, so that this prevalent and important source of the vitiation of the air of rooms is absent. For lighting purposes in towns not provided with electric lighting, and in all villages, oil is used ; such oil is usually of a low grade, which consumes much oxygen and gives off a large amount of CO_2 and other gases.

One ounce of low grade oil gives off about one cubic foot of CO_2. In the lower class Indian houses, wood and dried cakes of cow dung are usually used for heating and cooking purposes, and usually no provision is made for the escape of the gases generated during this combustion, they being allowed to escape by the door, or any other available aperture, with the result that the air of such rooms becomes exceedingly foul and poisonous, and has a deleterious effect on the health of the occupants of the room.

Vitiation by Industrial Occupations.—Air is vitiated in mines and in many industrial occupations owing to the dust that is produced.

The air of coal mines is laden with coal dust; of gold mines with the dust of quartz; of salt mines with finely powdered salt.

The air of works for the production of any metal is loaded with fine particles of that metal; in earthenware works the air becomes impregnated with fine siliceous dust; in wool and cotton mills fine fibres of the material are continually floating in the air.

Effect of Occupations on the Health.—In England, by the use of comparative mortality figures, Tatham has shown that an excessive mortality from phthisis and respiratory diseases occurs among workers who manufacture metal and earthenware goods; and Ogle has shown that high mortality also exists in workers in wool and cotton factories, but not so high as in earthenware and steel works.

Coal miners seem to enjoy a comparatively low death rate, and this has been attributed to the softness of the particles of coal, which produces little irritation in the bronchi as compared with siliceous and metallic matter. It is also due to some antiseptic property of the coal, which seems especially to protect the coal miner against phthisis.

In England, the Cornish tin miners exhibit the highest mortality from respiratory diseases, as they inhale a sharp, angular, irritating stone dust. Gold miners in tropical countries are well known to be short-lived, and to suffer greatly from respiratory diseases, especially phthisis.

In brass foundries, the workers are liable to a disease called "*brass founders' ague*," and to *chronic copper poisoning*, the symptoms of which are described in text books on the subject.

In woollen mills, the workers are exposed to *anthrax* from contact with infected wool.

In England, the Factory Acts contain many stringent provisions regulating the ventilation of mines and workshops, containing special provisions for each industry, which have the effect of reducing the incidence of the various diseases to which the workers are specially liable, and certain provisions are also made in India and other tropical countries. In India, these are, however, not at present very extensive, and will have to be considerably added to in view of the increasing numbers engaging in industrial occupations.

Anthrax in Wool.—There are many woollen mills in India now, so that the prevention of the spread of anthrax from infected wool is becoming increasingly important.

The infection is set up by the presence of the spores of anthrax in the wool. These spores can get into the blood stream through cuts and abrasions, the lungs by inhalation, or the alimentary tract, and in these situations set up the three different forms of the disease. Precautions should, therefore, be taken in woollen mills and hide godowns to protect the workers. The hair should be detached from the hides under water, and the wool should be kept wet. The workrooms should be specially ventilated by exhaust shafts with their mouths opening near the workers' benches, to immediately remove flying particles from the room. All workers suffering from cuts and abrasions should be excluded till recovered. The mouths of workers should be protected by fine muslin cloths; they should not be allowed to eat in the workrooms; and should wash their hands and faces thoroughly before leaving the works. They should wear overalls while at work to protect their clothes from the deposition of any infected hairs.

The air exhausted from workrooms should be passed over furnaces and incinerated. Cases of anthrax should be isolated for treatment, and if the disease is discovered among living cattle, the infected cattle should be destroyed and buried at least 6 feet below ground in quick lime. The provisions for controlling anthrax in force in India are dealt with in the chapters on Sanitary Law.

Ventilation.—Ventilation may be defined as the replacement of vitiated air by pure air, both inside and outside dwelling houses.

The ventilation of towns and villages is dependent on the width of the streets, the number and disposition of open spaces, the height of the houses and the provision for the free access of light and air. The sun, rain, wind and vegetation purify the atmosphere on a large scale, and purification and ventilation are also due to the diffusion and expansion of gases.

Diffusion of Gases.—Gases diffuse inversely as the square roots of their densities. Air expands $\frac{1}{491}$ of its volume for every degree Fahrenheit it is raised, and $\frac{1}{273}$ of its volume for every degree Centigrade.

Hot air is, therefore, lighter than cold air, and therefore rises and allows cold air to take its place to restore equilibrium. On this property are founded the principles of the ventilation of houses and rooms, whether ventilated by mechanical means or by natural means. The ventilation of streets and buildings is carried out by the action of the winds, which are also produced by this property of expansion of gases; and the sanitarian has only to provide for the proper access of wind and light in order to efficiently ventilate towns and villages.

Internal Ventilation in Inhabited Rooms.—As stated above, no inconvenience is felt in breathing the air of a room until the percentage of CO_2 present reaches ·06 per cent. De Chaumont assumed such air could be breathed with impunity, and that no greater impurity should be permitted. This permissible limit of ·02 per cent., or ·0002 cubic foot of CO_2 per cubic foot of air of respiratory impurity, is generally adopted.

Now if D = the amount of fresh air delivered in cubic feet and E = the amount of CO_2 exhaled, and r = the respiratory impurity per cubic foot of air, $D = \frac{E}{r}$.

So that, if we know two of these quantities, we can find the third.

It has been seen that a male adult expires ·72 c. ft. of CO_2 per hour at rest; the female adult gives off about $\frac{1}{5}$ less than this, and a child averages about ·5 cubic foot per hour. The average adult during gentle exertion gives off ·9 cubic foot, and during heavy exertion 1·8 cubic feet. Among the general population of adults and children the CO_2 given off per head is taken as ·6 cubic foot per hour.

E per head therefore = ·6 c. ft. per hour and if r = ·0002 c.ft. then $D = \frac{E}{r} = \frac{\cdot 6}{\cdot 0002} = 3000$ cubic feet per hour.

Therefore each individual in a room requires 3,000 cubic feet of fresh air per hour to keep the respiratory impurities down to ·0002 cubic foot, or the total impurity to ·06 per cent. of CO_2.

On this formula, after due allowance has been made for impurities caused by combustion and other causes, all calculations as to the required amount of cubic space per head and ventilation are based.

Natural Ventilation.—The cubic space per head ought to be enough to allow 3,000 cubic feet per head of fresh air per hour, without the causation of a disagreeable draught. If 1,000 cubic feet of space per head is allowed, then the required 3,000 cubic feet of air can be supplied if the air of the room is only changed three times an hour ; this causes no draught in warm weather, if the area of the inlet is sufficiently large. An area of 24 square inches will supply the required amount at the rate of 5 feet per second. In cold weather, however, this speed could not be borne with comfort, so that efficient ventilation in cold weather is difficult to obtain unless the entering air is sufficiently warmed.

From the formula : $A \times v = V$ where $A =$ the sectional area of the inlet for air in square feet, $v =$ the velocity in feet per hour, and $V =$ the volume of air required per hour in cubic feet, the third quantity can be estimated if two are known.

Example :—In a room in which two people sleep, which has a cubic capacity of 2,000 feet, what area of inlet opening is required to give 3,000 cubic feet of fresh air per occupant per hour at 5 feet per second ?

$$A \times v = V \qquad \text{then } A = \frac{V}{v}$$

$$A = \frac{6{,}000 \text{ c.ft.}}{5 \times 60 \times 60} = \frac{1}{3} \text{ sq. ft.} = 48 \text{ sq. in.}$$

In an ordinary inlet it is usual to deduct one-fourth for friction.

The difference in temperature of the inside and outside air is not taken into consideration in the above formula, nor is the difference in level of the inlet and outlet openings.

In England, the temperature inside houses is almost always greater than the outside temperature ; the difference in the densities of hot and cold air thus allows natural ventilation to take place where inlet openings are placed below outlet openings. The velocity of the entering air can be calculated theoretically by using *Montgolfier's formula*, which makes use of the well-known law in dynamics which regulates the velocity of falling bodies.

The acceleration in the velocity of falling bodies is due to the action of gravity. This varies from the Equator to the Poles, being greater at the Poles, as the Poles are nearer the centre of the earth than the Equator.

For practical purposes the value of this force may be taken as 32 feet per second in the inhabited parts of the globe.

Then if V = the velocity in feet per second
and g = the acceleration due to gravity
and h = the height fallen in feet.

$$V^2 = 2gh$$
$$\therefore V = \sqrt{2gh}$$
$$\therefore V = \sqrt{64 \times h}$$
$$\therefore V = 8\sqrt{h}$$

In this case h = the difference in level of the inlet and outlet openings.

This must be multiplied by the difference in the inside and outside temperatures, and divided by 491, since the volume of air increases $\frac{1}{491}$ of its bulk for every increase in temperature of 1 degree Fahrenheit.

Montgolfier's formula therefore is :—

$$V = 8\sqrt{\frac{(h-h') \times (t-t')}{491}}$$

where h = height in feet of exit aperture from the ground;
h' = " " " entrance " " " " ;
t = temperature inside in degrees Fahrenheit;
t' = " outside " " "

An allowance of from $\frac{1}{4}$ to $\frac{1}{2}$ should be made for friction, but as it is difficult to tell with accuracy what allowance should be made for friction in different cases, this formula is not much used in practice, the actual velocity being measured by means of an anemometer.

Friction.—In the case of straight tubes for admitting air, the friction varies directly as the periphery, so that circular tubes, which contain a greater sectional area than any other shape with the same periphery, are the best. The friction varies directly with the length of the tube, so that ventilating tubes should be as short as possible.

In tubes of similar shape but unequal size, the loss by friction varies inversely as the diameter. If the tubes are dissimilar in shape, the loss of friction varies inversely as the square roots of these sectional areas.

The friction in bent tubes is much greater than in straight tubes, so all ventilating tubes should be as straight as possible. A right angle bend reduces the velocity of the current of air by one-half.

Natural Ventilation in the Tropics.—In the European text books on hygiene many methods of obtaining good natural ventilation are described, some of which are applicable to tropical climates, especially those which have a cold season. In the hot season in tropical climates it is usual in larger houses to try and exclude the external hot air during the day as much as possible by closing all doors and windows. These are opened at night, and left wide open till morning, to allow the vitiated air to be replaced by fresh air. In order that this system may not have a deleterious effect on the health of the occupants this should only be done in houses with very large rooms and few occupants. These rooms should have very high roofs, so that the vitiated air may accumulate there and not be breathed again by the occupants. The breathing of such air for several hours a day has, however, an undoubted effect on the health of the occupants, as it is not practicable to make the rooms large enough to supply the required amount of fresh air per occupant that is necessary. Another plan is to use a thermantidote, which supplies cooled fresh air mechanically to the interior of houses. Such air, however, has a very high degree of humidity, and is at such a low temperature when contrasted with the outside air, that passage from one to the other is liable to produce chills, pneumonia and rheumatism.

In such houses, moderate comfort can be attained by keeping the air constantly in motion by means of "punkhas", and by leaving the clerestory windows open to allow the vitiated air to escape. The inside temperature will still remain lower than the outside air, but will gradually rise during the day, owing to the influx of hot fresh air from outside from under doors and other small apertures.

The great mass of the inhabitants of tropical climates, however, live in small houses, and in the hot weather spend the day in open air in the shade of trees or in verandahs, and the night on the roofs of the houses.

In rainy weather, however, they sleep in their houses, and even if the doors and windows, if any, are open, there is often serious over-crowding produced; their health is adversely affected, and the spread of contagious and respiratory diseases is facilitated.

Also, owing to the prevalence of house-breaking, the doors and windows of houses, both in villages and towns, are usually kept closed all night, whether the inhabitants are sleeping in them or not; and, if they are, the vitiation of the atmosphere is very great. All houses should, therefore, have some efficient system of ventilation to allow of the doors being closed without causing a stoppage of ventilation.

In the tropics in the hot season some of the systems described in European text books (fig. 12) are of very little use.

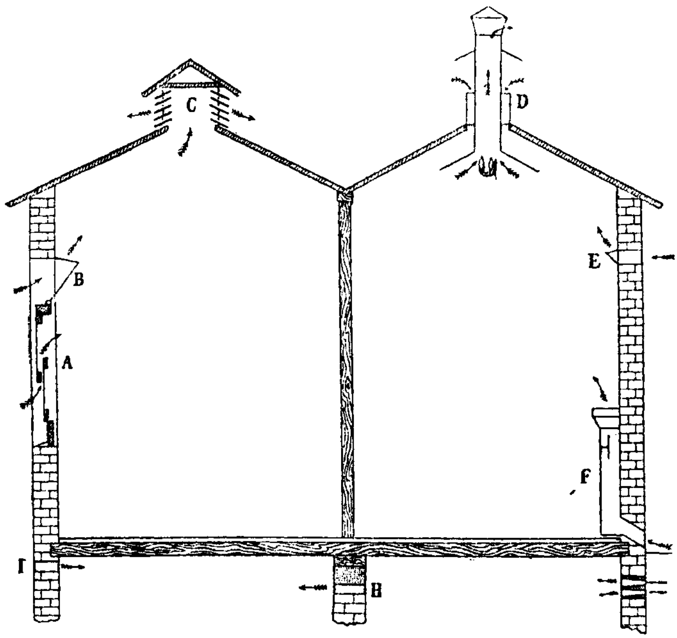


FIG. 12.—DIAGRAMMATIC SKETCH OF VARIOUS PROVISIONS FOR VENTILATION.

A, Sash window with Hinckes-Bird's arrangement. B, Hopper sash-light falling inwards. C, Louvred outlets. D, Mackinnel's ventilator. E, Sheringham's Valve. F, Tobin's Tube (showing valve open). G, Ellison's Conical Bricks. H, and I, Grid ventilators below floor joists.

(*Parkes* & *Kenwood's Hygiene* & *Public Health*).

Hinckes-Bird's system, which requires windows with upper and lower sashes, is inapplicable, as such windows are not in use in the tropics.

Cooper's ventilator, in which a number of holes are arranged in a circle in a window pane, which can be closed or partially closed by turning a circular plate superimposed over them with a similar aperture, is not to be recommended for introduction in the houses of the lower classes in the tropics, as it would probably only act as a ventilator in cold weather, when the inside temperature was greater than the outside, which does not often occur in the tropics. For the same reason, such systems as Sheringham's valve, Tobin's tube, and Ellison's bricks would also be inapplicable.

The best system for houses in the tropics are *louvred* outlets near the roof, with or without *louvred* inlets, at a height of about one to three feet from the floor. These will allow of a continuous flow of fresh air and the escape of vitiated air. Mackinnel's ventilator would also be useful in one-storey houses. It consists of two tubes one inside the other, carried through the roof of the building. The inner one, which is for the escape of foul air, projects outside above the outer, and inside it projects below it. At its lower end it has a broad circular flange which deflects the entering outer air and causes it to spread laterally in the room. It should be protected on the outside by a cowl. Often the action of the two tubes is reversed. In the absence of louvres, clerestory windows of sufficient size should always be present.

Ventilation by the flues of fireplaces is made use of in colder weather, but in the tropics generally rooms are not provided with fireplaces.

Artificial Ventilation.—This means of ventilation is only used in most countries to ensure a supply of fresh air to large buildings occupied by large numbers of people at a time, such as halls, theatres, school rooms, school dormitories, lecture rooms, factories, workshops and mines.

Mines and large buildings may be ventilated by connecting all the exit apertures from the various parts of the mine or building with the bottom of an extraction shaft in which a fire is kept constantly burning. This, by causing the heated air in the shaft to rise rapidly, causes a partial vacuum which aids the extraction of foul air from the areas connected with it by tubes. If such tubes, however, are long, narrow, and tortuous, such action is almost completely neutralized by friction. The tubes, therefore, connecting the exits with the extraction shaft should be as short, wide and straight as possible.

In mines there is usually an upcast and a downcast shaft, and the air is propelled by fans working at a high rate down the downcast shaft, and made to pass through all the galleries of the mine before it escapes by the upcast shaft. If the building provided with an extraction shaft is provided with a system of heating by steam or hot water pipes, these may be used to heat the column of air in the extraction shaft. Few buildings in the tropics, however, need artificial heating of this kind.

This extraction shaft method of ventilation is not to be recommended for introduction in the tropics, as any method in which a large furnace requires to be maintained in the building is undesirable in hot climates.

The method of placing extractor fans driven by an engine, revolving at a high rate, in the upper corners of large halls occupied by a large number of people, is much to be preferred, as this removes efficiently the vitiated air which has risen to the ceiling; the fresh air rushes in through apertures placed low in the hall, such as louvres, to replace the partial vacuum caused. This is known as the *Vacuum System* and is to be recommended for use in all halls and large rooms in which no special treatment of the entering air is considered essential.

The converse of this system is known as the *plenum* system.

In this system the air is propelled into the building by rotary fans, such as the Blackman Air Propeller, driven by gas, steam, oil or electric engines. The air thus propelled is allowed to find its way out by any of the numbers of apertures by which the average room is connected with the external air. In this system all windows and doors must be kept closed, the air is admitted by special shafts connected with the propelling fans, and the air can be purified, heated or cooled at will before admitting it, or its humidity can be raised or lowered.

This system is specially recommended for hospitals in which an equable temperature is required and pure air is essential. It has also been recommended for school class rooms to overcome the difficulties which are met with in efficiently ventilating this class of building. This matter will be dealt with in the chapter on School Hygiene. It is, however, a bad object lesson for scholars on whose minds it is desired to impress the value of light and air to see all the windows of their school class rooms closed.

A system in which a combination of the *vacuum* and *plenum* systems is used is known as the *balance* system, and this probably is the best system for large halls which may be occupied by large numbers of people at a time and in which there is no objection to keeping the windows closed.

This system is to be strongly recommended for use in the tropics in large halls and hospitals, especially in hot weather.

The entering pure air can be collected and cooled by passing through "tatties" kept constantly moist; the excess moisture can be removed by passing the air through calcium chloride, sulphuric acid, or other absorbents of moisture and admitted to the room at the desired temperature and humidity, thus conducing greatly to the comfort of the occupants of the building. The introduction of such a system in large hospitals would be a great boon to the patients and would greatly assist their restoration to health. In large factories and mills and offices it would undoubtedly add to the efficiency of the workers during the hot season.

An objection which has been raised to the plenum system in England is that air that has travelled through long shafts is likely to cause lassitude among those breathing it.

The purity of such air is undoubted, but it is possible that the unknown vitalizing principle that is characteristic of fresh air is diminished.

PRACTICAL APPLICATION OF THE PRINCIPLES OF VENTILATION.

In order to apply the above-mentioned principles the cubic space of the room must be ascertained.

The following rules will be of use in calculating cubic space :—

Area of circle	=	πr^2.
Circumference of circle	=	$2\pi r$.
Area of ellipse	=	product of the 2 diameters × ·7854.
Circumference of ellipse	=	half sum of two diameters × π.
Area of triangle	=	base × ½ height.
Cubic capacity of cube	=	length × height × breadth.
Cubic capacity of solid triangle	=	area of base × height.
Cubic capacity of cylinder	=	area of base × height.
Cubic capacity of dome	=	area of base × ⅔ height.
π	=	3·1416 or roughly $\frac{22}{7}$

In calculating the cubic capacity of a room, it is usual to deduct 3 cubic feet for each occupant, and 10 cubic feet for each bed with occupant. The cubic capacity of bulky objects in the room are measured and their cubic capacity deducted from the total.

The areas of inlet and exit of air should be measured and the rate of influx of air taken by the anemometer. This rate should not be taken while a wind is blowing directly on the aperture of inlet.

It is not possible in a room ventilated by natural ventilation to estimate the total quantity of entering air, as air enters a room by every minute crevice and aperture. It is best, therefore, to estimate the amount of air leaving a room, as it usually does so by channels in which its rate can be observed. Such channels, in the absence of a fire or fireplace will, in the tropics, usually be a roof ventilator, or a clerestory window.

The following are the chief points to which attention must be directed in examining a scheme of ventilation :—

1. Hot air rises and cold air falls in a room.
2. The provision of exits for foul air is of supreme importance; inlets are not so important, as fresh air can enter through many crevices and apertures under doors, etc.
3. The inlet provisions should total 24 square inches for each person, and should be larger than the outlet provided.
4. Inlets should be low in the rooms, and outlets high. In the tropics in hot weather the entering air is hotter than the inside air and tends to rise, so that the occupants breathe the vitiated cool air over and over again, till the temperature of the vitiated air rises above that of the entering air. The entering air, therefore, should be projected downwards, or the inlet be placed very low in the room. An exhaust fan at the outlet is an additional advantage in the tropics even in small rooms. The tendency of the fresh entering air to take the nearest route to the exit should be prevented by every possible means.
5. 250 cubic feet per head is the least space in which anything like satisfactory ventilation can be maintained by natural means.

6. Rooms should not be ventilated by openings from other rooms, but by openings communicating direct with the outer air.
7. Through ventilation of houses by perflation of wind should be possible, so that the air of a house can be thoroughly purified at frequent intervals.
8. In rooms not provided with a chimney there must always be an exit aperture for foul air high in the room, and if fires for cooking are to be lit, the provision of a suitable chimney should be insisted on.
9. In factories or workshops a minimum of 400 cubic feet per occupant should be insisted on, and where injurious gases or dust are produced, artificial ventilation is absolutely necessary to quickly remove them.
10. The above minimum is also essential in rooms which are slept in, and should be insisted on for lodging houses.

If the plenum system of ventilation be established in a large building the source of the air and the temperature of the incoming air should be carefully considered. In hot countries it is not desirable to have the temperature of the inside air much lower than the outside from the health point of view. In parts of the tropics, like Ceylon, Bombay, Singapore and the West Indies, where the temperature varies between 80° and 90°F., and the air has a high degree of humidity, it would be sufficient to dry the air and lower its temperature about 5 to 10 degrees inside the hall, office, or hospital. In cases where the air outside has a high temperature between 100° and 115°F., and a low degree of humidity, the dry air could be lowered to a temperature of 80°F. without causing any ill effects, as long as it remains dry.

Warming.—The different methods employed for warming rooms in European countries, as described in text books, are scarcely ever employed in India and hence we do not propose to deal with them in a volume of this character. It may be mentioned that in this country wood fires are used for the purpose of warming when it is found necessary.

Lighting.—The principal agents in use for lighting in this country are certain oils and electricity, whereas in European countries other illuminants such as coal gas, water gas, etc., are also used. Oil lamps are largely in use in nearly every Indian town and are found to be fairly satisfactory. They, however, raise the temperature and produce Co_2 and watery vapour. The cheap impure kerosine oils, as sold in small Indian towns give off unburnt carbon in the form of soot, which is a source of great nuisance. Country mustard oil is also used in many Indian households for lighting purposes.

The chief effects of the burning of coal gas are an increase in the amount of CO_2 and watery vapour in the air of the room and a raising of its temperature with the production of sulphurous acid and of other bye-products of combustion. Roughly, one cubic foot of coal gas vitiates the atmosphere to the same extent as one adult. Welsbach mantle burners are largely used for increasing the luminosity of the gas.

Electricity, which is being introduced gradually in most large towns in India for the purpose of lighting, may be regarded as the most hygienic for the reason that no oxygen is consumed, and there is no production of CO_2 or moisture to render the air impure.

CHAPTER IV

The Disposal of Refuse

THE REMOVAL OF STREET AND DOMESTIC REFUSE

Owing to the greater warmth in the tropics, the organic matter in refuse undergoes much more rapid putrefaction and fermentation than in temperate climates. The amount of rotting vegetable refuse is usually considerable in tropical countries, where the population are for the most part vegetarians.

It is essential, therefore, that this refuse should be removed at more frequent intervals than in temperate climates or a serious nuisance would ensue. Such refuse does not as a rule contain as many used tins, broken crockery and glass as in Europe, as crockery and glass are very little used, and tins are made use of by the inhabitants and not thrown away. It usually consists of ashes, rotting vegetable material, such as fruit skins and stones, the waste from maize, sugarcane, rice, etc., stable manure, paper, organic and other street sweepings.

In Calcutta 2,000 tons of street and domestic refuse used to be removed daily in over 1,000 carts. These have now been almost entirely replaced by motor rubbish trucks, which have been found to be more efficient and more economical than bullock carts. They have also been introduced in Bombay and one or two other large towns and it is to be hoped that their use will extend to all large towns in India. The system of daily removal is best for tropical countries to prevent nuisance. In some places the refuse is allowed to lie for days and weeks either in heaps at street corners or in old circular brick dust-bins. In these heaps flies lay their eggs and eventually millions of adults breed out. In warm countries the time that elapses between the laying of the egg and the emerging of the adult fly can be as short as 8 days, so that in all cases refuse should be removed at least once a week. The refuse should be collected from the streets and houses daily by hand labour and stored in removable corrugated or galvanized iron dust-bins (fig. 13).

Experience will teach the authorities how many dust-bins are required to remove the whole of the refuse daily, and how many are required in each quarter of the area. These bins should be emptied preferably during the night, and the refuse removed in rubbish carts. The bins should be light enough to be lifted by the driver of the rubbish cart and one other man and the contents emptied into the rubbish cart. A better plan still is to provide flat carts and take the full receptacles bodily away to the place of disposal, from whence they can be returned after emptying and cleaning. This does away with the nuisance often caused by emptying a dust-bin full of foul matters into a rubbish cart. Another plan is to have carts of smaller size, which stand in the area as bins and remove them at night. They are wheeled away by hand, and this may be done by the scavenger of the area at the end of his

Fig. 13.—Galvanized corrugated dust-bin.

day's work. All rubbish carts should have close fitting lids (fig. 14).

Methods of Disposal.— It has been the custom for many years both in Europe and the tropics to dispose of refuse of this description by tipping it in certain places set aside for the purpose, such as pits and depressions in the ground which it is desirable to fill up. In India this is being done in many towns at present. There is no doubt that this is a most objectionable method of disposal ; it causes a nuisance owing to the putrefaction of the organic matters over a large area, and forms an enormous breeding ground for flies, so that a town which disposes of its refuse in this way may swarm with flies in spite of having a well run system of

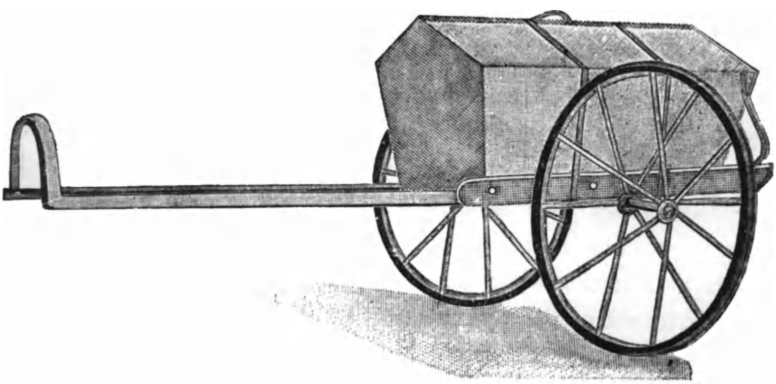


Fig. 14.—Covered Cart for carrying refuse, fitted with Hinged Lids, opening from centre.
—(*Empire Engineering Co.*).

scavenging. In flat countries where most of the houses are built of brick and where holes have been dug indiscriminately to provide the material to make bricks, it is a great temptation to use the street refuse to fill these depressions up to surface level. It is very desirable to get rid of these useless depressions, which in rainy weather fill with water and form ideal breeding grounds for mosquitos. It is questionable, however, if the means is justified by the end. If the refuse is trenched in these depressions at some depth and layers of fresh earth thus cover the garbage, it is probable that very little nuisance is caused, if the operation is properly carried out under constant supervision, and this plan may be used in towns where it is especially desirable to get rid of insanitary depressions, and where there is no available earth to fill the depressions with.

The best method of disposal is cremation, and except in the above-mentioned cases, the proper cremation of street refuse should be introduced into towns and cities in the tropics. The material collected is easily combustible in dry weather, but in wet weather it is almost impossible to get it to burn without fuel and a forced draught.

In large towns some type of destructor with a forced draught such as the Horsfall, Beaman and Deas, etc., should be put in use and all the rubbish cremated daily. The cinders and ashes which would result can be used for filling up depressions. The fumes produced in the process of combustion should be cremated in a fume cremator. Such a destructor can be established in the middle of the town without causing a nuisance and save a large amount of labour in carting the rubbish long distances to tipping pits outside the inhabited area.

In high temperature destructors, a temperature of 2,000°F. is attainable. In slow combustion or low temperature destructors, fume cremators are necessary, whereas in the high temperature type they can be dispensed with. 6 to 16 tons of refuse can be disposed of in this way per cell of the destructor in a day, the amount varying with the type of refuse and destructor. It is estimated that in England a high temperature destructor of 10 cells will dispose of all the refuse in a town of 100,000 inhabitants.

The cost of erection before the war was about £500 per cell and the cost of cremation 9d. to 2s. 6d. a ton. It is

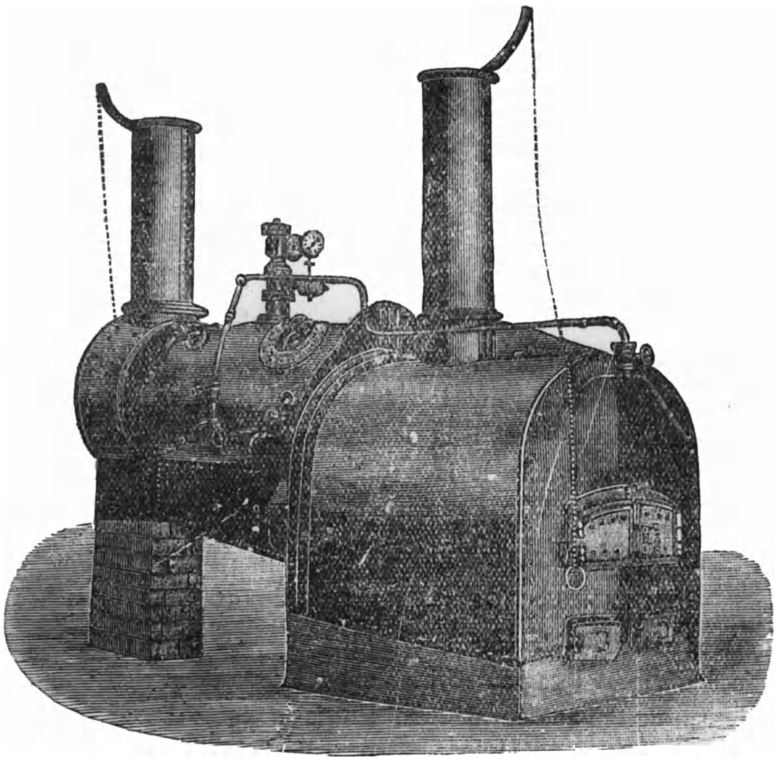


Fig. 15.—"Horsfall" Destructor "Self-Contained" or "Portable" Type.

probable that at present prices, the cost of erection will be doubled. In India it will probably be found that both the initial cost and the recurring expenditure will be much less owing to labour and material being cheaper here. A portable type of Horsfall destructor is shown in fig. 15.

In smaller towns, ordinary small incinerators without fuel or forced draught are quite satisfactory in dry weather, but they must be placed outside the inhabited area as the fumes and unconsumed gases often cause a nuisance. In wet weather fuel must be supplied to burn the refuse. In many places sheds are provided near the incinerators in which to store garbage till it is dry during the rainy season.

An excellent pattern of small incinerator has been recently designed by the Superintending Engineer, Public Health Department, United Provinces, which is capable of burning about 1 ton of street rubbish daily together with the night-soil of 500 to 700 people, should it be deemed necessary to consume the latter also. Its present cost of erection is about Rs. 500. No fuel is required in dry weather. (See App. III—i-iv).

Experience has shown that such garbage dries very slowly unless spread out over a large area and that it causes a nuisance especially in windy weather. If it is not spread out to dry, flies breed in it before it is dry enough to burn. On the whole it is perhaps better that this refuse should be trenched in depressions, in the case of small communities which cannot afford a proper destructor.

THE AMOUNT OF REFUSE TO BE COLLECTED.

Reduction.—Having supplied an efficient method of refuse disposal local authorities should devote their attention to lessening the amount of rubbish to be collected and facilitating its collection.

The amount can be lessened by reducing to a minimum the wear and tear of roads, as in the surface cleaning of bad roads large amounts of dust have to be collected as well as garbage.

In towns with badly constructed roads more labour is required to keep them clean than in towns with well-laid roads of good surface.

In dry weather the accumulation of dust in towns, in the tropics, which flies about in windy weather, is very great. This dust contains quantities of bacteria, both pathogenic and non-pathogenic, and pulverised organic matter of fæcal origin. In most towns in the tropics at present the best laid roads are water-bound macadamised roads, and in dry weather a large number of water-carts have to be kept up in order to keep the dust down to any reasonable extent. In many towns in England the dust-nuisance has been almost completely abolished by laying the roads with tar. There are many systems of doing this advertised, and it is found in most of them that, although the initial expenditure in laying the road is much higher, the life of the road is much longer.

In large towns like Bombay and Calcutta some roads are laid with asphalt which makes an excellent and easily cleaned surface. In Calcutta the oiling of roads with crude oils has been tried, but not with much success. It was also tried in Allahabad, but did not give a lastingly good surface Tar-macadam, in which the road metal is laid in tar, each piece of metal being immersed in the tar, gives much better results and ensures a strong lasting surface. The difficulty in India is to obtain tar as there are very few gas works.

The dust-nuisance in large towns is so productive of disease that it will be absolutely necessary to manufacture tar for use on roads, especially in view of the fact that motor transport is very rapidly replacing the bullock cart in all large towns. In the absence of tar-macadam, local bodies should endeavour to keep their roads in constant repair with a good surface, and water them frequently in dry weather.

For side and back lanes which are used for foot traffic only, nothing is better than properly laid brick on edge and many local bodies are laying this in a certain number of such lanes annually.

In Lucknow, large numbers of back lanes have recently been paved with concrete slabs under the direction of Messrs Lane Brown and Hewlett. This material is very durable, and can be laid at a cheaper rate than brick on edge. It is also used for making pavements and has a clean and neat appearance. It is the duty of medical officers of health and sanitarians to draw the attention of local bodies to the necessity of making adequate financial provision for the upkeep of roads in view of the fact that flying dust is responsible for the spread of many diseases. The saving of labour in scavenging and maintenance will adequately compensate them for extra initial expenditure.

Local bodies should also institute byelaws to prevent occupiers of shops and houses throwing domestic refuse into the streets. Domestic refuse should be collected by the occupiers and put in a proper receptacle from which it can be emptied into the street dust-bins for removal. In most Indian towns there are no regulations on this subject so that the labour of collection is greatly increased. The storage of domestic refuse on premises in the inhabited area, which is often done in order that the rotting vegetable and animal matter may be used for manuring fields, should be prohibited.

Byelaws are also required to regulate the width of iron tyres on carts. The thin iron tyre seen on many "ekkas" in India is admirably constructed to tear a water-bound macadam road to pieces in a very short time. No bullock cart should have an iron tyre less than 3 inches in width and no horse-drawn vehicle of any sort should have a tyre less than 2 inches.

The *staff* employed on surface sweeping and the collection and removal of refuse is usually inadequate in Indian towns. A standard for guidance is suggested in App. IV. The conditions vary greatly in different towns, but the local authority should divide the whole area to be kept clean into plots of such a size that each plot can be kept properly clean by one sweeper and in each plot there should be a dust-bin. For each 10 plots there should be a mate, whose duty it would be to see that each sweeper is attending to his work.

The number of refuse carts should be sufficient to remove and empty all the dust-bins once daily.

In most towns in India, the system of employing part-time sweepers in municipal work still exists. These sweepers are known as hereditary or customary sweepers, who in many cases have a legal right to the refuse and night-soil collected and who dispose of these materials in a manner prejudicial to the public health of the community. Every endeavour should be made in towns to replace these men by wholetime employees for the public service.

Collection and Disposal of Refuse in Villages.—In villages in which there is no local taxation and no scavenging staff, the problem of maintaining a reasonable degree of surface cleanliness is difficult. In Indian villages, refuse heaps and manure heaps abound all over the inhabited area, on the side of roads, on waste land, and within the premises of the houses. There are no laws regulating this practice, and in many small towns it is customary to store manure on private premises for agricultural purposes.

This practice encourages the breeding of flies to an enormous extent, and as flies are known carriers of cholera, enteric fever, and many other diseases, owing to their habit of feeding both on infected dejecta and on food exposed for sale, the hands of sanitary officers are tied in this respect in endeavouring to stop epidemic outbreaks of cholera.

Even if the water supply channel of infection has been eliminated, dropping cases of cholera continue from time to time and the infection in these cases is undoubtedly fly-borne.

This problem of the cleanliness of village areas will have to be solved before we can hope to bring epidemic outbreaks of cholera to a rapid end, and reduce the death rate from other fly-borne diseases.

Flies have been proved to carry on their legs and bodies, in addition to those above mentioned, such bacteria as staphylococci, streptococci, B. dysenteriæ, B. mesentericus, B. coli and the amæbæ of dysentery. They also carry the eggs of many of the parasitic worms.

Much of the ophthalmia and trachoma so prevalent among Indian children is undoubtedly due to flies, and there is substantial evidence to show that diarrhœa and other disorders of the intestinal tract are due to infections carried by the same agency.

The infantile death rate in most tropical areas is very high, being more than double that of England, and much of this high rate is caused by intestinal disorders.

Tetanus and sepsis are often introduced by the entrance of the organisms into wounds and abrasions in flying dust, and by way of the umbilical cord at birth.

CHAPTER V

DISPOSAL OF EXCRETA—CONSERVANCY.

The proper collection, removal and disposal of human excreta is most important from the public health point of view.

There are two main methods employed to effect this, viz., the *dry system* of collection or *conservancy* and the *water-carriage system.*

The Dry System or Conservancy.—This system is in almost universal use in the tropics except in some of the very largest towns where the water-carriage system has been introduced to deal with the removal of excreta in part or the whole of the inhabited area. In India the water-carriage system has been introduced and is being gradually extended in many towns, but in no town in this country is this system alone employed for the disposal of excreta.

Quantity of Excreta Per Head—In the tropics where the majority of the inhabitants are vegetarians the amount of solids to be removed is greater than in meat-eating countries, and may be put down as 7 oz. per head of the population in 24 hours. The amount of urine excreted is less than in temperate climates as much more fluid is lost by way of the skin.

Most of the inhabitants, however, use water for cleaning or "abdust" purposes and this adds about 10 to 12 oz. to the quantity of fluids to be disposed of, so that a total of about 60 oz. per head has to be dealt with. This represents roughly half a gallon of mixed excreta per head of the population.

Domestic Conveniences.—In towns, most of the better class of Indian houses have some sort of privy, which the inmates of the house use for the purposes of nature, but the large majority of the houses of the poorer classes have none.

Even in the better class houses the arrangements are very primitive. They usually consist of a small room in which there may or may not be one or more earthenware dishes into which the inmates defæcate, the urine is usually allowed to soak into the ground, or if the floor of the privy is of impermeable material, it drains into the nearest surface drain, or into a receptacle from which it is occasionally removed by the house sweeper. The sweeper sometimes removes the excreta to receptacles in the nearest public latrine in some kind of vessel or disposes of it to agriculturalists for the purpose of manure. In some towns the excreta is periodically removed by the municipal sweepers.

In upper storey houses, the fæces and urine fall down a shaft to the ground floor in which there may be a bucket. This arrangement is called a "sandas" and the walls of the shaft get into an indescribable state of filth, as does the chamber at the bottom. It is periodically "cleaned" by the domestic sweeper and disposed of. This state of affairs is exceedingly primitive and most objectionable ; the stench from these sandases is sometimes the cause of a serious nuisance. As stated elsewhere, these domestic sweepers have sometimes hereditary rights and are the legal owners of the excreta from the houses they attend.

The local authorities are particularly careful to preserve the "rights" of these individuals and any suggestions that the supervision and removal of excreta from the houses should be undertaken by the local authorities are met with the answer that these rights must not be interfered with.

In practice, however, in several towns where the matter has been taken up, it is found that these individuals are only too willing to accept a monthly wage as public sweepers in return for the surrender of their rights.

In any case no condemnation can be too strong for any local authority which permits this most objectionable state of affairs to continue.

In all areas in which there is local taxation, the collection and removal of excreta and refuse both from houses and public conveniences must be under the control of the local authority in order to be at all satisfactory or efficient.

It will probably be necessary to impose a conservancy tax in most places in order that this may be efficiently carried out, but the whole cost can be covered by a very small tax, which even the poorest, living in houses with private conveniences, can afford to pay. For the very poor, public latrines are already provided.

The floors of all these conveniences should be made impermeable, and a proper receptacle provided for the reception of fæces. In each, there should be some dry earth with which the fæces can be covered. The floor of this privy should be sloped so that the urine will flow directly into a receptacle, which should be removed at fixed intervals. The "sandas" should be absolutely abolished. The floors of these privies should be flushed daily with water, and the use of some disinfectant is also advisable, if the inhabitants can be prevailed upon to use it.

A good disinfecting powder, such as carbolic acid powder, in which lime is not the vehicle, will probably suffice as such a powder is a good deodorant. Disinfection cannot be obtained in this way.

In each privy there should be an air-tight receptacle for the storage of the solids and the municipal carts should call daily to remove the excreta, or the receptacles for the storage of the excreta should be removed to the nearest public latrine and disposed of there as soon as possible by the sweeper.

In towns with an efficiently flushed system of surface drainage with which all tax-paying communities should be provided, the urine may be allowed to flow into the surface drains, but only if these are *efficiently flushed* at frequent intervals. In better class houses sitting places with a pail placed underneath should be put into use instead of the earthenware dish. In any case a dish of metal of about 15 inches diameter is much better than one of earthenware as it can be cleaned much easier.

A cheap house privy is shown in figure 16.

Even with every precaution and stringent supervision house conservancy is bound to be unsatisfactory in India in the absence of a water flush system.

Public Latrines and Urinals.—In most towns one or more types of public latrines and urinals have been erected for the use of the poorer classes and many of the types in common use are most unsatisfactory. In some types the urine, "abdust" water and fæces are received in the same receptacle and in others the solids and liquids are separated and removed separately.

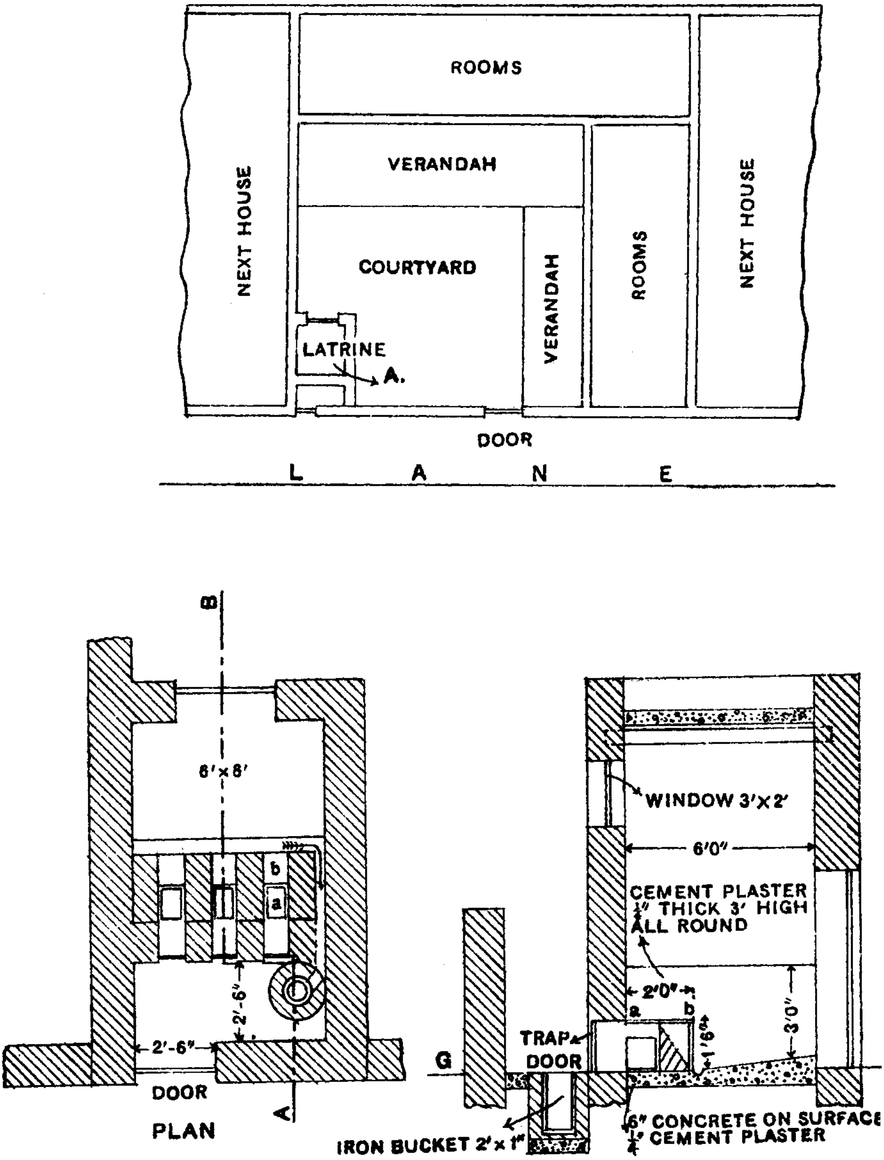
The following are some of the requirements of a good latrine :—

1. It should be raised on a plinth of masonry at least 6 inches but preferably 1 foot above the surface of the ground and should be properly sloped from the centre to the edges of the platform.

2. The edge of the platform should have a drain with a raised outer wall so that when washed, the washings will not overflow and soak into the ground round the latrine but can be conducted to an effluent drain or to a receptacle for disposal.

3. The latrine should have a roof to protect users from rain in wet weather.

PLAN OF HOUSE



DETAIL OF PLAN OF PRIVY AT A. SECTION ON A. B.

Fig. 16.—DESIGN OF A CHEAP (KADAMCHA) TYPE OF PRIVY

SCALE OF FEET.

FEET 5 0 5 10 15 20 FEET

Photo. Zinco., February, 1925.—No. 1211-7

4. The latrine should be thoroughly ventilated.

5. The receptacles should be easy of access for removal and for cleansing purposes.

6. The washings and urine should not drain into a receptacle the contents of which have to be subsequently bailed out for removal.

7. The attendant should be provided with a suitable disinfecting solution for constant use.

8. It should be provided with air-tight receptacles for the storage of excreta, pending their removal from the latrine.

9. Clean water should be available near the latrine for ablution purposes and for the cleaning of the receptacles after use.

10. In all latrines, receptacles for the reception of the solids must be provided.

Many patterns of latrines answer most of these requirements. These may be of corrugated iron, such as the Horbury (fig. 17), or Donaldson pattern, or of masonry. A good pattern of latrine is a masonry latrine with boundary walls of fenestrated brickwork to allow of free ventilation and with the Donaldson system of seating (fig. 18). The seats are raised from the ground and the solids are received into a pan or pail while the urine drains into a common drain connecting a row of seats. At the end of the row it is received into a receptacle into which it drains over a spout. There are seats on each side with a passage up the middle for the attendant. The solids are removed from the receptacles under the seats and stored in an air-tight receptacle for removal. In App. V is illustrated an excellent type of public latrine recently designed by the Superintending Engineer, Public Health Department, United Provinces, from sketches supplied by us.

Urinals.—Urinals should be provided at convenient places in the inhabited area. A type in use in the United Provinces, called the "Hardwar Pattern", is very efficient

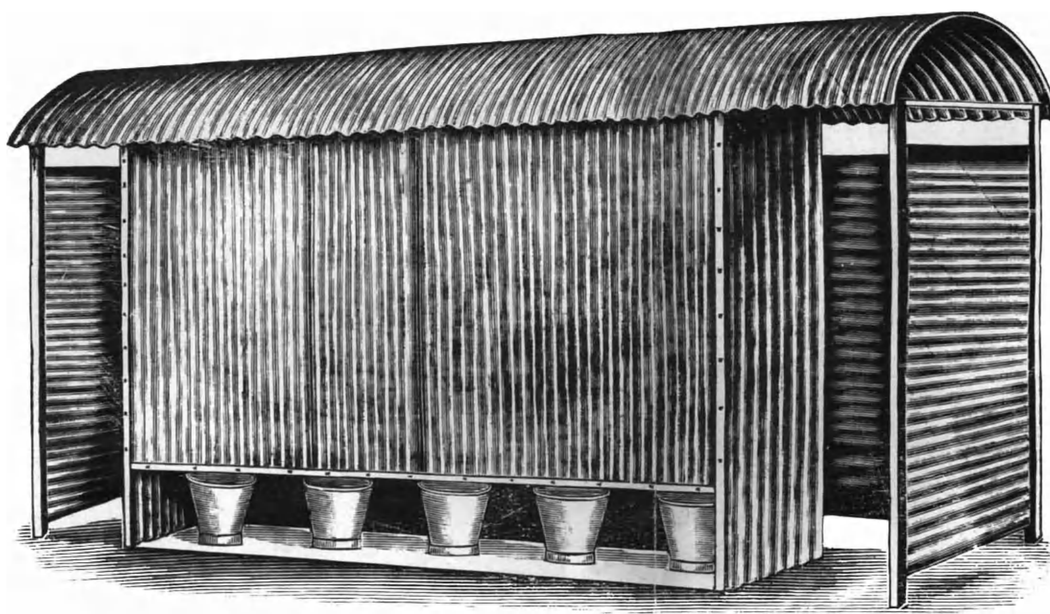
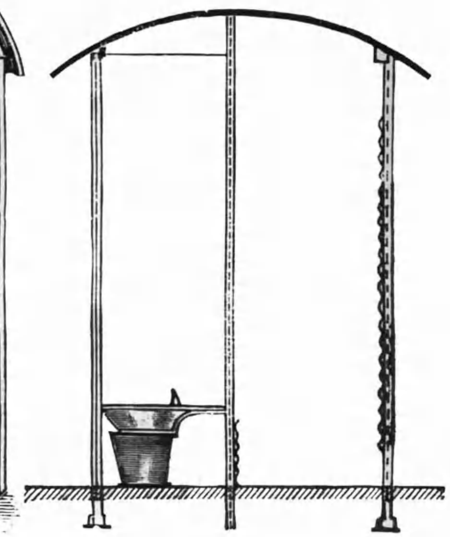


Fig. 17.—HORBURY PATTERN—Combined System.



SECTION.

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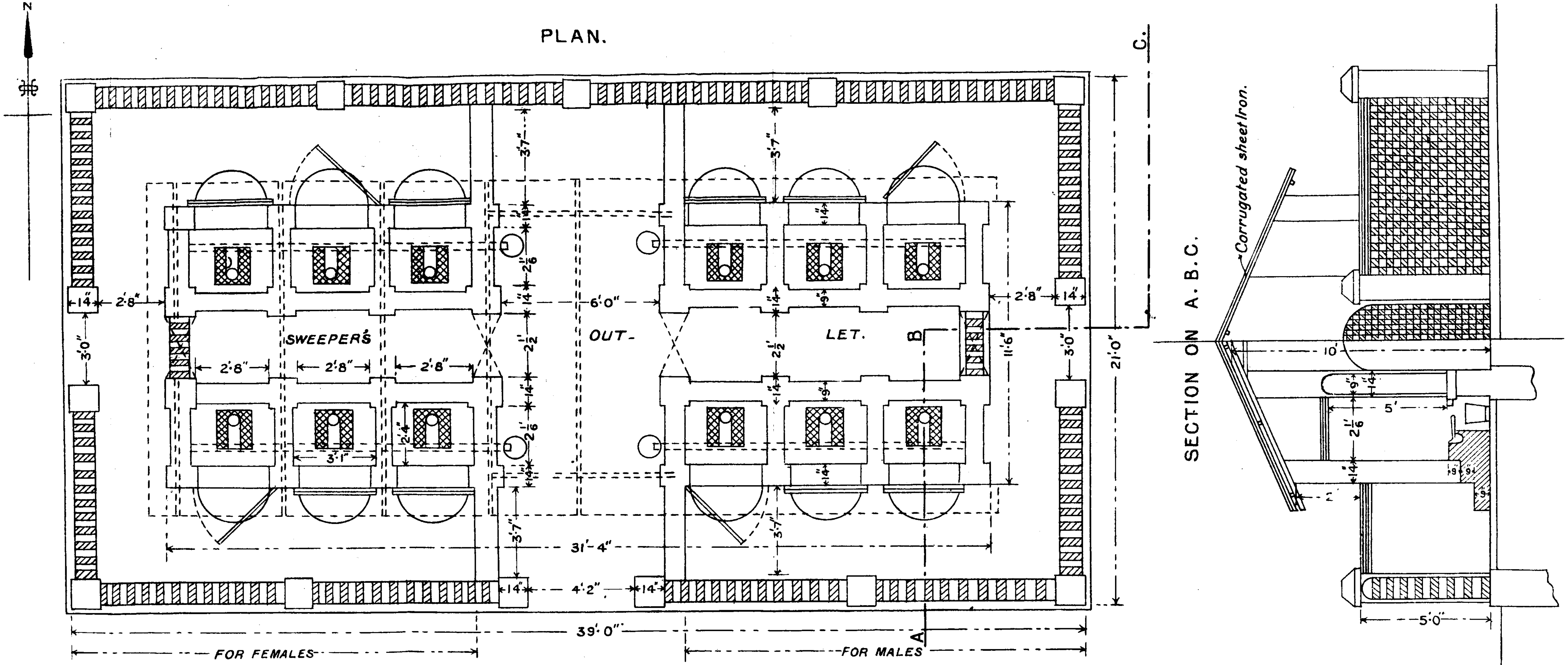


Note:— Doors and partitions are not usually required by females, but may be added if desired.

Fig. 18.—TYPE PLAN
OF
A SEPARATE SYSTEM OF LATRINE
WITH HONEY-COMB BRICK WALLS & DONALDSON'S SEATS

(fig. 19). The urine from each seat drains into a common receptacle or into a well flushed surface drain.

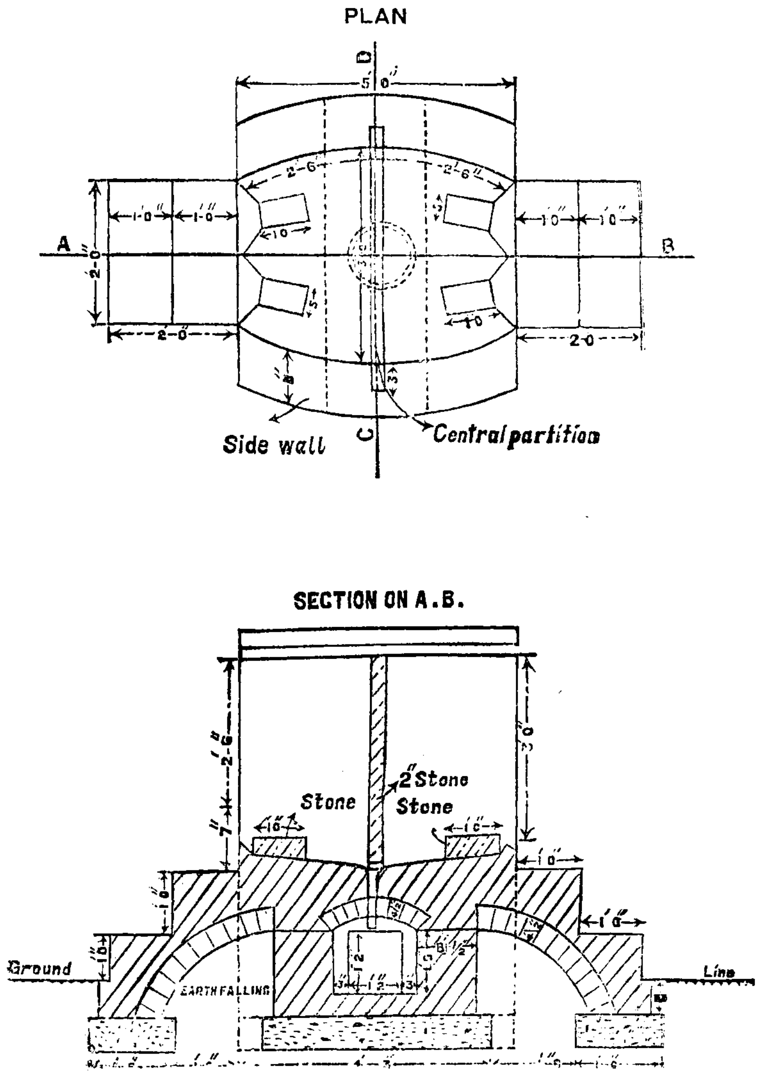


Fig. 19.—FLAN OF MALE URINAL

(Cheap Type)

Masonry latrines and urinals are to be preferred to iron ones as in the latter the seats have to be tarred and they cannot be kept as clean as masonry latrines. The latter can be thoroughly cleaned with water and disinfected with 1-500 perchloride of mercury which cannot be used in the case of iron latrines as it corrodes the iron.

Single Donaldson pattern seats would be excellent to instal in domestic privies if local bodies would insist on their adoption.

When masonry latrine seats are to be constructed the materials should be carefully selected. The best material is polished marble, but this is expensive and can only be expected to be used in the best houses.

Enamelled bricks are cheaper and should be used for the walls inside the latrines; the seats themselves should be of glazed stoneware or the Indian patent stone and the "kadamchas" or pedestals for the feet of the same material but grooved so that a firm hold is provided for the users' feet. If the latrine seats are of iron, the parts on which the urine falls should be of enamelled iron and the foot rests grooved. Polished wooden seats are only used by Europeans and are not recommended for the use of Indians.

Temporary Latrines.—When large numbers of people congregate together for festivals during pilgrimages, temporary latrines have to be provided in large numbers.

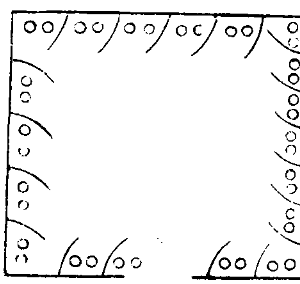


Fig. 20.—Courtyard latrine for males

Types of temporary public latrines for use at fairs in India. They are generally of one of the following patterns:—

(A) The courtyard type (fig. 20). In this a courtyard is formed by enclosing a square area by a wall of matting about 5 feet in height.

For males separate small enclosures are constructed round the walls by the use of pieces of matting curved in the form of a segment of a circle. Within these enclosures dry earth with or without receptacles is used for the reception of excreta. For females the courtyard contains no separate compartments, it is simply an empty square surrounded by matting walls. The excreta have to be removed by sweepers and buried in trenches at some suitable place.

(B) A second common type (fig. 21) consists of a double row of compartments containing separate seats. On each

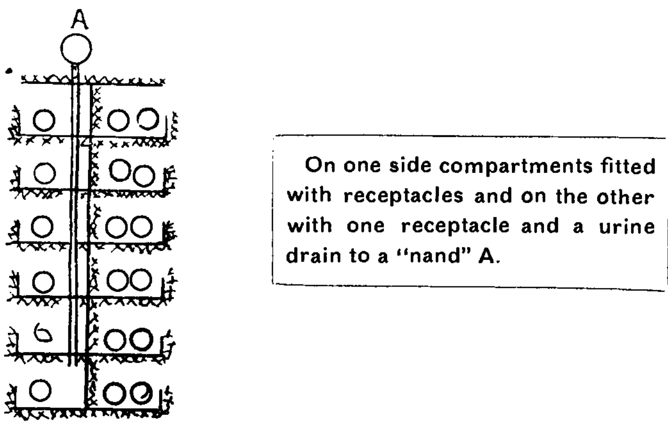


Fig. 21.—Another type of temporary latrine with earthen receptacles.

side of a central wall small separate compartments are formed by putting up at regular intervals pieces of matting at right angles to the central wall. Each compartment is made private by erecting another piece of matting parallel to the central wall. Each compartment thus forms with the next compartment a rectangle. Inside each compartment are placed either two vessels, one for solids and one for liquids, or one vessel and a drain for the urine. This drain runs the length of the latrine and empties into a "nand" or cess-pool at the end. In this type of latrine, as in the courtyard type, the excreta have to be carried away and buried in trenches elsewhere.

(C) A third variety is the one largely used for temporary latrines by the railways (fig. 22).

It consists of two mat screens between which is placed a row of mud or brick seats. Each seat is provided with an iron pan or two vessels. If the latrine is for males each seat is separated from the next by a matting wall. In this type of latrine as in the two former, excreta and urine have to be carted or carried to the trenching grounds. This is a great drawback to the construction of these latrines. It will be found a practical impossibility to cart or carry away, even with a large sweeper staff, all the filth in a fair say, of about 5 lakhs of pilgrims. If they are to be kept clean and in good order it is necessary to build some kind of latrine whence the actual removal of the excreta will not be required. The essential feature of such a latrine (fig. 23) is that the excreta are deposited directly into a trench

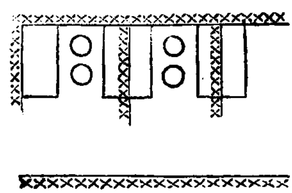
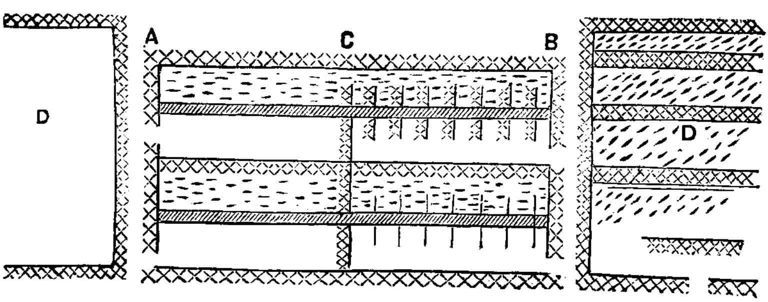


Fig. 22.—Type of temporary latrine adopted by Railways.

Diagrams of Latrines.



A to B = 48 feet.

G to S = 24 feet with 8 seats.

D—Female courtyard latrines.

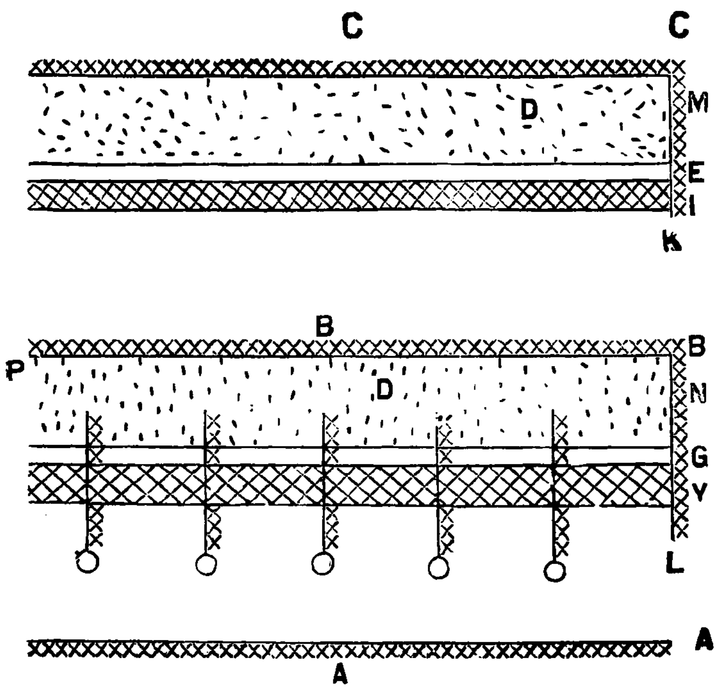
Fig. 23.—Trench pattern latrines for fairs.

6

and buried *in situ*. This reduces enormously the work to be done by the sweeper and makes it possible to keep the latrines clean in the largest fair. Wherever it is possible to dig trenches this type of latrine should be adopted. In some places where latrines have to be put up on stony or rocky ground it may not be possible to make trenches; in such cases one of the types of latrines described earlier may be erected. Of these types C is the best, B is not so good.

The details of the type of latrine (fig. 24) recommended for general adoption are as follows :—

A trench 48 feet long and 10 inches wide is marked out and dug to a depth of 18 inches. Behind this trench a second similar trench is dug. If the latrine is to be made for males, the second trench will be 7 feet behind the first trench; if the latrine is for females the distance between these trenches need be 4 feet only. The reason for this difference is this; in a latrine for males separate seats, each screened from observation must be provided; while in a latrine for females no such privacy is required and an open undivided courtyard suffices. The earth removed from each trench is pulverised and placed behind the trench, care being taken that a strip of 6 inches along the border of the trench is kept clear, to leave room for the feet of the person using the trench as a latrine. Moveable screens are placed both in front of the trench and at the back of the trench behind the pulverised earth. In a latrine for males each seat must be at least 2 feet 6 inches or preferably 3 feet wide. The separate compartments for men are made by placing screens 3 feet wide across the trench; each screen being 3 feet distant from the next screen. The person using the latrine will squat with one foot on each side of the trench. The screens forming the separate compartments for males are placed directly across the trench, but do not extend to the screen that runs right along the back of the trench; a narrow path is left here for the sweeper to pass along and throw earth over the excreta. All outer screens must be 6 feet in



A—A—Screen No. 1.

B—B— „ No. 2.

C—C— „ No. 3.

D—Pulverised earth areas 2 feet wide.

E } Foot space
G } 6 inches wide.

I } Trenches.
Y } 10 inches wide.

K } Paths
L } 4 feet wide.

M } Side screens.
N } 4 feet length.

O Partition screens.

P. Sweepers' passage.

Fig 24.—Another type of trench pattern latrine for fairs.

height. Entrance to the latrine can be obtained from either end : the width of this passage should be sufficient to allow the user to enter the latrine easily and without brushing against the walls. The trench which is 48 feet in length will be divided in the middle by a partition screen say 4 feet in height. Thus on each side of this partition will be 24 feet of trench and each section will hold 8 seats for males. When the first trench is filled the screen in front of it is removed and placed behind the second trench ; in this way the screen that was originally behind the first trench now becomes the screen in front of the second trench, and so on, for as many trenches as are required.

For the female enclosure, no separate compartments are required. Fig. 25 shows clearly how such an enclosure is to be made.

In the open courtyard rows of trenches are dug 4 feet apart, with the pulverised earth piled up behind each trench ready

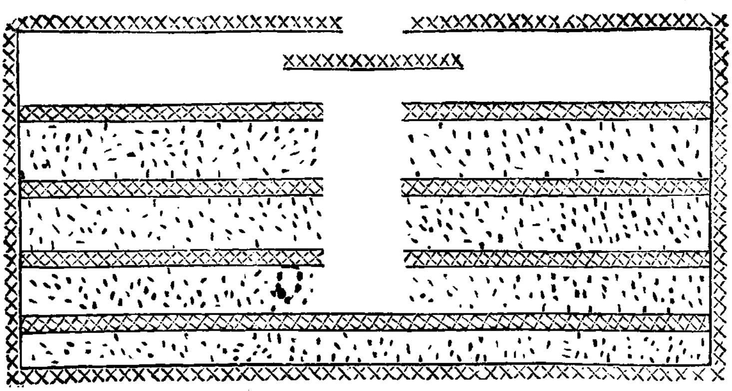


Fig. 25.—Type of temporary latrine showing female enclosure with entrance gate and trenches.

to be used to cover excreta. When the trenches are filled, the matting screens surrounding the enclosure are removed further back to enclose a second set of trenches and so on as required.

On sandy soil the edges of the trenches are apt to fall in of themselves or to break down with the weight of the user. Trenches in such soil cannot be dug more than one day before they are required. In sand in which nitrifying organisms are few, and which will be covered in the rains by the river, trenches may be dug 3 or 4 feet deep and 1½ to 2 feet wide. The space on which sand excavated from the trench is thrown should be 5 to 6 feet in width and the entrance path to the latrine 4 to 5 feet in width. In this case the posterior edge of each trench will therefore be 9 to 10 feet away from the anterior edge of the next trench. The partition walls for the seats should be 4 feet in length. These trenches dug in sandy soil must be given plank seats. This is carried out in the following manner :—

Cross planks (figs. 26 and 27) 5 feet long, one inch thick and 6 to 8 inches in width, are placed at intervals of 6 to 9 feet

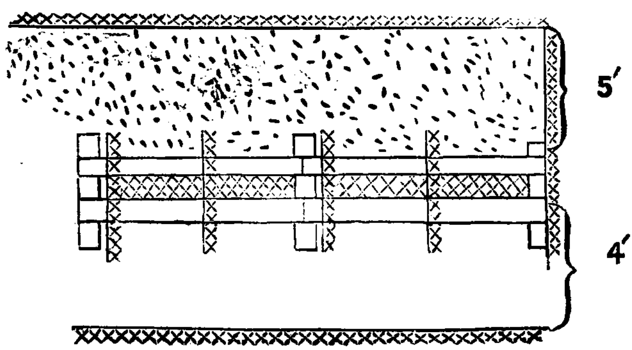


Fig. 26.—Type of latrine with plank seats on sandy soil.

across the trench. At right angles to these planks two boards 6 inches wide and 1 inch thick are nailed, parallel to each other and to the trench at a distance of 10 inches from each other. This space of 10 inches must be directly above the trench. The user then squats with one foot on each board and the excreta fall directly into the trench. These latrine seats can be stored after the fair is over and used again in

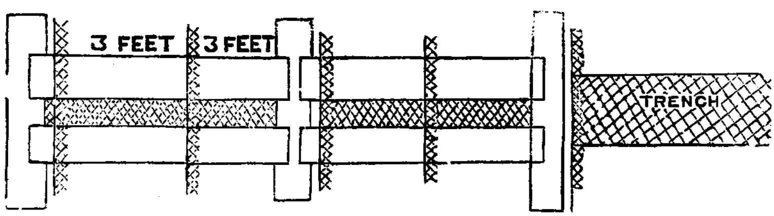


Fig. 27.—Ground plan of seats and position of screens of latrines on sandy soil.

subsequent years. Screens are supported by thick bamboo stakes 7 to 8 feet long and the cross screens over the trenches by thin bamboos of 5 feet in length. It is essential in hard soil that the holes for these supporting stakes should be prepared well before the date of the commencement of the fair so that the screens round trenches required for immediate use may be rapidly erected.

For a fair that is visited daily by pilgrims who do not live in the fair, the number of latrine seats required may be put roughly at one for every 1,000 of the population. For pilgrim living within the fair area the number of latrine seats required may be put at one for every 300.

Types of private latrines for fairs.—This tendency should be discouraged as far as possible as the supervision of private latrines is difficult; and wherever private latrines are allowed they should be licensed and substantial fees charged for permission to erect them. Usually the type of private latrine is either a pair of wooden planks on legs placed over a trench, or what is known as a modified Durbar pattern latrine. This latter consists of an iron seat with two horse-shoe shaped apertures, one for use in the ordinary way and one for washing. Beneath the apertures iron pans are placed. Either of the types described is satisfactory.

Types of temporary public urinals for use at fairs.

Urinals should be placed at the corner of each block of the inhabited site of a fair. In ordinary soil a pit 4 feet square and 5 feet deep is dug and filled in with road metal to a depth of 4 feet; in each corner of the square is placed a kerosine oil tin with a perforated base; this tin contains saw dust, soaked in perchloride of mercury of a strength of 1 in 500.

The disposition of the matting in the male and female urinals is carried out as shown in Fig. 28.

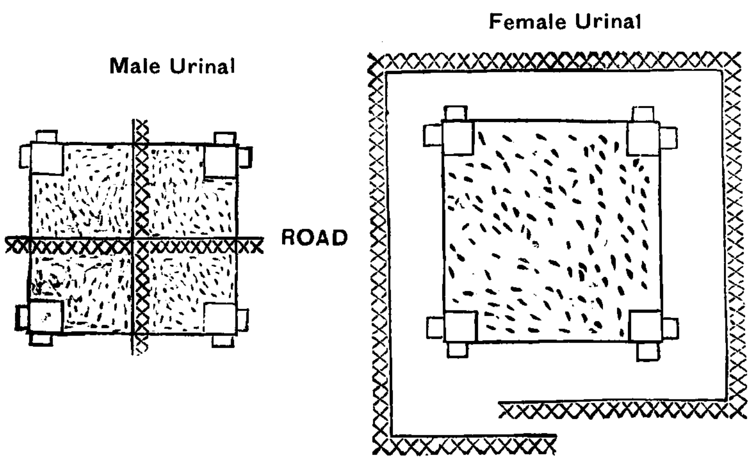


Fig. 28.—Temporary Male and Female Urinals for Fairs.

Where the fair site is on sand it suffices to sink a kerosine oil tin with a perforated base. Two bricks should be placed by the tin for the convenience of the user. Another satisfactory type of urinal for sandy soil is simply a trench across which planks are laid.

Removal of Excreta from Houses and Latrines.—In removing excreta from privies and latrines, the prevention of nuisance from offensive odours is the main object to aim at.

To attain this end the *receptacles must be suitable*, there should be as little transference from one receptacle to another as possible, receptacles should be capable of being *thoroughly cleaned*, the removal should be *expeditiously carried out* and at a time when the traffic in the street is at a minimum.

Receptacles.—Many kinds of buckets with and without lids are in use, most of which are not very suitable for the purpose. Sheet iron buckets of various sizes are in common use and these are tarred periodically, but it is very difficult to thoroughly clean the excrement off the surface of tar and these buckets are often offensive. Galvanized iron buckets are better, as they have a smooth polished internal and external surface which can be thoroughly cleaned with water and disinfected by some non-corrosive disinfectant. These receptacles should always be provided with a movable lid and if the lid can be easily clamped down so as to be air-tight, it is an additional advantage.

There are various patterns on the market; the "T. M." receptacle of the Empire Engineering Co., Cawnpore, (fig. 29), is probably the best air-tight receptacle. It is of iron and has to be tarred. A galvanized iron receptacle such as supplied by Burn & Co., Howrah, to railway latrines would be better, only the lid is not made to render the receptacle air-tight. A combination of these two receptacles would be an excellent one. They are supplied in 5 gallon and 9 gallon sizes. These receptacles should be brought into general use for all private privies and public latrines. In houses where the inhabitants can be relied on to use dry earth or disinfecting powder after defæcating, these receptacles could very well be placed under the "chowki" or seat and replaced when nearly full. This would save transference of the solids from the dish under the seat to the storage receptacles. Another receptacle should stand under the urine drain. No urine should be allowed to drain into pits from which it has to be bailed out.

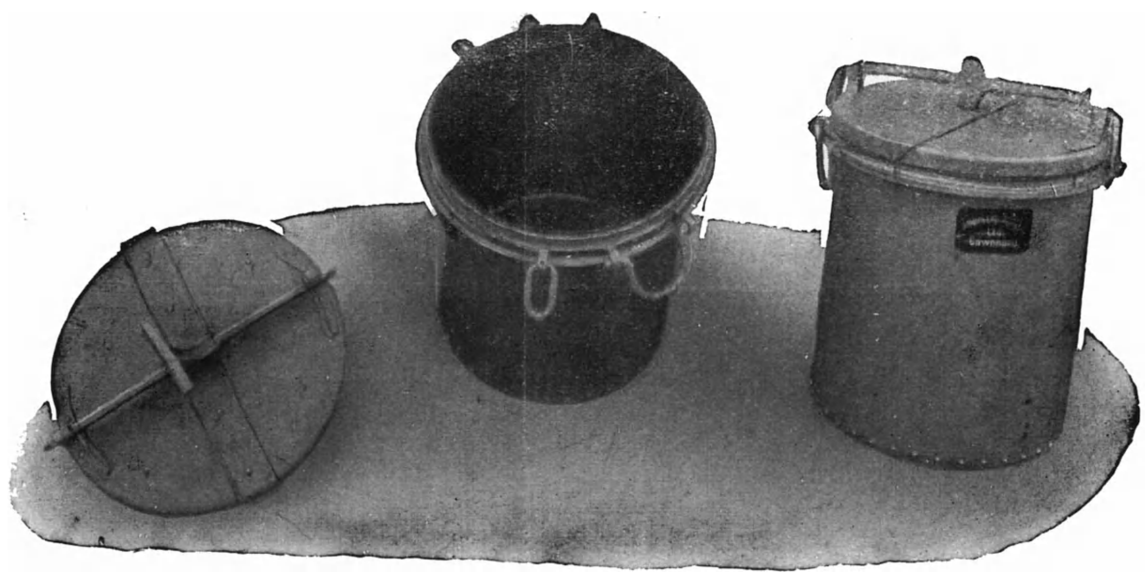


Fig. 29.—T. M. Receptacles.
(Empire Engineering Co., Cawnpore).

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Receptacles for solids and liquids should always be in duplicate so that when one is away being cleaned, the other is in use.

Removal.—In places where carts cannot approach the houses, the excreta have to be removed by hand. In many places the sweepers simply collect it in baskets and remove it to the place of disposal. In others it is mixed with earth and removed by small donkeys in sacks or baskets. Both methods are most objectionable and where this is being done better methods should be substituted. The air-tight receptacles of the 5 gallon size described above can be removed by hand without any nuisance being caused.

The distances which these receptacles have to be carried by hand should be as short as possible, therefore *night-soil depôts* should be established to serve suitably sized areas. The full receptacles should be placed there and clean empty ones stored ready to take away. From these depôts the full receptacles should be removed in carts to the places of ultimate disposal.

Night-Soil Carts.—There are many types of carts

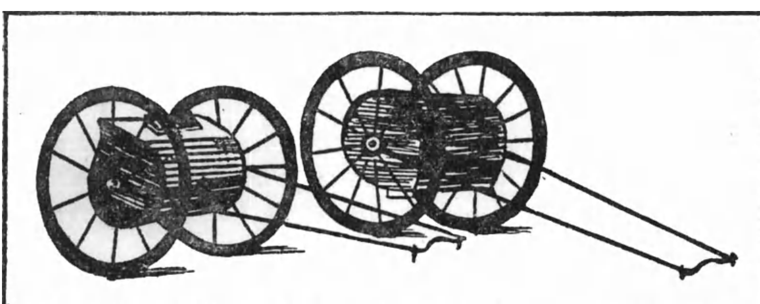

Fig. 30.—Crowley's Night-soil Cart. Revolving Body. *(Simpson).*

on the market and in India the type in common use is the "Crowley" cart (fig. 30).

These carts are made as a rule to remove 80 gallons. They are cleaned by being washed inside and outside and are tarred at regular intervals. The objection to these carts is that a serious nuisance is caused by emptying the solids from the receptacles into the carts. They, however, are useful as urine carts and for the removal of slop water, as practically no nuisance is caused by the transference of these liquids from the receptacles to the cart.

The best type of cart for the removal of night-soil is one which is made to receive a certain number of these receptacles in which they can be removed to be finally disposed of. The makers of the "T. M." receptacles supply these in various sizes, both hand and bullock driven. They are well designed and most suitable for the purpose. These carts should call periodically at the night-soil depôts and remove the receptacles (fig. 31).

Pail Depôts.—In towns which are partially sewered pail depôts can be established for the disposal of night-soil. The receptacles can be brought to the depôts and tipped into the sewer with a strong flush of water. If these are in the inhabited area a nuisance is often caused and thus the system is objectionable, though it allows of the rapid removal of the excreta. For the disposal of urine and slop water these pail depôts are very useful and for this purpose alone, it is very advantageous to have them erected in partially sewered towns.

Ultimate Disposal of Excreta.—The excreta can be disposed of in several ways. It may be *pitted*, *trenched*, *turned into poudrette*, used in the *fresh state as manure on* the land, or it may be *incinerated.* All these methods are in use in various parts of the tropics.

Pitting.—This is a method for the disposal of both solid and semi-solid night-soil. It is employed where private sweepers have the customary right to scavenging. They sell the night-soil to cultivators direct, on the understanding that it will be allowed to be pitted in their own fields. In this

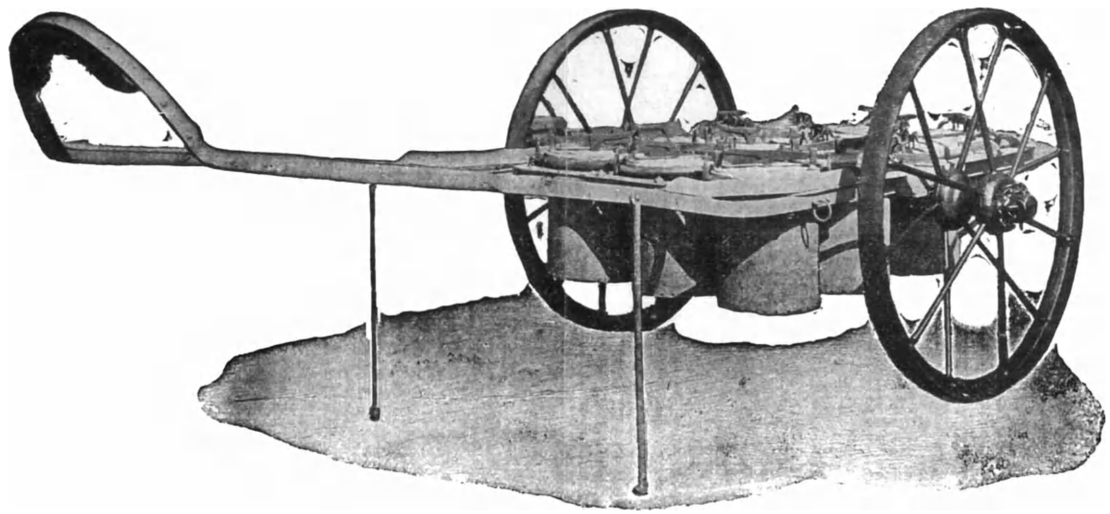

Fig. 31.—Cart for T. M. Receptacles.
(Empire Engineering Co., Cawnpore).

This illustrates a single bullock cart of steel to carry 8 receptacles of 9 gallons each or 12 receptacles of 5 gallons each.

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case the night-soil is deposited in pits 3 feet deep 5 feet wide dug by the cultivators and inspected by the conservancy staff. Care should be taken that the pits are not made too large or too deep. This system was largely prevalent in Lucknow and some other places in the United Provinces a few years ago. It is not a very satisfactory method of disposal of night-soil but is much liked by the cultivators. Most careful supervision is necessary.

In some of the western districts of the United Provinces the custom is to deposit the filth in deep and large pits and then dig it up after a variable interval, often unchanged, and sell it to cultivators. The system is radically wrong.

The following instructions regarding "pitting" will be found useful :—

(*a*) No pits should be permitted within a minimum distance of 300 yards of habitations, wells and other sources of water-supply.

(*b*) Pits should not be more than 3 feet deep, and, if possible, a layer of earth should be placed over each cart-load of night-soil that is unmixed with sweepings. Each pit should be covered by a foot of earth. Cultivators prefer deep pits, as then comparatively little change occurs in the night-soil. Owing to the paucity of nitrifying organisms in soil below 3 feet from the surface, pitting or trenching below this depth is inadvisable.

(*c*) Pitting should be done by municipal employees who are under control ; if done by cultivators it should be under municipal supervision.

Pitting should not be resorted to except in places where the area of land at the disposal of the local body is very small and other methods of disposal are not available.

Trenching.—This method of disposal is in almost universal use in the tropics. Trenching grounds should be chosen with care and discrimination. The land should be well drained and high lying. In wet weather the ground is liable to become water-logged if not well drained. A loamy soil is the best; very sandy soil and stiff clay soils should be avoided. A trenching ground should be situated outside the inhabited area as even with good supervision offensive odours are unavoidable. It should be so situated that the prevailing winds will carry the offensive odours away from the inhabited area. The approach road to a trenching ground should be well laid and have a good surface; otherwise jolting, splashing and spilling of the excreta occur unless air-tight receptacles are used.

The roads should divide up at the trenching ground into intersecting roads which cut the trenching ground into plots. The plots should be of sufficient size to accommodate a month's sewage but should not be too large, and so in a very large community several trenching grounds should be provided.

There should be a water supply on the trenching ground, preferably from a pipe supply or a pump well, so that receptacles and carts may be properly washed and disinfected.

TYPES OF TRENCHES.

Shallow Trenches.—These are usually about 2 to 2 feet 6 inches wide and 1 foot deep.

6 inches of night-soil is placed in the trenches and then covered with the foot of earth excavated, so that the filled trench is 6 inches above the surface of the land and dome shaped. This is to allow for settling. No night-soil should be allowed to ooze through to the surface.

Deep Trenches.—These are usually dug 2 feet 6 inches deep and 2 feet wide and a foot of night-soil can be placed in each trench. These are used from considerations of space. The trenches should be parallel to each other with one foot of earth between two trenches. The shallower trenches are preferable as conversion occurs quicker. In dry loamy soils, complete conversion is attaind in as little as 3 months in shallow trenches, but may take 6 months to a year in deeper trenches. In rainy season the conversion is much slower. The necessity for proper drainage is seen when inspecting a trenching ground in the rains. If the ground is badly drained, the trenches are full of water and the night-soil cannot possibly be properly trenched so that a serious nuisance is caused. Sanitary inspectors in the tropics should devote considerable attention to the trenching grounds under their control as they are a cause of nuisance unless they are strictly supervised. Unless the night-soil is properly covered with fresh earth, the eggs of flies develop into larvæ and adult flies, which can bore their way to the surface through loose earth. In sand, it has been found in Allahabad that adult flies can come through as much as 5 feet of sand when they emerge from the pupal stage of development.

Cultivation of Trenching Grounds.—After conversion the night-soil can be dug up and sold if there is any market for this substance in the neighbourhood. If not the trenching ground may be ploughed up in 3 to 6 months according to the season and sown with crops.

The best crops to grow on trenching grounds are sugar-cane, tobacco, rye grass and vegetables such as cabbages, cauliflowers and others in which the leaves are eaten. There is no objection, however, to root vegetables being planted as there is no danger whatever from vegetables grown in such a way being eaten.

The Thornhill System of Wide Trenching.—Where there is a larger area available for trenching this system is excellent.

The trenches are dug 16 feet long, 5 feet wide and 6 inches deep. The night-soil is laid over this to the depth of about ½ to 1 inch and covered with the earth. The subsoil should be loosened to a depth of 6 inches before adding the excreta so that it may immediately take up the liquid portion. When an area has been trenched in this way it should be put under cultivation without ploughing and rye or other grass grown on it. Millet may also be grown. Six crops a year of grass can be got off this land and three of millet.

In this system, the breeding out of flies is not prevented, which is a serious objection.

On the whole, deeper trenching is probably preferable owing to its prevention of the breeding out of flies.

Poudrette.—This is made by chemically treating the night-soil with sulphuric acid to fix the carbonate of ammonia produced by the fermentation of urea and evaporating the mixture. The cost of production is high and is not compensated for by the sale of the poudrette, owing to the small demand for it, and its high price. In Poona the night-soil used to be treated with the ashes recovered from the burning of the street refuse, but a certain amount of nuisance was caused and there was very little demand for the poudrette, so the process is now being discontinued.

Fresh night-soil.—In many towns fresh night-soi is removed in carts to a collecting area one or two miles outside the town, and dumped on the ground from which it is supposed to be removed at once by agriculturalists who have bought it. In India the agriculturalist is a firm believer in the efficacy of fresh night-soil for manure as compared with converted night-soil and is willing to pay high prices for it. In practice this system is the cause of much nuisance, as the night-soil accumulates at the dumping ground owing to tardy removal, the odour evolved is something appalling and can be smelt for miies. Theso accumulations also become a seething mass of fly larvæ and millions of flies infest the neighbouring towns and villages. This system should therefore be completely prohibited as a method of disposal.

Incineration.—When incineration is properly carried out in destructors with forced draught, it is an excellent method of disposal and in a proper incinerator with a fume cremator, it gives rise to no nuisance.

In dry weather the street sweepings are sufficient fuel, but in the rains, dry fuel must be provided. Slow combustion incinerators are not so efficient. They are in general use in cantonments and various patterns have been devised by the military authorities and when properly supervised, they are still considered by those authorities to be the most convenient method of disposal. There is no doubt that they are efficient if properly and constantly supervised, but they cannot be said to be always free from nuisance and for this reason, the civil population make many complaints where they have been erected. Owing to this unpopularity, local bodies very seldom make use of them for the disposal of excreta, but their uses for the disposal of street and house garbage cannot be too strongly emphasised.

The cost of forced draught destructors is usually too high for small communities and the necessary cost for fuel and maintenance usually decides the question against their employment.

The incinerator illustrated in appendix III—i-iv is the best we have seen for the destruction of both rubbish and night-soil.

From the sanitary point of view incinerators are strongly to be recommended and are much to be preferred to trenching grounds.

Removal of Slop Water and Trade Effluents.—These are best removed in carts of the Crowley pattern if there is no efficient flushed system of surface drainage or sewers.

In India a nuisance is caused in most towns by the presence of thousands of small "nabdan" or "hauz" for the reception of slop water and urine. These are usually built of masonry and concrete and have a capacity of about 2 to 3 cubic feet. They may be square or circular in shape, or may simply be an earthenware "gharra" or pot sunk in the ground. They are nearly always leaking and if not, are often found overflowing into the streets and lanes, so that they are surrounded by a quagmire of filth which is usually most offensive. The larvæ of many kinds of insects are found in them, especially of culicine mosquitos. Anophelines are rarely found breeding in them as the contents are too filthy for these mosquitos, which prefer moderately clean water in which to lay their eggs. Public bodies should make every effort to abolish these insanitary contrivances.

In towns without adequately flushed surface drains, properly constructed removable receptacles should be substituted for them and the slop water should drain into them from a spout. These receptacles should be in duplicate and when full should be removed by the municipal sweepers to the night-soil depôts.

If the town is provided with good surface drainage the slop water channel should be connected up with the nearest surface drain. If there are sewers, connection should be made with the sewer. The substitution of absorption pits has been suggested for the disposal of this water. These pits are dug to a depth of 5 or 6 feet and filled with rubbish such as broken bricks, road metal or clinkers.

These are found to dispose of the slop water very well for a time but they eventually become choked and the slop water spreads over the surface of the ground. In rainy weather the absorption naturally ceases and they are of no use unless they are thoroughly drained. By this method after a lapse of time the subsoil water must get into an exceedingly pollute state and the neighbouring wells would probably show pollution. The best that can be said for them is that they are very much better than the present system, where all the pollution of the subsoil water goes on daily, with an intolerable nuisance on the surface in addition.

It is preferable to remove such sullage from the inhabited area altogether. If removed in carts it should be trenched outside the inhabited area or better in properly constructed large absorption pits on high lying well-drained ground. This is much better than absorbing such matter *in situ*.

Disposal of Excreta in Villages.—In small villages without any sanitary staff little can be done to ensure the sanitary disposal of excreta and indeed very little is necessary. From time immemorial the villagers have used the fields for the purposes of nature, with the result that the agricultural value of fields near villages is always much greater than those at a distance. Regulations should be made prohibiting the deposit of excreta in the inhabited area and for an area of about 200 yards round it.

The provision of one public latrine and one night-soil cart in many places would be an advantage if there are any funds available to pay for its upkeep.

For slop water, as there is no system of removal possible, absorption pits might be substituted for the "nabdans" in use in most villages at present. As there are usually no surface drains worthy of the name, and no flushing except by rain, no other method of removal is possible.

CHAPTER VI

DISPOSAL OF EXCRETA.—WATER CARRIAGE SYSTEM.

The Water Carriage System has been introduced in most large towns in the tropics and is being annually extended, and in all towns where a sufficient pipe water supply is available, there is now no doubt that it is the best. Even if only parts of a town are sewered it greatly facilitates the removal of the excreta from the unsewered areas. Local bodies, who have determined to adopt this system of sewage disposal, and in all places where there is an adequate water supply and funds are available it should be adopted, should have in view the ultimate extension of the system to the whole area under their control. They should also make provision for the increase of the population and expansion of the area to be served. Main sewers and outfall sewers should be designed to deal with more sewerage than the amount that would have to be dealt with in the first few years after the completion of the initial works. A large and comprehensive scheme should therefore be projected which will permit of being taken up and completed *in sections* when the necessities of the population require it and funds permit. Local authorities are fortunate in having at their disposal all the experience acquired by other bodies who have constructed sewers and should be able to avoid the errors fallen into in the case of earlier installations.

There are two systems of sewerage and drainage which are in common use : the *combined* and the *separate* systems.

In the *combined system* both the surface drainage and the sewage are removed by the same set of sewers, while in the separate system the sewage and slop water alone are removed by the sewers, all rain and storm water being excluded.

The advantages of the separate system are :

(*a*) A much more concentrated and smaller quantity of effluent has to be dealt with.

(*b*) The effluent is more uniform in composition.

(*c*) The sewers are much smaller; consequently the initial cost of their construction is less.

(*d*) Practically no earth and sand from the surface gains access to the sewers, therefore there is very little deposit.

(*e*) Small sewers require less flushing water than large ones.

The disadvantages are :

(*a*) Two sets of pipes are required, one for surface drainage and storm water and one for sewage.

(*b*) In Indian towns the sullage in the surface drains is often very foul and would be better disposed of with the sewage.

(*c*) The sewers never receive a thorough flushing as they do in the combined system by the storm waters.

In the tropics with a long dry season and a short season of very heavy rains, there is no doubt that the separate system is the best. In the combined system if it is intended that all the rain water is to be carried off by the sewers, they must be very large or a system must be installed in which only the first washings of the rain gain access to the sewers and another set of channels carry off the storm waters either under or above ground. At all connections between the surface drains and the sewers, arrangements must be made to prevent the entrance of silt to the sewers or serious deposition or even blockage will occur.

The methods of preventing the entrance of silt to the sewers, etc., which are in use in Madras are dealt with under Surface Drainage.

In Cawnpore a deposit 2 to 2½ feet deep of silt was once found in the main sewers. Unless proper silt-intercepting arrangements are made, much labour will be required to keep the sewers clean and efficient.

In both systems the sewers should be water-tight and should not be expected to remove the subsoil drainage. In London these old drain sewers are still in use in the greater part of the area served, with the result that the ground water is seriously polluted and shallow wells cannot be used.

Sewers should be laid in back lanes and not in main streets as has been done in older systems. As water-closets are usually at the back of the houses or should be so, the house drains are easily connected with such sewers. The necessity for long curved drains to reach sewers in main streets is thus obviated, as is the alternative of taking the house drains under the houses. This should never be done if it can be avoided, and if it is considered necessary, arches should be built over the drain as it passes under the walls. Such drains also should be of iron piping and not earthenware.

Sewers should be laid at such a gradient as will render them self-cleansing. To effect this the velocity of the sewage in smaller sewers should not be less than $2\frac{1}{2}$ feet per second and 2 feet per second in larger sewers. Sewers 10 feet in diameter should have a fall of 2 feet per mile, 5 feet in diameter a fall of 4 feet per mile, 2 feet in diameter 10 feet per mile and 1 foot in diameter 20 feet per mile. If the volume of sewerage to be conveyed increases in due proportion to the size of the sewer, the velocities in all these sewers will be the same.

Calculation of the Discharge from Sewers.

The *Hydraulic mean depth* of a sewer is the sectional area divided by the *wetted perimeter*. In sewers running full or half-full it is one-fourth the diameter.

Let $D =$ the hydraulic mean depth, $V =$ the velocity of flow in feet per minute and F the fall in feet per mile,

$$\text{then } V = 55\sqrt{D \times 2F}.$$

Shape, Friction.—The friction in a sewer must be taken into account so that sewers should be so shaped as to offer the least surface to friction for the greatest volume of sewage.

Ovoid sewers with the small end downwards answer these requirements and have superseded the rectangular, circular and oval sewers.

Materials.—The inner surface of a sewer should be smooth so as to reduce the friction. Small-sized sewers are conveniently made circular in shape of glazed earthenware while larger sizes are made of brick. Iron pipes are stronger but are very liable to corrosion and should not be used if their use can be avoided.

Large sewers should be laid in $4\frac{1}{2}$ to 9-inch brickwork and set with the best cement mortar.

When a small sewer joins a larger one the top of the arches should be level, giving a fall from the smaller to the larger sewer equal to the difference in their diameters. The branch sewer should join the main sewer at such an angle that the sewage in it will not retard the main flow.

Sewers should have inspection manholes at every bend. These are shafts sunk from the surface of the road protected by a heavy iron trap-door at the street level. The sewermen can descend into the sewer by the aid of an iron ladder fixed to the wall of the manhole. These points are convenient for the junction of branch sewers with main sewers. This is effected by openings in the sides of the manhole and curved channels in the floor of the chamber.

Flushing gates can also be fitted in these manholes. They consist of sluice gates by which the exit sewer from the chamber can be closed and the sewage allowed to rise in the manhole. The sluice gate is then raised and a strong flush is caused in the sewer below the manhole.

The ventilation of sewers is effected by connecting a ventilation pipe with these manholes, leading it up the side of a house and protecting the top by flap valves which allow the entrance of air and prevent the escape of sewer gases. If not thus protected the shaft should be carried up above the roofs of the houses.

House Drainage.—Properly flushed closets should be constructed in all houses connected with the sewers. In European houses some such closet as the short hopper or wash-down closet, provided with a siphon trap is the best. These have been found by experience to be superior to long hopper and wash-out closets.

In tropical climates the trap should be deeper than in temperate climates as the trap is liable to become unsealed by evaporation. The flush of water after use should therefore be greater than the amount which suffices in Europe; 4 gallons will usually be found sufficient.

It is unnecessary to discuss here such contrivances as the pan closet, D trap, plug closet and waste water-closet, as their deficiencies have become so apparent as the result of experience that they are no longer put into modern houses. For the use of Indians, who squat on their feet when attending to the calls of nature, short hopper or wash-down closets are now made by many firms and have been constructed in many of the better class houses. The difficulty is to obtain such a closet at a price which will be within the reach of the poorest owners of houses, and to ensure its proper use by the lower classes.

Any system which depends on the presence of a flushing tank, the contents of which must be released by the user for its cleanliness, is liable to fail owing to the users neglecting to flush the closet. In the poorer houses, the flush would be better to be automatic, but this entails a great waste of water.

A good contrivance is one in which the flush is released by the weight of the user depressing the pedestals or "kadamchas," which are connected with the flushing tank by a lever, which starts the siphon action. This however does not prevent the trap being blocked by material thrown into the closet without the kadamchas being touched.

The flush therefore should be completely automatic and occur at frequent intervals or constant inspection and punishment for careless use must be relied upon to eventually impress on the users the necessity for releasing the flush after use. Automatic flushing entails such a great waste of water that on the whole the latter alternative appears to be preferable.

The flushing water should emerge from perforations all round the rim of the closet ; the flushing tank should have at least a capacity of 3 gallons, should be placed 6 feet above the closet and may be supplied direct from the main or from a cistern, if any such exists in the house.

A flushing tank with a siphon action, such as Field's, is the best, as the plug has only to be pulled to start the siphon action and not held until the tank is empty.

Slop sinks are probably unnecessary in India and other parts of the tropics as there is very little slop water from Indian cooking and any that there is could be disposed of in the water-closet or be allowed to flow into the surface drains.

Soil pipe to receive the contents of the closets should be of 4-inch iron piping *well jointed.* Only in the better class houses will lead soil pipes be likely to be employed. Lead soil pipes are, of course, the best, but the substitution of iron pipes must be permitted for financial reasons.

Water-closets can be constructed in the privy rooms previously occupied by the old "sandases" in Indian towns and if they are on the upper story, the pipes can be led down the existing brick shaft. In new houses the soil pipe should always be outside the house. If more than one closet on different levels is connected with a common soil pipe, antisiphon pipes must be connected between the top of the traps and a ventilating pipe which may join the soil pipe above the highest closet junction. The soil pipe should be carried up to the roof of the house and the top should be protected by a wire rose to prevent the entrance of flying matter which would cause blockage.

The soil pipe should join the sewer below the springing of the arch and should be disconnected from the sewer to prevent the entrance of sewer air, rats, etc. The Commission on the disconnecting trap in England recently decided that such a trap was not necessary, but the majority of medical officers of health are still of the opinion that the advantages of such a trap are greater than its disadvantages. The supporters of the trap, however, failed to definitely prove that sewer air was injurious to health. Only under special circumstances, such as when great splashing is caused have pathogenic bacteria been found in sewer air; moreover it was found that the health of men who were continually going down sewers did not appear to suffer very much.

Sewer air, however, is specially liable to gain access to houses in the tropics owing to the evaporation of the water-seal in traps when the closets are not in constant use, and where the combined system is in force, by sewer air being forced into the houses when the sewers and their connections are full of water.

As most old privy shafts, which are now used for water-closets, and soil pipes are built in a jutting out portion of the house and are shut off from the rest of the building by doors, there should be little danger of serious pollution of the air of a house, if the closet room is properly ventilated by a large window. The only disadvantage of disconnecting traps is that they are liable to block. Proper construction and careful supervision should minimise the risk of this. The trap should be easy of access for inspection and is better to be in an inspection chamber, just outside the premises at the foot of the soil pipe.

The gradient of drain pipes leading to the sewer should be—4-inch—1 in 40; 6-inch—1 in 60; 9-inch—1 in 90. This will give a velocity of four feet per second in each case.

Drains should be carried, if possible, in straight lines to the sewer, and should have a *cleaning eye* provided with a close fitting removable cap in the inspection chamber. A cleaning gang with rods and brushes should be maintained to clear out blocked drains or small sewers. All disconnecting inspection chambers should be daily inspected for blockage.

Kitchen slop sinks in European houses and hotels should discharge by a pipe over a grating under which is a *grease gully*, as in England. The waste water from paved yards and the rain water pipes should connect with the surface drains.

The testing of drains is carried out in the same way as in England, the water test being the one commonly used in India.

Water-Flush Latrines.—These latrines are now taking the place of the old hand-served types in most towns in which sewers have been laid; and combined plants are also being erected in unsewered towns or where the latrine is not commanded by the sewers, in which case the sewage is treated on the spot in a septic tank and a percolating filter.

The usual type of water flush latrine is a trough latrine with the required number of seats placed over the trough with a siphon trap at the end of the trough. These are automatically flushed by means of a Field's annular siphon flushing tank at required intervals in accordance with the amount of use.

This type is probably the best for the tropics as all parts of it are easy of access and can be easily cleaned. As inhabitants of the tropics are in the habit of throwing sticks, stones and other objectionable matter which is likely to cause blockage into the drains gratings of iron wire of about half inch mesh should be fixed under each seat to intercept these. These wire gratings can be cleansed daily by the sweeper in attendance. Any light material which passes through the mesh will not be likely to block the drains and heavy materials such as small stones can be removed from the trough periodically. In sewered areas these latrines should be connected with the nearest sewer by a suitably sized pipe, no disconnecting chamber being necessary.

In an unsewered area a latrine is often built on the top of a *septic tank*. This tank is divided into two chambers, the larger being at the outlet end. The separating wall should reach from the roof of the tank to the floor and be pierced by an aperture about two feet from the floor and about one foot high, extending the whole breadth of the tank. The effluent pipe should be one foot from the roof of the tank. The floor should be sloped from the upper to the lower end and from the sides to the middle, and at the lowest point should be capable of being opened to remove the sludge if necessary.

The excreta gain access to the tank after passing through the trap by a pipe leading to one or two feet below the surface of the liquid. In this chamber the solids are liquefied by the anærobic bacteria and a thick scum forms on the surface. The liquefied sewerage passes through the partition wall to the second chamber where it is further acted on. Heavy substances such as grit and mineral matters settle to the bottom. In the tropics it has been found that a satisfactory effluent with one-third to one-half the suspended matter liquefied can be obtained by 6 hours' treatment in the tank. The tank therefore should be big enough to hold a 6 hours' supply. This will ensure thorough liquefaction. There is reason to believe that smaller tanks would give equally efficient results in the tropics as the temperature is higher and thus more favourable to bacterial activity than in England. The type of sewage to be treated in the tropics is different, having more vegetable organic matter in it than European sewage, and this is more difficult of digestion.

The effluent from the septic tank is then treated on a percolating ærobic filter and the final effluent is pure enough to be allowed to run into the surface drains.

In flat areas where it is impossible to lead the sewage away by gravitation, some system of elevation must be employed. In Madras sewage "sumps" are constructed large enough to receive the sewage of suitably sized areas and from these the sewage is pumped up by Worthington pumps to a higher level and led away by gravity.

In Bombay and Rangoon the *Shone* system is in use.

In this system there is a central air compressing station from which compressed air is distributed in wrought iron pipes to ejectors (fig. 32), placed at the lower end of the

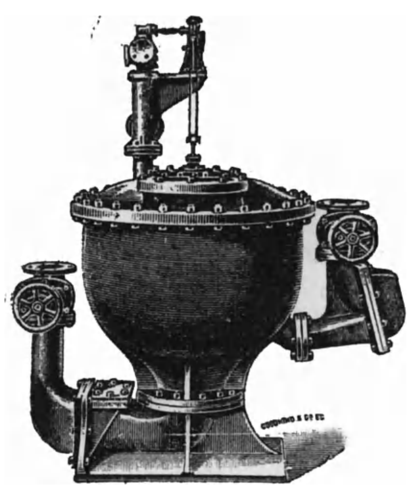


Fig. 32.—Shone Pneumatic Ejector.

pipes from which the sewage is to be raised. When the ejectors are full, a float on the surface of the liquid opens a valve by means of a lever and admits the compressed air. The sewage is forced up a rising main to the higher level desired by the compressed air. The sewage inlet pipe is provided with a ball valve which prevents the regurgitation of the sewage. The sinking of the level of the sewage closes the valve controlling the entrance of the compressed air and a fresh charge of sewage enters. The whole system is automatic in its working and good gradients can be given to the whole of the drains and sewers of a district thus served.

There is no doubt whatever that this system is a highly efficient one and is strongly to be recommended for towns in flat areas.

Sewage can also be raised by centrifugal pumps and chain pumps as described under "wells", but these methods are not nearly as efficient or cleanly.

Another system applicable to flat areas and to towns with a limited water supply is *Liernur's system.* This system is at work in Amsterdam. An air-tight system of sewers is required. The sewage is sucked in to central stations at various convenient spots. From these chambers it is drawn into vessels in which it is heated to about 100° C. and the ammonia fixed by sulphuric acid. Poudrette is thus made and sold as manure.

As there is very little demand in the tropics for poudrette, little return is to be expected to balance the cost of working this system, which is much greater than that of other systems.

Disposal of Sewage.—In India and other parts of the tropics with systems of sewerage, the sewage is usually either applied to the land or discharged untreated into rivers or the sea. Untreated sewage is discharged into the Ganges at

Allahabad, Cawnpore and Benares and owing to the enormous volume of swift flowing water appears to produce little nuisance, but sanitarians should endeavour to impress on local bodies the necessity of treating their sewage before discharging it into rivers. Both the sewage and sullage of Indian towns should be treated before discharge. The sullage from the surface drains of unsewered towns is almost as pollute as pure sewage.

Treatment of Crude Sewage.—Crude sewage may be treated by applying it to suitable areas of land, by chemical purification methods, and by biological methods.

In the tropics as there is usually plenty of suitable land available, land treatment will probably be found the best in most cases.

Treatment on Land.—This system gives the best results in dry climates. The soil should be light and porous, stiff clays being most unsuitable. The area chosen should be properly under-drained and flooding by storm water prevented by the construction of intercepting drains. The sewage should be screened in order to remove heavy suspended matters, otherwise the land will very quickly become clogged and percolation will cease.

The sewage may be applied to the land by *broad irrigation* or *intermittent downward filtration*.

Broad irrigation signifies the distribution of the sewage over a large area of agricultural land in order to produce a large amount of vegetation, and at the same time to purify the sewage.

The distributors of the sewage should be masonry channels. At right angles to these the surface of the land should be laid out in *ridges and furrows*. The ridges should be 50 feet broad and should slope from their centres to the furrows. The sewage is led down small channels along the middle lines of the ridges and allowed to overflow towards the furrows on both sides. When the central channel becomes clogged, another should be made beside it and the old one filled in.

In England one acre is sufficient for one to two hundred of a population if soil be good, and it is probable that good soil, well under-drained, will deal with this quantity in the tropics, but experiments are required to settle this question. Rye grass, vegetables and roots can be grown on the land and rich crops should be obtained. Sewage should not be applied to root crops except when they are very young.

Cattle may be kept on a sewage farm ; the meat of such cattle may be safely eaten and there is no danger in drinking the milk from cows grazed thereon. Several plots should be laid out and the sewage turned on to each in turn, care being taken not to oversoak the land.

A sewage farm on this principle is working in Allahabad and it is proposed to dispose of the whole of the sewage and sullage of Lucknow on a sewage farm which is now being prepared and will come into use when the new main sewers and the pumping plant are ready.

If there is a fair gradient, the catchwater system may be adopted. In this system furrows and trenches are dug parallel to each other at right angles to the direction of the slope. The sewage is allowed to fill the first trench and then to find its way into the second and so on. The subsoil effluent can then be allowed to run into a stream. This system is very suitable to treat the sewage of hill stations.

Intermittent Downward Filtration—In this system a large amount of sewage is allowed to run on a small area of land. The land must be of a porous nature and thoroughly under-drained. The area should be laid out in plots, and sewage allowed to run on to each plot for 6 hours, which is then given 18 hours' rest. By this method the sewage of 1,000 people may be treated on an acre. If the sewage is purified by screening, sedimentation or receptacle treatment, one acre will deal with the sewage of 5,000 people. This system simply aims at the disposal of the sewage and no return from crops is expected.

Sedimentation and Screening.—Sewage should always be screened or allowed to settle in sedimentation or detritus tanks before any other treatment is applied to it. The coarse organic matters removed should be destroyed in the refuse destructor, while mineral sludge should be dried and trenched into the land. It is of little use for manurial purposes.

Chemical Purification.

Precipitation.—The common precipitants used to aid the settlement of the matters in suspension are lime, alumina, iron protosulphate and alumino-ferric.

Lime alone may be used, the usual amount for average sewage being 12 grains to the gallon. If combined with alum, 5 grains of each to the gallon of sewage is sufficient.

London sewage is precipitated by adding 5 grains of lime and 2 grains of protosulphate of iron to the gallon.

The effect of these precipitants is to cause the deposition of nearly all the suspended solids ; they also act as deodorants.

The sludge thus deposited contains very few manurial ingredients, most of these being in solution. The precipitants are added to the sewage in sedimentation tanks and should be left in contact with the sewage for 6 hours. The sedimentation may be effected by retaining the sewage in one large tank for 6 hours or in a series of tanks, the period varying from 2 to 4 hours in each. The Dortmund tank is the best form of tank. It is conical in shape and the sludge can be removed from the apex of the cone.

The A. B. C. Process.—In this process alum, blood, clay and charcoal are added to the sewage. The clay is the weighting material, the charcoal deodorizes and the blood is supposed to act as a refining material. The effluent is very clear and the sludge has considerable manurial value.

The effluent from any of the above mentioned precipitation methods may be run into large rivers or streams in which the volume is fifteen times that of the effluents. If no river is available the effluent may be treated by irrigating waste land or passing it through filter-beds. It may also be treated by the oxychloride process described below, and allowed to run into a stream.

The sludge should be dried, pressed and trenched into the land. Its manurial value is very small as a rule.

Sterilization.

The Amines System.—The sewage is treated with lime and herring brine, which contains methylamine. This substance is a deodorant and the sludge produced can be dried in air without a nuisance being caused.

The Hermite Process.—The sewage is treated with electrolysed sea-water ; the fluid contains about 18 grains to the gallon of chlorine. It is supposed to sterilize the sewage. It contains no free chlorine.

The Oxychloride Process.—This is a similar process to the above but has given better results. Water containing 10 per cent. of common salt is electrolysed and a liquid is produced containing 140 grains per gallon of available chlorine. Rideal found at Guildford that by adding $3\frac{1}{4}$ gallons of this to 1,000 gallons of final sewage effluent, *B. coli* were reduced from 100,000 per c. c. to total absence in 1 c. c.

Biological Treatment.

Biological methods have now largely superseded chemical methods of purifying sewage. The advantages of biological treatment are that the amount of sludge to be dealt with is enormously reduced, no chemicals are required and a much more satisfactory effluent is produced. The work of purification is carried out by millions of micro-organisms, anærobic and ærobic.

The anærobic organisms are chiefly instrumental in liquefying the solid matter contained in the sewage, the organic matter is broken up, and unstable liquid compounds are formed, which break up into methane, ammonia, sulphuretted hydrogen and carbonic acid gas.

The ærobic organisms complete the process by converting nitrogenous and other organic matter by oxidation into nitrates, sulphates and chlorides.

It is usual to combine these methods, the first consisting of treatment in a septic tank and the second consisting of æration.

The Scott-Moncrieff System.—The sewage is passed into a tank filled from below upwards. The tank is filled with large stones below and smaller ones above. The stones become covered with solid matter, swarming with anærobic bacteria. The effluent to be ærated is run into a series of shallow channels filled with stones or through a series of perforated trays with filtering material in between.

Contact-Beds.—The sewage is first screened and then passed into coarse filter-beds filled with material 1 to 2 inches in diameter, from above downwards. These beds are about 4 feet deep and the sewage is allowed to rest in "contact" for two hours. The beds are then emptied and allowed to remain empty for 6 hours. The beds are thus filled three times in 24 hours. The surface of these contact-beds is liable to become clogged with solid matters so that they must be periodically raked.

Instead of treating the sewage in one bed only it can be treated first in a coarse bed for four hours and then given two hours' further treatment on a finer bed. This gives a purer effluent.

The Septic Tank Treatment.—The sewage travels slowly through the tank taking 6 hours to reach the outlet as described under "latrines." The deposit which consists of innocuous mineral or indigestible matter forms very slowly and need not be removed for years. The gases given off are methane, nitrogen and a little carbonic acid gas. The gas is thus highly inflammable and at Matunga in Bombay the gas provides light for the Leper Asylum and runs a gas engine.

The effluent is then ærated by being run over cascades and run on to a filter about 4 feet deep, of coke-breeze, clinkers, broken bricks or other similar material.

The filters are sometimes allowed to fill for 6 hours, stand full 6 hours, and remain empty 12 hours ; therefore for each septic tank two sets of filters are required for continuous working.

Owing to the thick scum which forms on the surface of the liquid in a septic tank, there is no necessity to close the tank but owing to the offensive nature of the gases, it is better to do so. The gases should be led away from the tank and let out by a high shaft or cremated in a coke furnace or better still turned to use as at Matunga.

Dibdin Slate-Beds.—Dibdin advocates the preliminary treatment of running the crude sewage into slate-beds for two hours, after which the effluent is treated in contact-beds. The slates are laid horizontally in layers about 3 inches apart in a bed 4 feet deep. The solids deposited on the slates are acted on by bacteria. The slate-beds only need be cleaned about once in two years and the deposit has no sewage odour. The effluent is clear and inodorous. The beds are allowed to stand full two hours. They are slowly emptied and not used for several hours thereafter.

Colonel Ducat's Method.—In this method a filter of coke and agricultural drain pipes in layers is built up from the ground. The pipes incline from the periphery to the centre and allow of thorough æration. The layers of coke are about 18 inches deep and are separated from each other by layers of pipes and large stones. The sewage is run continuously through this filter from the top. Colonel Ducat claimed that the liquefying and ærating processes go on together and a fair effluent is the result.

Aerating or Streaming Filter.—These are usually made of coke, clinkers, burnt brick, ballast or of other such fine grain material. The sewage percolates through them and issues from the bottom. The sewage is usually distributed all over the surface either by travelling distributors or by branching channels. Some of these distributors are worked by the power of the entering sewage. They are liable to clog and have to be cleaned periodically.

These filters are more expensive to construct than contact-beds but they give an excellent effluent.

In the tropics all exposed filter-beds become a nidus for the dissemination of countless swarms of flies, which actually breed out in the filters and this is the chief objection to their use.

In closed septic tanks, this nuisance is avoided, but the effluent from a septic tank needs further treatment. The fly nuisance is much less in the case of contact-beds in which they cannot breed.

A million gallons of average sewage can be dealt with per day by an acre in England, that is, about 200 gallons per square yard of surface. The liquid capacity of a filter-bed of this description is usually about one-third of the total cubic capacity.

Contact-beds can also deal with a million gallons per acre per day, if the eight hour cycle is adopted, *i.e.*, 1 hour filling, 2 hours contact, 1 hour emptying and 4 hours rest. In the tropics it is probable that a much larger number of gallons per square yard will be found to be adequately dealt with owing to the higher temperature favouring the increased activity of the germs.

In Whittaker and Bryant's installation in which the temperature of the sewage is raised artificially, it is claimed that 600 gallons can be treated to each square yard.

In England, efficient effluents can be obtained by any of the above methods of purification provided that the installations are properly supervised, though probably the best effluent is obtained by streaming filters.

In the tropics we still lack conclusive information on this subject. Lt.-Col F. H. G. Hutchinson, I. M. S. carried out a series of experiments in Poona with various installations for sewage purification.

The results were published in 1915. The conclusions to be drawn from his report using a 15-gallon sewage are that septic tanks work well in Poona but that secondary treatment for the removal of suspended solids is necessary as in England.

Macerating tanks work excellently in removing suspended solids but are productive of nuisance owing to the production of sulphides. The effluent from these tanks can be treated on streaming filters composed of medium material at a rate not exceeding 150 gallons per square yard with a depth of not less than 5 feet.

In the septic tank a volume of sewage equal to twice the capacity of the tank can be passed through it daily provided that a secondary tank is provided to remove the suspended solids.

He concludes that the experiments have brought to light nothing new except that the problem of treating sewage in this country presents no novel features. This to our mind is a most important thing to know.

With regard to Dibdin slate-beds he found that they required constant fairly skilled attention, that they caused no smell and that secondary tanks to remove suspended matter were advisable.

"Activated Sludge" Process.—We consider that the treatment of the subject of sewage disposal would be incomplete without a short account of the "activated sludge" process, which has been adopted in some towns in England and in one or two places in India, and is likely to be tried in other cities as well in this country.

In this process finely-divided air is forced through the sewage in tanks which consist of a series of long narrow channels, through which the sewage flows. As a rule, the channels are put side by side, the flow being in opposite directions in contiguous channels, which together make a rectangular tank divided up by the walls of the channels. After the sewage has entered the tank the solids deposit at the bottom and the supernatant liquid is run off. Sewage is again allowed to enter the tank, the process being repeated several times.

The oxygenation commences immediately the sewage enters the tanks and is completed before it finally leaves. The method consists in agitating and ærating the inflowing sewage in the most intimate mixture that can be achieved with "activated sludge" in the presence of air. The oxidising organisms appear to reside in the activated sludge.

The sewage at Manchester and Sheffield is dealt with by this process. At Manchester the agitation and æration is carried out by means of compressed air, that is, the air is blown through the sewage which not only keeps it in a constant state of agitation but also ærates it directly, the oxygen being taken up by the sewage from the air which is blown in. This method is supposed to work better on a large scale. At Sheffield no air is forced into the sewage but it is made to circulate round the channel by mechanical means. The purification effected is similar to the natural purification which goes on in rivers and streams, the whole of the necessary oxygen being absorbed through the surface of the sewage. The latter process avoids the use of air-compressors and air-mains, while the compressed air in the former produces a uniformity of agitation of the sewage.

The advantages claimed for the activated sludge method are :

1. It produces better effluents than any other biological processes.

2. It yields a sludge that is as good as, if not better than, that produced by other processes.

3. Its tanks occupy approximately the same space as required for septic tanks, and thus there is a saving in the space required for filters.

4. No roof is required for the tanks and if the sewage is reasonably fresh, there seems to be little danger of nuisance from the plant.

Mr. F. C. Temple, Chief Town Engineer to the Tata Iron and Steel Co., Ltd., who has very kindly permitted us to use his note on this subject, is of opinion that small "activated sludge" tanks could no doubt be used in this country and that they would offer the very great advantage over septic tanks of a stable non-putrefactive effluent. This could be discharged direct into surface drains. The tanks could be worked by compressed air supplied from a central air-compressor. The process, however, requires efficient supervision to guard against the stoppage of any kind.

The Purity and Standards of Sewage Effluents.—In England a sewage effluent having the following composition would be considered fair :—

	Parts per 100,000
Free and saline ammonia	1
Albuminoid ammonia	0·1
Oxygen absorbed in 4 hours at 80° F.	1·5
Nitrates and nitrites	1
Chlorine	10
Solids in suspension	1·5
Solids in solution	100

It should be without fæcal odour. The amount of albuminoid ammonia and oxygen absorbed before and after treatment are reliable indicators of the purification obtained.

A purification of 95 per cent. can be obtained by preliminary treatment in septic tanks and subsequent treatment in ærating filters. In septic tanks alone a purification of 60 per cent. can be obtained.

The amount of chlorine in an effluent is much the same as in the crude sewage and is of use to indicate the concentration of the original crude sewage.

The Rivers Pollution Commissioners require the following standard for effluents before admission to a river :—

	Parts per 100,000
Solids in suspension	
(*a*) Mineral (dry)	3
(*b*) Organic (dry)	1

The Royal Commission on Sewage Disposal in England in their Fifth Report decided that an effluent would be provisionally satisfactory if it complied with the following conditions :—

(1) It should not contain more suspended solids than 3 parts per 100,000.

(2) After filtration through filter-paper it should not absorb more than ·5 part of dissolved or atmospheric oxygen by weight in 24 hours, 1 part in 48 hours or 1 ·5 parts in 5 days.

In their Eighth Report these recommendations were amended and extended because (1) effluents contain a cellulose dissolving enzyme which reduces filter-paper to a pulp and stops filtration ; (2) oxygen is absorbed from the air during the process. The new recommendations are :—

(1) The *unfiltered effluent* should not absorb more than 2 parts per 100,000 of dissolved oxygen in 5 days at 65° F.

(2) The water *receiving* the effluent should not take up more than ·4 gram per 100,000 c. c. in 5 days at 65° F. after having received the sewage.

(3) The recipient water above the point where it receives the sewage should not absorb dissolved oxygen more than ·2 gram per 100,000 c. c. in 5 days at 65° F.

Ordinary water contains about 7 c. c. per litre of dissolved oxygen. Now, 700 c. c. of oxygen weigh 1 gram, therefore 7 c. c. = ·01 gram by weight, and ·01 gram per litre = 1 part per 100,000; so, 7 c. c. per litre = 1 part per 100,000 by weight.

The following formula is given to calculate the dilution required by a sewage :—

$$\frac{x+yz}{z+1}=0{\cdot}4$$

when x = parts of dissolved oxygen taken up per 100,000 by effluent;

y = ,, ,, ,, ,, ,, ,, ,, river water above outfall;

z = dilution (proportion of river water to effluent).

The Commission also recommend a sliding scale for suspended solids.

When the dilution is 150 to 300 volumes—6 parts per 100,000;
,, ,, ,, ,, 300 to 500 ,, —15 ,, ,, ,,
,, ,, ,, over 500 —only screening necessary.

The Eighth Report also says that if the dissolved oxygen content of the recipient water below the outfall is less than ·4 gram per 100,000 c. c., *i.e.* ·4 parts per 100,000, a nuisance may be expected.

The New York Commission laid down that the recipient water below the outfall should not fall below 3 c. c. dissolved oxygen per litre. This is equal to 48 part per 100,000 by weight.

The Incubation Test.—If the water is incubated at 30° C. for 5 days there should be no putrefaction produced and consequently no odour.

In India it is probable that no nuisance is caused through running untreated sewage into rivers like the Ganges, Jumna, Indus, etc., as the dilution is far beyond that required by the Sewage Commission, but in towns on the banks of small rivers it is essential that crude sewage should be properly purified before being allowed to run into the river.

In the tropics in most places it will be unnecessary to resort to the filtration of sewage on filters, as it will usually be the case that there is plenty of suitable land available on which to carry out broad irrigation or intermittent downward filtration, but where such land is not available, the system that will probably give the best results is preliminary sedimentation in a detritus chamber followed by treatment in a septic tank and secondary treatment on percolating filters. Such plants are exceedingly compact and deal with large volumes of sewage to the square yard and require practically no supervision. It would be well in the tropics to protect the open top of the percolating filter by wire gauze to render it fly-proof.

CHAPTER VII

SITES, SUBSOIL AND SURFACE DRAINAGE

Sites.

Low-lying Areas.—In the tropics the importance of the avoidance of ill-drained and water-logged areas for building purposes is even greater than in temperate climates. Low-lying land which in rainy weather becomes a swamp, in most cases tends to increase the incidence of malaria in the vicinity. The high splenic and parasitic indices obtained among the dwellers in such areas are well known to malariologists. The site of a town or village should be as dry as possible Porous soil is the best because the storm water readily percolates through it and does not lie in pools and depressions on the surface. In places where the ground water is high, even moderate rain causes the formation of many collections of water, of which many become potential breeding grounds for mosquitoes.

Town and village sites should therefore be elevated above the rest of the plain so that they may permit of being properly drained.

Artificial Water-logging.—The obstruction of drainage, both surface and underground, may easily be caused by the building of railway embankments, canals and raised roadways.

Engineers should therefore design such works with a sufficient number of outlets, so that the water can pass under such obstructions in cases where they cross the line of natural drainage of the area. Owing to the non-observance of this principle in the past, districts which were previously healthy have been rendered unhealthy.

Burrow Pits.—In the past, and unfortunately in many places at present, the practice of making burrow pits while carrying out construction works on railways, roadways and buildings is very common. The result of this practice is, that after the rain these burrow pits are turned into ideal breeding grounds for mosquitoes and the health of the locality suffers accordingly. As earth must be excavated for these purposes, stringent regulations are necessary to control this practice. For lines of railway and roads, the excavations should be in the form of a continuous trench on each side, properly sloped, so that the water is carried off by the nearest natural water course. These excavations are in these circumstances really storm water channels and are an advantage rather than a disadvantage. For buildings, no burrow pits should be permitted in any inhabited area. Owing to disregard of this in the past, old towns and villages are often riddled with holes and depressions of various sizes. The making of bricks entails the excavation of large areas and such works should not be permitted anywhere near a town.

In the case of old towns and villages, the gradual levelling of the inhabited area should be taken in hand. The filling up of depressions with untreated street rubbish has been referred to already and condemned as unhealthy. It may, however, be permitted if the rubbish is properly treated. In places where destructors have been installed for dealing with the surface sweepings, the ash and clinker which result may advantageously be used for this purpose.

Ruined Areas.—In most towns in India there are numbers of old, ruined and unsafe houses. These are very common even in towns with increasing trade and population. It is a noticeable trait in the character of orientals in general that they will spend a great deal of money in erecting fine buildings, but have often no fixed plans for keeping such buildings in good condition, such as a thorough annual repairing. Repairs are usually carried out in a very makeshift fashion with the result that the building gradually gets unsafe and ruined and is given up as a habitation. These ruined houses soon come to be used for the deposition of all kinds of rubbish and are used as latrines by the inhabitants of the neighbouring houses. The result is a nuisance and the creation of an ideal breeding ground for flies.

According to the Municipal Acts in force, local bodies can call upon the owner of a ruined house to put it in a proper state of repair or raze it to the ground.

These provisions are either not enforced at all or with great laxity. In most cases the owner replies that the house is not worth repairing and that he is not going to spend money in levelling the site, and usually no further action is taken. It is the duty of the local authorities in such cases to do the work of levelling themselves and recover the cost thereof, by distraint if necessary, from the owner of the house.

There are large numbers of towns and villages which are full of tanks and depressions ; all of these could be filled up by the material from the ruined houses, which is otherwise practically worthless.

Subsoil Drainage.

In the case of towns built on retentive soils, subsoil drains of loosely jointed or perforated pipes should be laid in channels surrounded with broken bricks, stones or gravel. They should lead the subsoil water in the direction of the natural drainage watercourse of the district. If such subsoil drains become blocked with silt they should be dug up and relaid where necessary.

Intercepting Drains.—A site which would normally be water-logged can often be kept dry by constructing an intercepting drain between the site and the area from which the ground and surface water reach the site. The intercepting drain is thus carried round the site outside the inhabited area and discharges its water below the site. Marshes near towns which are by the configuration of the district incapable of being drained themselves, can often be treated in this way also with beneficial results. These catchwater drains should follow as a rule the contours of the high land above the site, but it may be necessary to build them at the foot of hilly country from which water drains on to the inhabited area. The slope of such drains should be attended to and no undulations permitted, which allow of the damming back of the water. These drains are not costly and are easily constructed. They should not be allowed to silt up, and so should receive attention from the local authorities.

Embankments.—Sites on low-lying lands can also be protected by the construction of embankments to prevent flooding from surface waters and river waters. This plan has been carried out in various places, such as Port Swettenham in the Malay States and Srinagar in Kashmir.

Canals.—Many previously fairly healthy localities have been rendered unhealthy by irrigation from canals. In many towns in the Punjab and United Provinces these conditions have arisen, good examples being Amritsar and Saharanpur where the ground water level is practically at the surface in many parts of these towns. The provision of efficient subsoil drainage in such places is essential and stringent measures should be taken to prevent over-irrigation. The canals should be constructed so as to prevent leakage and the consequent formation of swampy areas in their vicinity. It is better still to prevent irrigation from canals in such areas altogether as it is not necessary when the ground water is so close to the surface and the agriculturalist can gain easy access to it by means of wells for irrigation purposes.

Cultivation.—The cultivation of such crops as rice, which require to be continually flooded with water, should be altogether prohibited in close proximity to the houses. The cultivation of other crops and grass near houses is healthy, as it prevents the formation of pools and puddles during heavy rain and in hot weather modifies the temperature by preventing the overheating of the soil.

Pollution of the Subsoil Water.—The subsoil water of all inhabited areas gets polluted in spite of all precautions but the soil bacteria can cope with a certain amount of pollution, and good subsoil drainage aids in removing the polluted water rapidly. Every effort to reduce the pollution to a minimum should be made, in order to keep it within the limits of the purifying capacity of the soil organisms. This is most important in small villages, where the only available drinking water supply is from shallow wells.

Surface Drainage.

Every town and village should have a system of surface drainage for the removal of house and street waste water, sullage and storm water. These drains should be carefully designed with proper gradients, so that their contents are easily and quickly carried away from the inhabited area. The sullage and storm water may be discharged at various points into the sewers in the *combined system*, or may be carried away in a distinct system of sewers or conduits as in the *separate system*.

The surface waters may be carried away completely by drains which are wholly on the surface or both on the surface and underground.

The Separate System.—The best system is undoubtedly the separate system in which the surface waters have their own system of sewers to carry away the sullage and storm waters. In large towns this system should always be selected.

All the streets in the inhabited area should be built with a proper curve or *cam*, the centre of the road being the highest point, from which the sides slope gradually to the edges of the road. The road itself should be of as impermeable a material as possible, in order that disintegration of the surface and the formation of dust and silt may be reduced to a minimum. The side drains should be at the edges of footways for passengers where there is wheeled traffic, and at the edges of the houses in back and side lanes with no wheeled traffic. The section of the drain should be shaped like a wide V with a slightly curved apex lying on its side thus ⊾, the vertical limb being formed by the edge of the pavement in wide streets or the plinth of the house in lanes.

Under each street, common drains, branch sewers and sewers should be constructed to receive the surface waters which gain access to them by openings in the side drains at the lowest point of gradients of these drains. These openings should be protected by strong iron gratings which prevent the entrance of coarse material of more than a half inch diameter. Under the gratings should be receptacles to catch the silt washed in by the storm water to prevent its entrance to the underground drains which would eventually cause serious blocking. These receptacles should be large and should be removed at intervals, which can be determined by local weather and other conditions, and emptied into the dust-bins. If such a system is installed, all yard washings, bath water, kitchen waste water, etc., should be allowed access to the sewers through similar openings protected by gratings.

The Combined System.—If there is only one set of sewers, and in most cases for financial reasons, only one set is usually constructed, most of the disadvantages of the combined system can be overcome by a proper system of silt interception such as described above. Mr. Madeley, the special Engineer to the Madras City Improvement Trust, has constructed an ingenious silt interceptor for use between yard and house connections and the sewers (fig. 33). It is a circular

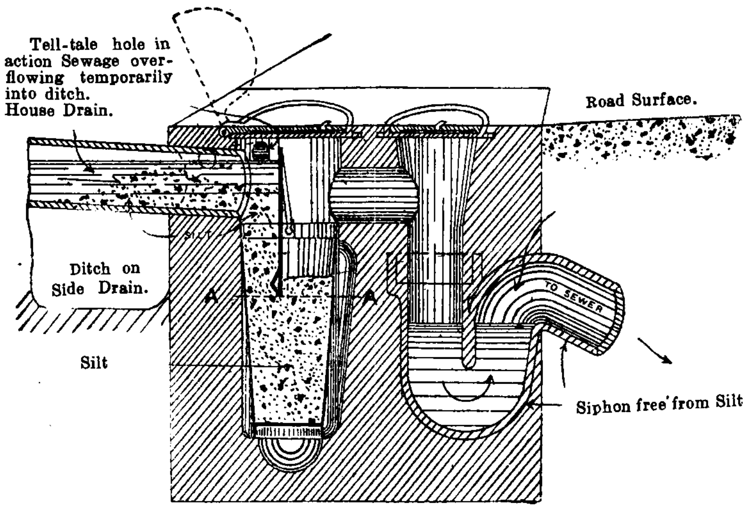


Fig. 33.—Silt catcher.

receptacle like a bucket which fits accurately into a cup constructed in masonry in the line of the effluent drain. It has a diaphragm dividing it into two at the upper part but this only descends about one-third the depth of the receptacle ; the effluent from the house drain flows into the proximal half of the receptacle, deposits its silt and passes up under the diaphragm to the drain leading to the sewer. It is constructed large enough to give a limited period of rest to the effluent in the receptacle to allow of sedimentation. If full it overflows on the surface and thus warns the sanitary staff that it requires emptying The intercepting trap is placed between the silt-catcher and the sewer.

The other objections to the combined system have been detailed elsewhere, such as the necessity for providing larger sewers, the great variations in the amount of effluent to be dealt with at various seasons, etc.

In the tropics where very heavy falls of rain in short periods are so often experienced and where the streets are nearly all of ordinary water-bound macadam, none of these systems of silt interceptors are likely to altogether prevent the entrance of silt to the sewers. Some system of allowing the storm water to escape by storm water exits when the amount exceeds a certain fixed quantity should be constructed, such as overflow weirs, leaping weirs, or plate weirs. In *Overflow Weirs* the inlet is constructed so that when the flow exceeds a certain maximum, the excess pours over a weir and flows into the storm water drains. In *Leaping Weirs* (fig. 34) the water normally drops down an opening

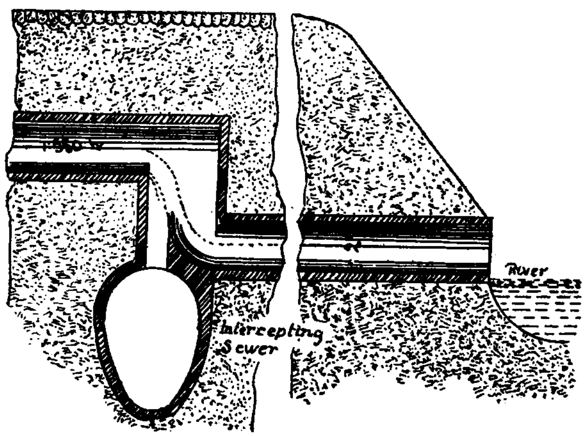


Fig. 34.—Leaping Weir. (Moore).

into the sewer, but with a good fast flow "leaps" this opening and reaches the storm water drains. In *Plate Weirs* a plate is placed horizontally across the channel so that in periods of normal flow the liquid passes underneath the plate, but in time of rain the level rises and some of the liquid passes over the plate to the storm water drain.

The first washings of rain are very pollute and should run into the drains, but afterwards the storm water may be allowed to escape by storm drains to the natural drainage watercourses of the locality, such as rivers, streams, etc. If a separate system has been constructed the necessity for most of these precautions is avoided.

Mr. Madeley has pointed out that the weirs above mentioned in places with a very heavy rainfall at certain times of the year like Madras, often become submerged and consequently cease to act, allowing large quantities of silt to enter the sewers. He has therefore designed a rain water separator (fig. 35) which is made to act when completely

Plan.

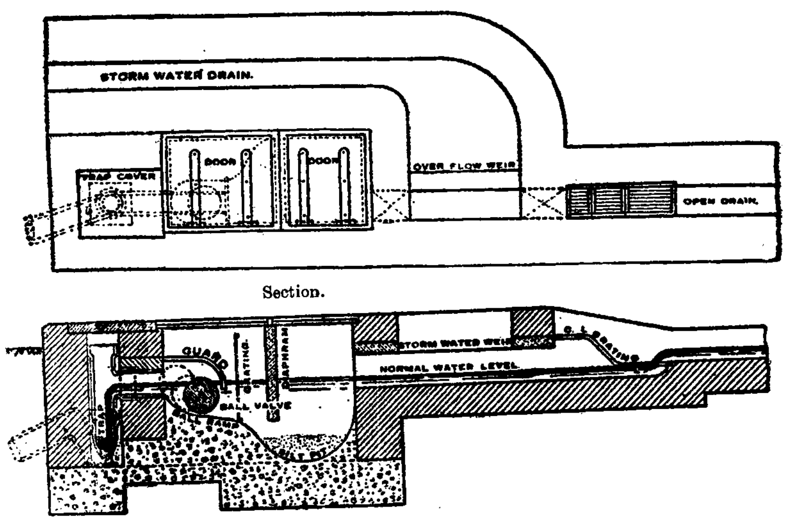
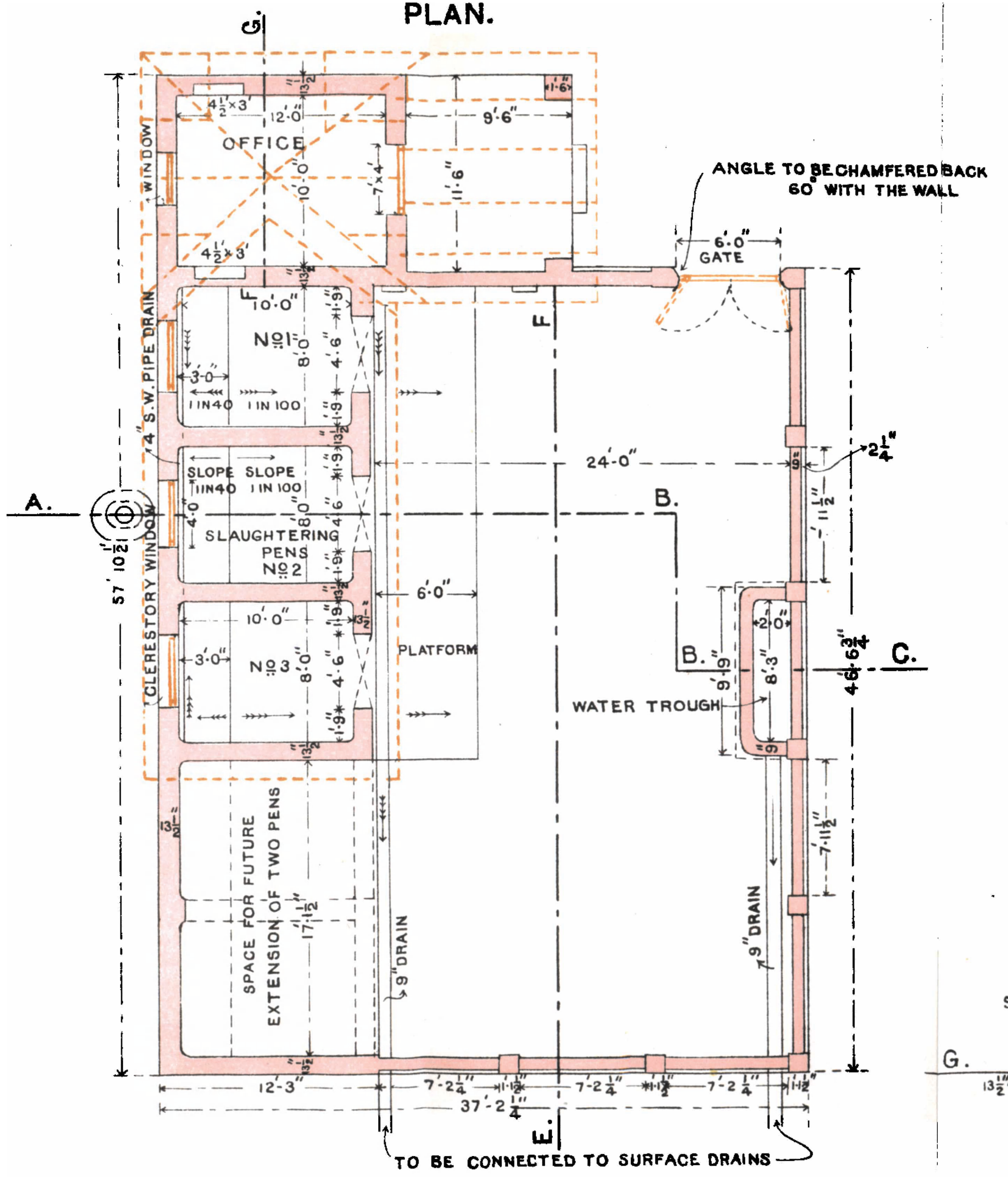
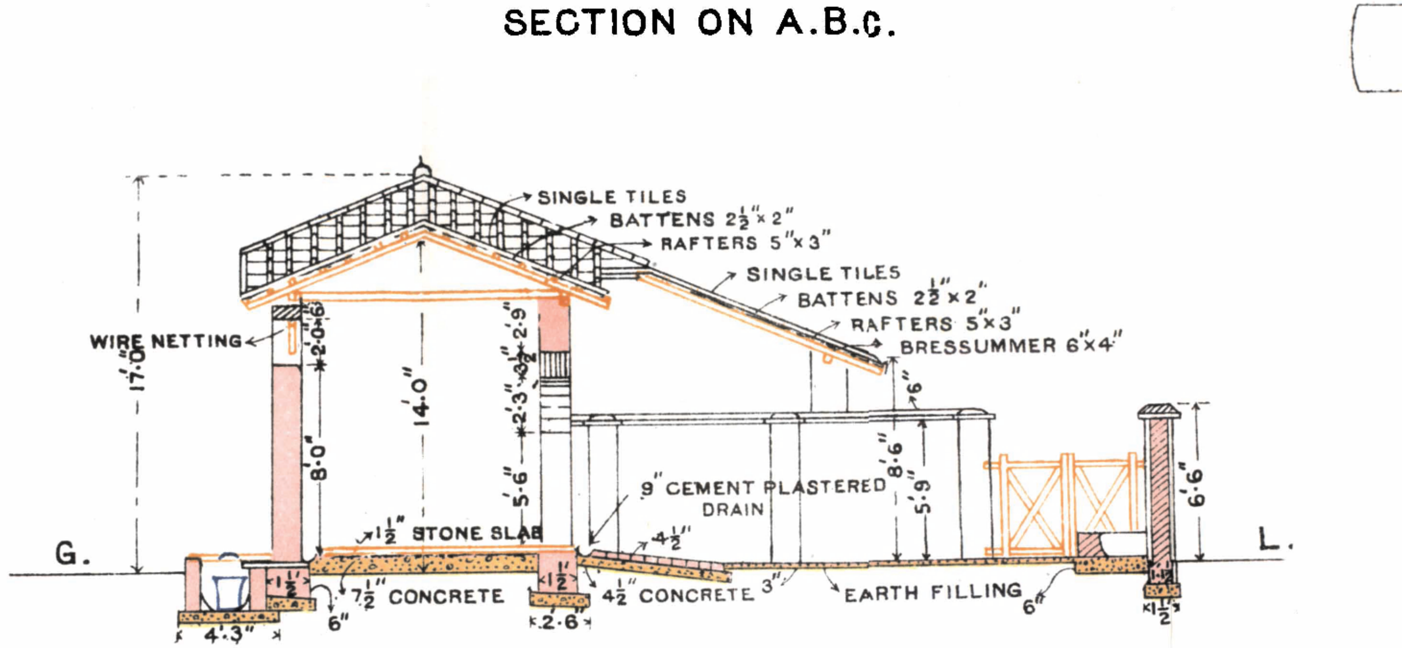
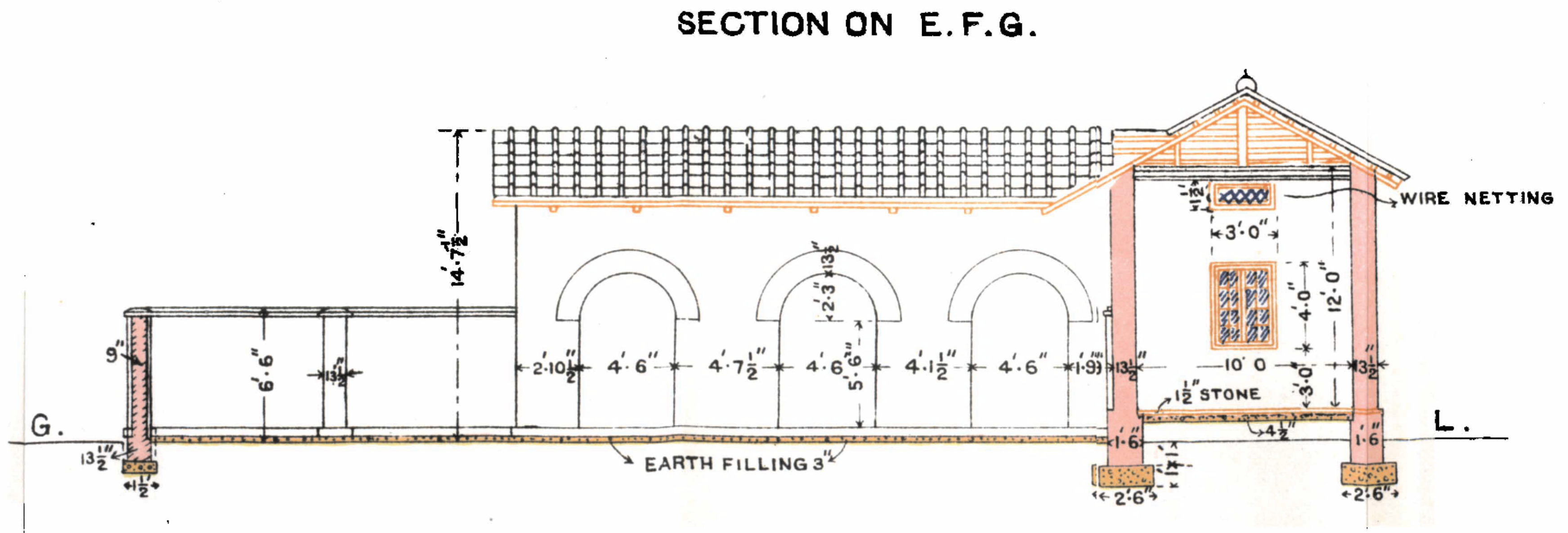


Fig. 35.—"MADRAS" PATENT STORM WATER SEPARATOR showing application to connection of side drain to sewer—(Madeley).

submerged. The liquid passes through a grating into a silt pit provided with a diaphragm and a second grating. The regulator is a ball valve closing the aperture to the sewer in times of heavy rain. Overflow weirs are provided on each side communicating with the storm water drains. The whole is covered by a manhole cover which can be lifted for inspection of the chamber and for cleaning out the silt after rain.







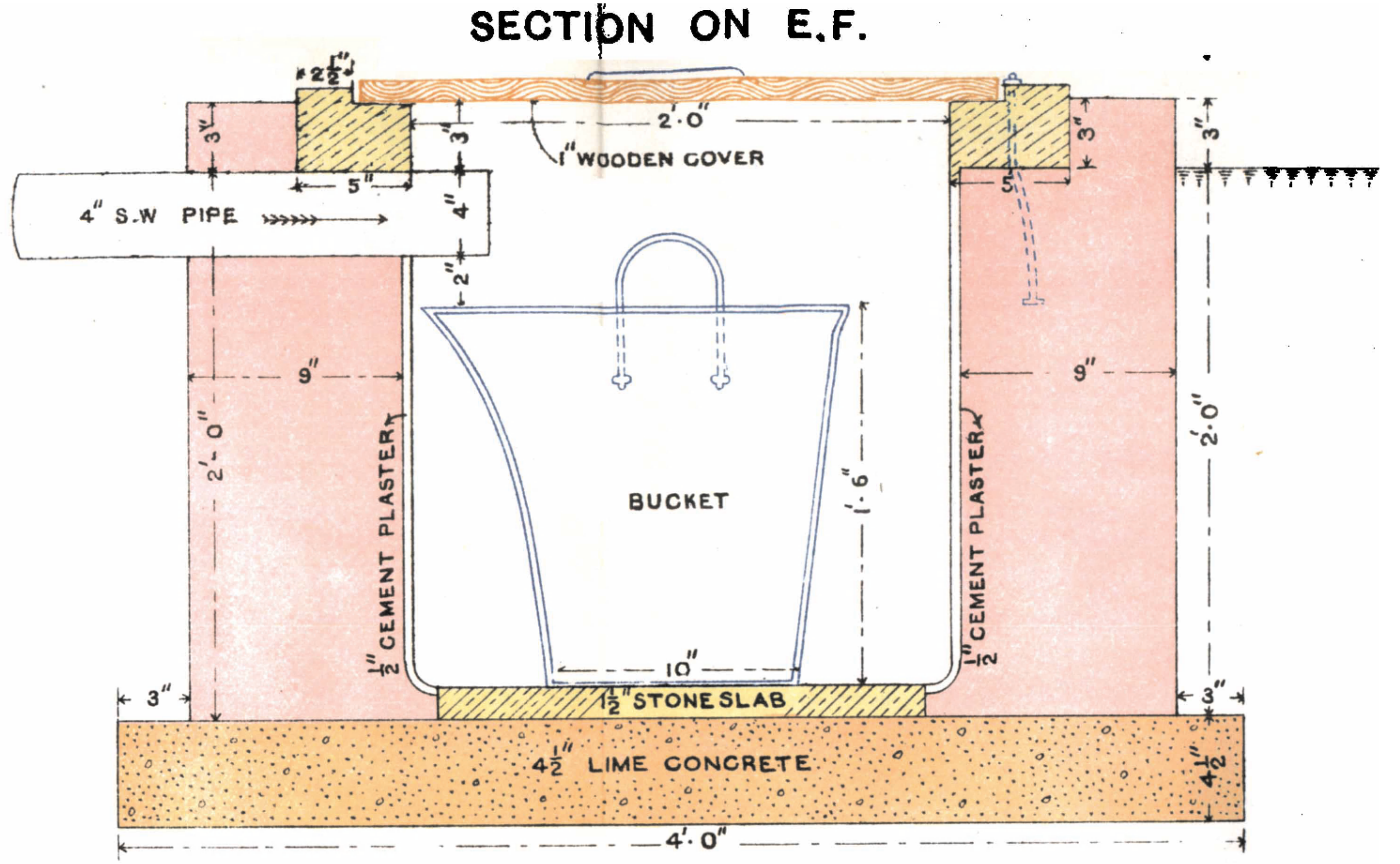


Fig. 36.

SMALL SLAUGHTER—HOUSE.

A. C. VERRIERES,
*Sanitary Engineer to Government,
United Provinces.*

Photo. Zinco., May, 1925.—No. 1211-9-2060.

The ball valve can be made so as to close when the water reaches a pre-arranged level.

Removal of Surface Water by Surface Channels.—In this method all the water is removed by the street side drains without gratings in each street. The surface waters of several streets are led by suitably graded drains to branch and main drains which may be partly or wholly underground. These drains require to be just as carefully designed and constructed as a set of sewers in order to ensure the rapid removal of the sullage, surface and storm waters. They should be constantly kept clean and not allowed to silt up. Sedimentation tanks may be incorporated in this system and constructed at the junction of a system of street drains with a branch or main carrier in order to prevent their blockage, and to permit of the easy collection and removal of the silt. Such pits should be periodically cleaned out and not allowed to remain full or half full as is often the case. These pits should be carefully designed as to size and depth, and should be in duplicate to be put into use alternately.

The branch and main carriers should be constructed V shaped or ovoid of impermeable material such as brick rendered in concrete and cement. The side drains should be constructed as described above under the system of underground removal of surface waters, but the angle of the V should be slightly more acute, thus √ or V, and also constructed of impermeable materials, such as brick rendered in cement, stone slabs laid in concrete, etc.

This system is naturally much less expensive than the underground system and is quite sufficient for small towns. In small villages where there are no funds available to provide brick drains, side ditches properly sloped will remove the storm water and prevent the site being water-logged. They should be kept free from silt and vegetation so that the flow of the water may be uninterrupted. The gradient should be greater than in brick drains as the friction will be greater in such drains. They should be properly graded and not undulating with no proper outfall, as is often the case in small villages and towns. A faulty system of surface drainage often sets up a state of affairs which is worse than the total absence of surface drains.

Surface drains should not be allowed to flow into a tank with no outlet, especially when such tanks are in the inhabited area. The outfall should be into a river, or watercourse leading to a river well outside the inhabited area. If the effluent is very foul it can be treated by broad irrigation on the land. In towns with no water-carriage system for the removal of excreta, such effluents are almost as foul as sewage in dry weather, as the contents of the "nabdans" above referred to are often very foul and contain a large amount of urine ; some fæcal matter also gains access to the drains.

Flushing of Surface Drains.—In view of the above condemnation, it is necessary to provide for the efficient daily flushing of such surface drains, and when the flushing is *efficient* and is done daily, there is very little objection to allowing urine from the urinals and house waste-water from the houses to gain access to the surface drains in the *smaller* towns.

In most small towns and some of the larger ones the flushing is exceedingly inefficient. It is carried out by water carriers, who fill their water skins at wells and empty them into the drains. All systems of surface drainage, when designed, should contain provision for efficient flushing. In towns with a water supply in pipes the solution is easy, and the drains can be flushed frequently. There should be a flushing tank of suitable size at the highest point of each system of drainage to allow of a good flow of water being periodically released from the tank into the drains. By having sluices at the different sides of the tank one tank may be used to flush 3 or 4 sections of drainage. In busy bazar streets a constant flow through the drains is necessary and should be provided for in estimating the quantity of water required while installing a public water supply. In the underground system of the removal of surface waters constant flushing is necessary in dry weather.

Where there is no public water supply in the smaller towns the flushing tanks should be situated at a well from which they can be filled. A large flushing tank situated at the highest point of a small town, which is filled by a pump, worked by a small engine if necessary, or animal power, is often sufficient to secure efficient flushing for the whole system of surface drains of the town. In large towns more of these flushing tanks are required. The important point is, that they should be included in the original design for a system of surface drains and the drains should be designed so that as many as possible can be flushed from one tank. It is too often the case that the surface drains are designed first and constructed and the flushing tanks added afterwards. It is usually the case in these circumstances that a tank can only be made to command a very small number of drains.

Erections Over Surface Drains.—It is only too common in towns in the East to find the surface drains built over by platforms projecting from the houses and wide flights of steps, with the result that the quondam "surface" drain in many places disappears completely from view. Proper access to these drains in order that they may be constantly kept clean, is absolutely necessary ; stringent regulations are therefore required to prevent the erection of such structures over the drains.

In wide streets there should always be a pavement for foot passengers with the surface drains between it and the road and no erections whatever should be allowed over such drains, nor are they necessary. If there is no pavement and the drain is constructed at the side of the houses, only such erections as are required for access to doorways should be permitted and the width of such erections should be strictly limited. No other erections should be permitted in any circumstances whatever. Local authorities have the power to make byelaws to prevent their erection under the Municipal Acts, but the Acts do not give them the power to demolish without paying compensation such as are already in existence. In the interests of the public health and convenience it is to be hoped that such powers will be given to the local authorities in the near future and that they will be exercised by them.

Such platforms are very common in India and they are used by shopkeepers as counters for buying and selling, to sit on in the evenings and to sleep on at night. If such erections are necessary to their avocations and comfort, they can easily be constructed inside the limits of their own premises, and not made so as to project over municipal property. Sleeping immediately over surface drains does not appear to be a particularly wise thing to do in any case so that the public health would doubly benefit by their total abolition.

All well platforms and pumps should be connected with surface drains in order that collections of water may not form in such places, and such waste-waters are also of use to keep the drains clean. Offensive trade-waste should not be allowed to flow into the surface drains.

Disposal of Surface Waters.—In towns with a separate system, as a rule, the surface waters require no treatment and may be allowed to escape into a river or into the natural drainage channels of the locality; but, if there are no sewers and urine and sullage are allowed to gain access to the surface drains, the effluent should always be treated.

Where it is possible to utilize sullage water for the irrigation of crops this should be always taken advantage of, as sullage water usually contains a large amount of nitrogen and is a most valuable fertilizing medium. In small towns without a pipe water-supply the irrigation of crops with sullage on the "ridge-and-furrow" principle should be adopted, as direct application of strong sullage has an injurious effect on the vegetation. For this very reason in some places sullage is mixed with well water. In cases where sufficient fall is not available sullage can be lifted by buckets and utilized on the land. Waste land so irrigated becomes very fertile and brings in a good income, as for instance at Agra.

In Amritsar, Allahabad, etc., the agriculturists pay high prices for land irrigated from the street sullage, which is carried to the land by impermeable channels after sedimentation, and serves the purpose of both irrigation and manuring, with the result that splendid crops are obtained. All local bodies should make use of this method of removal wherever possible, and in designing a system the disposal of the effluent on land should be taken into consideration. Too often at present this is not thought of and the effluent is allowed to run to waste in a river, small stream or ditch which may cause a nuisance.

CHAPTER VIII

FOOD SUPPLY

Staple Diet.—The staple diet of the vast majority of the indigenous inhabitants of tropical countries is vegetarian. The *nitrogenous material* necessary in all diets is taken in the form of leguminous grasses or pulses, which are nearly as rich in such materials as meats. They are also rich in carbohydrates and fats. *Carbohydrates* are consumed in large quantities in the form of cereals such as wheat, barley and rice. The last named grain is very rich in carbohydrates and poor in nitrogenous material, while wheat and barley contain a moderate quantity of nitrogenous substances. Maize is also eaten in nearly all parts of the tropics. It contains a good deal of nitrogenous material and fat. *Fats* are obtained from certain vegetable seeds such as "til" (*Sesamum indicum*), mustard seed, etc., but are usually consumed in the form of ghee or butter. Ghee is usually prepared by curdling the milk by the addition of a little sour milk and churning till the butter has separated out. The butter is then collected and melted. In the melting process the casein, salts and water separate out and the pure butter fat is collected from the surface.

Meat is also eaten in many parts of the tropics but in much smaller quantities than in more temperate climates.

In India, Hindoos are for the most part vegetarians but some will eat meat in the form of goatflesh and mutton. They do not eat beef as the cow is considered a sacred animal.

Mahommedans will eat the flesh of any animal except the pig, which is debarred in their religion as unclean flesh, and the wisdom of such a law in India is very evident. Pigs in

India are scavengers and will eat any offal or garbage with the result that a very large proportion are infected with the cysticerci of tapeworms, *Trichina spiralis* and other parasites of meat.

The custom of killing animals suffering from some disease, or old, thin and debilitated animals, which are useless for work, is exceedingly common in India, hence the necessity for the establishing of public abattoirs and meat markets which can be inspected, and slaughter and sale of animals supervised in order to prevent the spread to human beings of certain diseases, which can be communicated to man in this way.

Fish is also eaten by the inhabitants of the tropics where a fish supply is available. The degraded classes without caste will eat almost any garbage and the flesh of any animal clean or unclean. These classes usually do not practise any degree of personal hygiene and are usually very verminous ; it is therefore probable that these people are responsible for the spread of many of the parasitic diseases of the tropics. The higher castes are particularly careful about the cleanly preparation of their food and they therefore usually escape from attacks of such diseases.

Mahommedans are rarely infected with *Tœnia solium* as the cysticercus of this parsite is ingested with pigs' flesh.

Hindoos rarely suffer from tapeworms of any kind owing to their vegetarian diet. Such infections are however exceedingly common among the degraded classes, sweepers, etc.

Fruit is largely consumed by the inhabitants of the tropics and the consumption of large quantities of such fruits as water-melons, jack fruit, etc., in an unripe or overripe condition is often followed by severe enteritis and may cause death. Such fruits as water-melons are often contaminated by polluted water, which may contain the organisms of disease in the presence of an epidemic such as cholera.

Vegetables are also eaten and if eaten raw are frequently the cause of outbreaks of disease owing to their contamination with specific germs.

Dietaries.—It is not proposed that the construction of dietaries should be dealt with here at length as the consideration of such matters does not come into the routine work of a medical officer of health. The following standard diets for Indians after a table compiled by Church give the amounts of proteids, fats and carbohydrates required to keep the average Indian of 105 lbs. weight in good health.

They are expressed in ounces :—

Ration	Proteid	Fat	Starch	Starch equivalent	Nutrient Ratio
Bare sustenance	2·1	0·752	7·520	9·250	1 : 4·34
Moderate work	2·954	1·412	12·531	15·779	1 : 5·34
Hard work	3·635	2·506	11·190	16·954	1 : 4·66

The amount of pulse, cereal and fat required varies according to the pulses and cereals used. McNally and some other authors give tables in their books showing the food constituents of the various foods in common use in India with the aid of which dietaries may be constructed if necessary.

The food value of the various food substances is usually expressed in calories.

A "*Calorie*" is the amount of heat required to raise one litre of water to one degree centigrade.

The caloric value of food substances is found by their combustion in an apparatus called the calorimeter.

The caloric value of one gramme of

Proteid	=	4·1 calories
Carbohydrate	=	4·1 calories
Fat	=	9·3 calories

A subsistence diet should be sufficient to produce about 2500 calories.

The standard diets given by Atwater for a man weighing 70 kilogrammes are :—

Light work	Protein	110 grammes
	Fats and carbohydrates to make up to	3,000 calories
Moderate work	Protein	125 grammes
	Fats and carbohydrates to makes up to	3,500 calories
Hard work	Protein	150 grammes
	Fats and carbohydrates to makes up to	4,500 calories

The Adulteration of food.—Food is frequently adulterated by the producers or vendors before being consumed by the public and in order to prevent the sale of adulterated food to the detriment of the consumer, there are Acts in force in most civilised tropical countries. In India most local Governments have passed such Acts, the administration of which intimately concerns medical officers of health.

These Acts provide for the prosecution and punishment of persons selling articles of food "which are not of the nature, substance, or quality demanded by the purchaser or which it purports to be." Food grains are usually adulterated by the addition of some grain with a smaller market value or by the addition of dirt to increase the weight. Water is also sometimes added for the latter purpose. The addition of other grains can be detected by the microscopic examination of the starch granules, the character of which varies in the case of the various starchy foods.

The addition of dirt is often visible to the naked eye and the amount added may be roughly estimated by throwing a weighed quantity of the grains into water, when the dirt will sink to the bottom. When water is added the grains swell up by absorbing the moisture and consequently increase in weight.

Pulses such as "dal" (*Cajanus indicus*) and gram (*Cicer arietinum*) are also adulterated by the same methods.

Ghee is often adulterated by the addition of cheap oils such as Mowa oil, groundnut oil or animal fats. Such adulterants can be detected in the laboratory by the difference in the amount of soluble volatile acids which these substances contain in comparison with pure butter fat (Reichert-Meissel or Reichert-Wollny processes) or by the use of such instruments as Jean's Oleo-refractometer or Zeiss's butyro-refractometer.

Sugar is often adulterated by the addition of sand and dirt in order to increase its weight. If the sugar is dissolved in clean water the amount of dirt and sand can be roughly estimated.

Milk in India is almost always adulterated by the addition of water or the abstraction of fat. The amount of added water can be approximately arrived at by a comparison of the percentage of the non-fatty solids with the standard amount of non-fatty solids which should be present in all milk exposed for sale. The percentage of fat abstracted is arrived at by similar means. These methods are described in laboratory handbooks. The standards adopted in Calcutta are (Simpson) :

Constituents.	Cow's milk	Buffalo's milk
Water	88·5	83·5
Total solids ...	11·5	16·5
Non-Fatty solids ...	8·5	10·5
Fat	3·0	6·7
Ash	·7	·7

From this table it is easy to understand that dairymen can, by the judicious admixture of buffalo and cow's milk or by adding water and abstracting fat from buffalo milk and selling it as cow's milk, render it very difficult if not impossible for the public analyst to detect the fact that the milk has been tampered with in this way.

Cane sugar is often added to milk to disguise sourness. Its presence may be detected by suitable tests in the laboratory such as Cottons' test or the resorcin test.

The preservatives used in Europe such as boric acid, formalin, etc., are not used by milk vendors in India to any extent.

Unsound Food.

Unsound Grain.—Grain is often sold in an unwholesome condition owing to decomposition or the grain being diseased by the attacks of moulds such as *Mucor*, *Penicillium* and *Aspergillus*. The grains may also be attacked by parasites such as "rust" (*Puccinia graminis*) which attacks the stem and leaf, "smut" (*Uredo segetum*) and "bunt" (*Uredo fœtida*) which attack the ear, and ergot (*Odium abortifaciens*) which usually attacks rye.

The common animal parasites of food grains are the *Vibrio nëstritici* which destroys the grain, *Acarus farinæ*, the wheat mite, and *Calandra granaria*, the wheat weevil which eats the core of the grain.

Some of these parasites such as *rust* etc., attack the standing grain while others are the result of improper methods of storage and damp such as *mucor*. Some of the above parasites may be detected by microscopic examination, but the naked eye appearances, such as discolouration and the musty odour often produced, are sufficient evidences of unwholesomeness. The wheat weevil may be seen by the naked eye. All unsound grain of this description should be condemned by the medical officer of health, under powers granted by the local bodies.

Diseases Produced by the Consumption of Unsound Grains.—Mouldy flour is liable to produce colic, intestinal irritation and diarrhœa. The eating of *ergot* produces *ergotism*, the chief symptoms of which are loss of sensation, pain, arterial spasms, convulsions and gangrene. They are due to a sclerosis of the posterior columns of the cord and strong stimulation of the vasomotor centres. The eating of uncured, mouldy or decomposed rice is held by many authorities to be the cause of *beri-beri*, and the results of many feeding experiments carried out give very good grounds for this belief.

Pellagra is said to be caused by the eating of damaged maize in Italy and Egypt. This disease is also characterized by changes in the brain and spinal cord.

Lathyrism is also a disease in which the spinal cord is attacked and is ascribed to the eating of "Khesari dal" or *Lathyrus sativus* in large quantities. The poison is supposed to be an alkaloid product of the grain itself and not produced by the attacks of any parasite. If eaten in small quantities no ill effects appear to be produced but if taken in large quantities colic and dyspepsia are at first produced and afterwards paraplegic symptoms begin to appear, the muscles of the lower limbs alone being affected.

Ghee and *Butter* if exposed for sale in a rancid condition should be at once condemned. *Milk* also, which is not kept for sale in a cleanly manner, is liable to be contaminated and specific organisms often gain access to the milk from dirty vessels and added water. Cholera, typhoid fever and dysentery are frequently disseminated by the agency of milk. The decomposition of milk has also been known to produce a poison called tyro-toxicon. It is a benzene derivative and gives rise to nausea, vomiting, diarrhœa, cramps and collapse.

The subject of meat inspection, the parasites of meat and the diseases caused by the consumption of unsound meat are dealt with in a separate chapter.

The Storage of Foods and their Exposure for Sale.

All *grains* and *flours* stored for sale should be kept in specially made receptacles, such as tin-lined boxes with lids. They should be kept thoroughly dry and they would keep better if the access of air is prevented.

Milk and *Ghee* should be kept in thoroughly clean receptacles which preferably should be boiled before use. These receptacles should have covers to keep out flying particles of organic dust and flies.

Milk Shops should be thoroughly clean and each local body should pass bye-laws regulating the construction of such shops. The walls and floors should be of smooth impermeable material to minimise the accumulation of dust. A floor of concrete and cement would be suitable, but a properly laid tiled floor would be better. In default of walls of glazed bricks or some such material, the walls should be limewashed annually and kept in good repair. The roof should be well made so as to avoid the collection of dust.

Cowsheds should be open and airy and well ventilated. For the tropics the best type of cowshed is one which is open on all sides. The floor should be of impermeable material and sloped away from the centre of the shed on both sides. The mangers should be in a line in the middle of the shed. The shed should be surrounded with a properly sloped drain to carry away urine and washings.

There should be an abundant water supply and the floor of the shed should be washed down daily with water. No excreta should be allowed to accumulate on the premises; the dung should be disposed of daily and not kept for days on the premises for the purposes of sale. The urine and washings should be removed in urine carts in places with no system of drains.

The udder and teats of cows should be well washed before milking and the milker should see that his hands and the receptacles to receive the milk are thoroughly clean.

These are the objects which every medical officer of health should strive to attain, but in India it would be a long time before success will crown their efforts and a clean and unadulterated milk supply become available.

In many Indian towns a great part of the milk supply is brought in from outside the municipal area ; the cows from which it is drawn are kept under filthy conditions and the milk is brought in unsuitable receptacles. The public demand for a pure milk supply is almost completely absent ; the average consumer of the poorer class prefers to buy milk of which he receives a large quantity for his money rather than a dearer milk which is probably unadulterated.

Local bodies can make a start by establishing model cowsheds and dairies under their own supervision and by passing a byelaw that all milk sellers must be licensed. They can demand that dairies and cowsheds within the limits of their authority shall be properly constructed, and kept clean as a condition of a license being granted.

They can also refuse licenses to milk sellers who obtain their milk from cowkeepers who live outside the town and who keep their cows under insanitary conditions. Further, the cowkeepers themselves can be licensed and licences should be refused if their requirements are not complied with, and they should not be permitted to bring milk into the town for sale.

It is fortunate that it is the custom among Indians to boil all their milk before drinking it, otherwise epidemics of disease spread by milk would be very common.

Sweetmeats.—The custom of exposing sweetmeats of all kinds for sale in the Indian bazars without any protection from dust and flies is undoubtedly a frequent cause of the dissemination of disease. Organic dust, in which there may be pathogenic organisms, settles on these sweetmeats and swarms of flies infest the sweetmeat shops in Indian towns and villages. As flies feed indiscriminately on excrement and foodstuffs and as they have been proved to be able to carry the specific organisms of such diseases as cholera, enteric fever, dysentery and tuberculosis, the exposing of food stuffs to the access of flies is undoubtedly a great danger to the public health. That cholera epidemics are kept alive by fly infection after the water supply has been properly protected seems certain.

Local bodies should therefore require sweetmeat sellers to protect their wares from the access of flies by exposing them for sale in glass cases or boxes in which they can be seen and from which they can be taken out for sale to customers by means of a hinged lid or back.

In many places medical officers of health have induced sweetmeat sellers to adopt such methods for the protection of their wares, but such methods have not been rendered compulsory as yet.

The sale of meat should only be permitted in properly constructed meat markets.

The essentials of a good meat market in the tropics are :—

(1) They should be properly ventilated.

(2) They should be kept as cool as possible.

(3) They should permit of thorough cleaning by being flushed with water.

(4) They should be fly-proof.

To attain these objects these markets have to be carefully designed.

The windows should be large and so situated as to allow of a through current of air and they should be protected with fine strong wire gauze. The floor should be of impermeable material and provided with properly sloped drains. The meat stalls should consist merely of partitions in the market of thin walls carried up to a height of about 6 feet.

The meat should be hung on iron hooks from the roof and should be cut for sale on a slab of marble or polished slate and not on a wooden block. The stalls may be lighted from a large window at the back. The doors by which customers enter should be protected by turnstile wire gauze doors of four to six leaves to prevent the access of flies. A good plan is to have these doors at opposite ends of a central passage about 10 feet wide with the stalls opening into the passage, when erecting a small meat market of 6 to 8 stalls for a small town.

In larger towns the stalls might be placed in a large lofty hall.

Even such precautions will not prevent the access of flies, which will come in on the backs of customers. It is therefore necessary to periodically clear them out. This can be done at night with a spray of some disinfecting fluid such as formalin which is cheap and very effective in killing the flies.

Slaughter-Houses.—Houses for the slaughter of small and large animals should have a floor of some form of cement concrete which is impermeable and lasting. Floors of brick and stone allow blood and washings to get into the interstices where the blood putrifies. These interstices may be pointed, but experience goes to show that this pointing has to be very frequently carried out to be effective. The floor should be properly sloped to a central effluent drain or to a drain round the sides.

There should be an adequate supply of water at hand so that the floor can be properly flushed after killing. The blood and washings should not be permitted to run into pits from which they have to be bailed out, but should run from the effluent drain through a spout into a removable receptacle of suitable size, such as is recommended for the reception of urine in latrines without a water flush.

In the case of large slaughter-houses where many animals are killed daily, a urine cart should be placed under the spout leading from the effluent drain to ensure the ready removal of the washings.

In the tropics, slaughter-houses are better to be open on all sides, with a roof for protection from sun and rain during killing operations.

There should be arrangements for the speedy removal of offal, bones, hides, hoofs, horns and such parts of the animal as are not required for food, and the removal of meat found to be diseased and unfit for human consumption. Such meat should be destroyed in a refuse destructor or buried in deep trenches.

In the larger towns, meat markets and slaughter-houses are usually efficiently supervised, but in smaller towns such buildings are usually not suited for the purposes they are meant to serve. The importance of the provision of suitably constructed meat markets and slaughter-houses should be emphasised by the medical officers of health of such towns, and arrangements for the previous inspection of all animals brought for slaughter should be made. Constant supervision is necessary in order that these places may be maintained in a state of adequate repair and cleanliness.

Standard plans of slaughter-houses and meat markets are obtainable in most Provinces of India in the office of the Director of Public Health or the Superintending Engineer, Public Health Department. Those adopted in the United Provinces are given here (figs. 36 and 37).

CHAPTER IX

MEAT INSPECTION

The Appearance of the Healthy Animal and its Organs in the Carcase.—Every day the fact becomes more apparent that an important factor for the preservation of the public health of a meat-eating community is to have an efficient system of meat inspection, and hence a sound knowledge of this work is essential to all medical officers of health. The subject is a deep one involving a knowledge of animals in health, as well as of anatomy, pathology and bacteriology, and it is not possible to deal with it here in anything but a general way, but a few hints and suggestions on this special subject should be useful to medical officers of health in carrying out and supervising the duties of meat inspection. In order to carry out this duty in an efficient manner, thoroughness, method and acute observation are necessary. It is a duty that cannot be treated casually. If an animal meat for human food is carelessly examined, it is a waste of time, for defects and diseased conditions, which are likely to affect the health of the consumer, can be easily missed. In most countries the animals used for food are the ox, sheep, goat, horse, mule, donkey, swine, deer, poultry, game, etc., but in India, for all practical purposes, the ox, buffalo, goat and sheep are the chief animals used for food and with such medical officers of health are likely to be brought into contact in their inspections. Although their size, shape and habits differ, they are all polygastrics ; that is to say, they have more than one stomach, and hence are ruminants ; that is they go through a process of remasticating their food which is known as chewing the cud. A brief outline of the general anatomy of the ox will give a broad idea of how the others are constituted. The arrangement of the teeth is somewhat similar, although the periods at which they are changed are different. None of these animals have incisors in the upper jaw. A general description of the dentition will be found useful in order to know approximately if an animal is very old, and it is necessary to learn to tell the difference between the permanent incisors and the temporary ones, as it is on this that age, as told by dentition, is based.

The arrangement of the heart, lungs, and trachea do not call for any special remarks other than that it is necessary to know the position and arrangement of the organs in the thoracic cavity and the appearance and position of the various glands in the abdominal cavity ; the appearance and position of all the viscera should be noted carefully, and here again the glands should be noted.

The recognition of the general appearance of the live healthy animal must be cultivated in order to recognise at once an animal abnormal or diseased. Note whether the animal is emaciated or not (a very thin animal should always be regarded with suspicion) and if the skin and hair have a healthy appearance. A mangy or eruptive condition of the skin may merely indicate an affection of the skin itself, parasitic or otherwise, or may be the outward sign of some internal disease or may be due to the presence of intestinal parasites. The eyes and mouth will often indicate important diseases ; it should always be noticed if the eye is bright or dull and watery, and if the mouth is normal, or if there is a discharge of saliva. The condition of the nose of a bullock or buffalo is an indication of health or disease. In a healthy animal it has a natural dampness on it like spots of dew on grass. If the animal is diseased it is generally dry and hot. A careful observation of the animal in a quiescent state will often give some idea of its health, as a sick animal usually ceases to ruminate. The anus and vagina should always be carefully examined for traces of diarrhœa, and abnormal and diseased discharges ; the abdominal contour will usually indicate if an animal is pregnant. The eye and hand should be trained to systematically travel over the living animal from the tip of its nose to its tail, and quickly remark any deviation from the normal state.

It is plain that certain conditions in live animals justify immediate condemnation, whilst others need only be noted so that the condition may be remembered when the animal is killed and the carcase opened for inspection. Often it will be doubtful whether it is necessary to condemn or not, and here discretion must to a great extent guide the inspector. It goes without saying that an animal with symptoms of any of the contagious diseases must not be accepted and these include Rinderpest, Hæmorrhagic Septicæmia, Anthrax, Black quarter, Tuberculosis, Actinomycosis, Foot-and-Mouth disease, Pleuro-pneumonia, Cow-pox, etc., and although it is unlikely that these would all be diagnosed correctly, the symptoms would most likely be severe enough to justify condemnation or calling for the opinion of a veterinary officer. Meat inspectors should always keep themselves informed of any contagious disease prevailing in the neighbourhood as this will enable them to be on the look-out for disease when the animals come for slaughter. This information can usually be obtained from the District Board office or the Veterinary Department.

In examining animals suspected of anthrax, it must not be forgotten that this is communicable to man, and so great care should be taken in handling animals suspected. In inspecting the living animal intended for slaughter for food it must not be forgotten that care must be taken to detect and condemn animals showing certain septic conditions. Retention of the after-birth in the female and septic mastitis come under this category as well as bad abscesses and septic wounds. Diarrhœa and looseness in calves and other animals especially when accompanied with constitutional symptoms are regarded as suspicious.

These are some of the conditions likely to be met with in animals which medical officers of health may be called upon to pass for slaughter, but it will still be necessary to constantly educate the powers of observation until it becomes a matter of habit to distinguish a healthy animal from an unhealthy one. This being done the next point will be to discriminate under what conditions animals should be rejected. This decision in the living animal will not be difficult, as we know that disease not detected during life will probably be detected in the inspection of the carcase. In rejecting animals with the contagious diseases just mentioned or those suffering from septic conditions, those in very emaciated state or pregnant, or those showing severe constitutional disturbance or with evidences of parasitic affections, a meat inspector cannot go far wrong ; while those cases which are doubtful, but not in such a condition as to justify rejection should be subjected to a very searching examination after slaughter.

Some sort of familiarity with the various parts and positions of the organs in the dead body having been acquired, the points to be observed during inspection of a carcase now require to be described. As far as possible all the organs should remain in their normal or natural condition till after the examination has taken place and no organs should be removed by the butcher.

In examining the various organs, the chief points or characters to be noted are their size, colour, sheen, uniformity, blood content, consistence, and the appearance of their cut surfaces.

The following will be found a good systematic method to adopt for an inspection, and if thoroughly carried out, nothing should be missed. On the animal being slaughtered the process of skinning will commence, and here the inspector must be on the look out for blood extravasations, abscesses, skin tumours, effusions under the skin, œdema and other abnormal appearances. They may not mean anything but may be indications of other more serious conditions and in any case should be noted. The head, mouth and tongue should be examined for evidences of Actinomycosis and the lips and gums for Foot-and-Mouth disease, Rinderpest, etc. Often the masticatory muscles will, if opened, disclose the presence of cysticerci. The parotid, submaxillary and other glands should be carefully examined.

The thoracic cavity should be opened and its contents examined generally and in detail. It will first be seen if there is any morbid effusion or infiltration present to indicate the past or present existence of disease, after which the state of the serous membranes can be noted in order to determine if any traces of tuberculosis or other disease is present. The lungs and heart with a portion of the trachea should now be removed from the chest cavity and examined in detail. The trachea on being split open may show the presence of parasites and if it does it would be well to carry the knife a little further into the bronchial tubes. The shape, size, weight, colour and consistence of the lung substance should now be noted and the presence of tuberculosis, hepatization, consolidation and other morbid conditions remarked. The heart should be inspected and its consistence, size and colour observed. Sometimes echinococci and cysticerci are found to be present. At the same time all the adjacent glands in the vicinity of the thorax should be carefully examined.

In the abdominal cavity, the same procedure as to the presence of serous and other effusions must be gone through. The stomach, liver and other viscera may then be removed. The empty abdominal cavity will be viewed and a more detailed examination of its contents made. The liver should be carefully examined as to the colour, consistence, size, etc., and with a view to discovering the presence of degenerations inflammation, parasites, tumours, tuberculosis, etc. An incision into the lobes and large bile ducts should be made.

The four stomachs can now be examined on their external and internal surfaces, the chief points being the determination of the presence of or freedom from inflammations, tumours, parasites, actinomycosis, tuberculosis, etc.

The intestines come next and with the exception of gelatinous infiltrations the same conditions must be looked for.

The mesentery and omentum should receive especial attention as they are often the seat of pentastomes, hæmorrhages and tuberculosis, especially in the glands.

The testicles and bladder will require passing notice for tuberculosis and the uterus for the presence of retained fœtal membranes.

The udder in view of the likelihood of tubercular mammitis must also not be passed over too lightly.

In calves, especial attention should be paid to the likelihood of flukes, peptic ulcer of the stomach, enteritis, dysentery, navel-ill and septic arthritis.

In sheep especially, the carcase should be carefully searched for worms in the lung, liver and stomach and around important organs. The fat or adipose tissue should be examined to ascertain if it is of a proper consistency for health.

The Appearance of the Muscles, Fat and Organs in health and disease.—

Muscles.—Suppose that the carcase of the animal under inspection has been emptied of its viscera, etc., and is hung up to be dressed. Here the inspection of the meat will commence. It is first of all necessary to be acquainted with the appearance of fresh healthy meat and to compare it with meat not recently killed or diseased meat. The meat of various animals differs slightly. In cattle the colour varies according to the age and condition of the animal but young animals of from one to two years have a light red meat with very little fat and a firm elastic consistency. Bulls or working oxen are characterised by dark red, tough and coarse grained muscle tissue, which is also very poor in fat. Fattened heifers, which are not often met with in this country, have a bright red meat with a fair amount of fat.

Buffalo meat, when freshly killed, is darker and more red brown, but after cooling it often assumes a pale red colour similar to ordinary beef, but it always has a kind of blue look on a freshly cut surface. The meat is coarse grained and the muscular structure is held together by light connective tissue. There is a specific odour about buffalo meat, which is not met with in oxen.

Sheep flesh has a light or brick red appearance with a fine fibre and a firm consistency. If well fed, much fat is found under the skin, between the muscles and embedding the kidneys.

Goat flesh is somewhat darker than sheep's. It has also a specific odour and there is an absence of real fat.

Adipose Tissue.—The fat in animals in this country varies according to how the animal has been fed but it should not be of an oily consistency nor of a deep yellow colour, which often indicates a condition of jaundice or some liver disease.

In short, meat to be fit for food should be of the right colour, firm in consistency, with no abnormal odour but many variations will be found in these conditions, even in meat otherwise quite fit for food, and here again personal discretion will have to come into play. Tainted meat, putrid meat, meat from extremely emaciated animals, or meat of a very dark or green colour as well as of that of a fœtus should, of course, be condemned, as also that which gives evidence from its smell or otherwise that it has been improperly fed.

Pigmented portions and also carcases with melanotic tumours are not desirable for human food. Carcases showing infiltrations and croupous or diphtheritic conditions are always unfit. Carcases must always be rejected, the viscera of which show evidences of any of the infective granulomata. Degeneration, œdema, hæmorrhages, necrosis, serous infiltration, and malignant tumours will also come under this heading.

Digestive Apparatus.—In the *mucous membrane of the mouth and tongue* diseased conditions are often met with. These may be only inflammation or may be infectious granulations. The former are usually caused by wounds, irritating materials administered to the animals as medicines or taken by them as food. The second and most important may be the result of rinderpest, diphtheria (in calves), ulcerative stomatitis, aphthæ, actinomycosis, foot-and-mouth disease, etc. Rinderpest is differentiated by concomitant symptoms and other lesions in various organs; in foot-and-mouth disease there are bladder-like vesicles, but there are no lesions throughout the body as is the case with rinderpest, and the character of the excoriations is different. In actinomycosis there is a swelling and hardness of the tongue or buccal membrane, sprinkled with minute yellow spots. In the so-called diphtheria of calves there are croupous or diphtheritic membranes and in aphthae or stomatitis the diagnosis should not be difficult.

The larvæ of *gastrophilus* are frequently found in these regions.

In the œsophagus, papillomata, threadworms, etc., are often observed.

In the stomach and intestines the common abnormal conditions are inflammations and parasites as well as lesions of the infective diseases which have already been mentioned, and which will be described in detail later.

In the fourth stomach of calves the condition known as peptic ulcer is frequently met with, and sometimes death is caused from perforation of the stomach coats and general peritonitis. In these cases meat must be condemned.

The following parasites occur in the stomach and intestines :—

The larvæ of Gastrophilus which is a species of horse or cattle fly.

Amphistomes of different varieties are frequently met with and Strongylus contortus is often found in the fourth stomach of cattle, sheep and goats. Other strongyles also are often found. Monieza expansa are occasionally present in cattle and sheep and the larvæ of pentastomes are found in the walls of the small intestine. Often small nodules and tumours containing larvæ or worms are found in the submucous tissue. These may sometimes be mistaken in a superficial inspection for tuberculosis, but by crushing the caseous material with the addition of glycerine or dilute caustic potash, the worms may easily be isolated. The peritoneum of cattle frequently exhibits calcification, which may be mistaken for tuberculosis but can be distinguished chemically and microscopically. Peritoneal inflammations are very common and may be parasitic, tubercular or associated with alteration in the alimentary canal, ulceration of glands, etc. The peritoneal tissue, omentum and mesentery are favourable situations for the *Cysticercus tenuicollis* which varies from the size of a pea to a potato.

The Liver.—Cirrhosis, fatty liver, coccidiosis, hepatitis, rupture, atrophy, degeneration and occasionally necrosis may be met with. Tumours of the liver may be primary or secondary sarcomata. In an animal suffering from any of the infectious diseases already mentioned, lesions will usually be found in the liver. Parasites are very frequent especially echinococci, flukes, Cysticercus tenuicollis, and more rarely pentastomes.

"Calcareous" tubercles of a liver-yellow or yellowish brown colour, varying in size from a pin's head to a millet seed, are frequently observed in the liver.

The Kidneys—Here the most frequent conditions are hypertrophy, lime and pigment deposits, fatty or other degenerations and inflammations, and pyelo-nephritis. Tuberculosis is also frequently found.

The Lungs.—Hæmorrhages, broncho and pleuro-pneumonia, verminous pneumonia due to strongylus are frequently met with as well as abscesses, cavities, etc. The lesions of rinderpest, tuberculosis and hæmorrhagic septicæmia may all be found in this organ.

Specific Diseases.—*Rinderpest or Cattle Plague* is one of the most extensive cattle diseases in India. It is a specific contagious fever of a typhoid type characterised by eruption, excoriation, ulceration and apthous deposits in the mouth, on the gums, and tongue and extending throughout the alimentary canal, accompanied by great constitutional disturbance, diarrhœa with bloodstained fæces, and a high mortality. The presence of the concretions, ulcerations and apthous deposits in the mouth and other lesions will determine the nature of the disease.

Foot-and-Mouth Disease is also a disease in which there is a vesicular eruption in the mouth, but the nature of the vesicles will prevent the confusion of the disease with rinderpest.

Anthrax is the most dangerous disease usually met with in cattle as it is easily communicable to man by (a) inoculation, (b) inhalation, and (c) ingestion of affected meat. If such a calamity happens that an anthrax animal is slaughtered for food, it must be condemned and disposed of immediately either by burning or burying in lime and all the blood or discharges treated by fire or with some strong disinfectant. The indications of anthrax are a dark tarry condition of the blood, great softness and engorgement of the spleen and hœmorrhagic infiltrations into other organs. Its presence should be confirmed by microscopical examination and by cultural reactions.

Hæmorrhagic Septicæmia.—This is another fatal disease of cattle but not communicable to the human being. At the same time the meat is unfit for human food. It is chiefly recognised by great tumefaction of the throat and neck even down to the chest with profuse serous infiltrations.

Actinomycosis.—In this disease there is a fibrous thickening of the tongue, buccal membranes and jaws, caused by the actinomyces or ray fungus. It is a tough fibrous swelling studded with small yellow specks. This disease also affects man.

Pleuro-pneumonia (contagious) especially of goats and sheep, is very frequent. Here ascites is met with and pleural exudations and attachments. According to the severity of the disease, the living tissue will present every condition from mere congestion to consolidation and abscesses. Needless to say the meat is unfit for human food.

Tuberculosis in cattle, as found by post-mortem examination, generally occurs in one of two forms :

(1) Where the organs and glands only are affected.

(2) Where there has been invasion of the serous membranes.

The former is the more frequent form in cattle, and the latter is almost invariably secondary to disease of the organs.

Tuberculosis of the lining of the chest and abdominal cavities shows itself by the formation of a number of small lumps, or "tubercles", from the appearance of which the familiar name of "grapes", has been given. Sometimes these grow to an enormous size, so that they weigh several pounds ; at others the appearance presented is that of a roughening or velvety appearance of the wall, owing to the coalescence of a large number of small tubercles. Of the organs those most frequently affected are the lungs, then those of the digestive tract, and lastly the organs of generation. From a primary infection, all the organs of the body can be secondarily infected.

The tubercles are formed by the life processes of the bacilli, which live upon and bring about changes in the tissues, and in all cases, the bacilli can, if proper care is taken, be discovered. When the tubercles first appear they resemble little gray bodies, each of about the size of a millet-seed, or rather larger, and from this resemblance the name "miliary" tuberculosis has arisen. They rapidly increase in size by the multiplication of the bacilli, and by the formation of secondary foci in the neighbourhood of the primary ones.

Under the microscope, the appearance of a tubercle is very characteristic, from the alteration in the character of the cells of the tissue, which is brought about.

They are, however, unprovided with blood-vessels, and consequently undergo fatty changes or caseation. Sometimes the broken-down tissue hardens by the deposition of lime-salts, and the affected part gets shut off from the rest, and gradually heals. On the other hand, if pus forming bacteria gain an entrance, as is not infrequently the case, an abscess will be formed.

In meat inspection, the point that it is of the utmost importance to decide is whether an animal is affected with localised or generalised tuberculosis. The term "localised" is used when the disease is limited to one organ, or spreads to another organ by continuity, or by the lymphatic channels, or through the portal circulation (*i.e.*, the circulation between the intestinal tract and the liver), but not by means of the general blood-stream of the body. Examples of it are tuberculosis of the retropharyngeal lymphatic glands with tuberculosis of the lungs and bronchial lymphatic glands, tuberculosis of the lungs and pleura, tuberculosis of the intestines an mesenteric lymphatic glands, tuberculosis of the intestines and liver.

By "generalised" tuberculosis, as mentioned before, is meant the spread of the disease by the passage of tubercle bacilli into the main blood-stream or into the thoracic duct, and their conveyance thence to different organs and parts of the body, such as the lungs, liver, spleen, kidneys, bones and muscular tissue. If the bacilli in this case enter in large numbers into the blood-stream, then acute miliary tuberculosis (galloping consumption) results, but it by no means follows that in generalised tuberculosis all the organs and tissues become equally infected. Some tissues offer a particular resisting power to the organisms. The lungs are always attacked, then come in order the abdominal organs, the serous membranes, the lymphatic glands of the muscular tissue, the udder, kidneys, and lastly the bones.

Seeing, then, the importance of determining in a tuberculous carcase whether the disease is generalised or not, it is necessary to make a systematic examination of the organs and chains of lymphatic glands, which give the best indications of the presence of this condition. These are the lungs, liver, spleen, kidneys, the axillary glands, and the internal and external iliac glands.

Worms.—Among both groups of flat and round worms the following parasites are *not transmissible to man* by eating meat ;—

(*a*) All tapeworms of food animals, with the single exception of *Tænia echinococcus* of the dog.

(*b*) The larval stages of all tapeworms of food animals with the exception of *Cysticercus bovis*, *C. cellulosæ* and *Echinococcus polymorphus.*

(*c*) All fluke worms (trematodes).

(*d*) All nematodes (Ascaris, Eustrongylus, Filaria, Oxyuris, Strongylus, Trichocephalus and Acanthocephalus) with the single exception of *Trichina spiralis.*

In the case of the majority of these parasites, the discussion may be limited to the most important facts.

Flukes (Trematodes).—For the purpose of meat inspection the most important flukes are the liver flukes (*Distomum* or *Fasciola hepaticum*—fig. 38—and *D. lanceolatum*). *Amphistomum conicum* may also be mentioned as a less important member of the group of flukes. It is from 4 to 12 m. m. long and 1 to 3 m. m. wide, and usually of a red colour. It is found in the paunch of ruminants and is usually a harmless parasite.

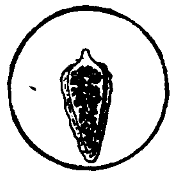


Fig. 38.—Fasciola hepaticum. (Knight's diagrammettes).

Liver flukes are found quite often in the lungs as well as in the liver. They are carried thither in the circulation, and are surrounded by a membrane which is at first of connective tissue, later becomes cartilaginous, and finally incrusted.

Although flukes are not generally supposed to be communicable to man by the digestion of infected meat, still a liver which is infested with them should unhesitatingly be condemned.

Round Worms (Nemathelminthes).—The worms are divided into two large groups, the thread-worms or nematodes, and Acanthocephali, of which the only representative which requires mention here is the giant Echinorhynchus of the hog.

The Ascaridæ (*Ascaris megalocephala* in the horse ; *A. lumbricoides* in cattle and hogs) live in the intestine and produce only exceptionally, in cases of excessive infestation, a disease of the affected animals. Isolated specimens may be occasionally found in the common bile duct and may cause icterus by retention of the bile.

In the fourth stomach of sheep and goats, *Strongylus contortus* lives parasitically (male 35 to 50 m. m., female 40 to 60 m. m. long). The parasite obtains its nourishment from the blood of the host, and in young animals may produce emaciation and hydraemic cachexia (stomachworm disease) in cases of excessive invasion.

Parasites which may be Transmitted to Man by Eating Meat.—There are three parasites of ordinary food animals which may be transmitted to man by eating meat :

(1) Beef bladder-worm (*Cysticercus bovis*) ; (2) pork bladder-worm (*C. cellulosæ*) ; (3) trichina (*Trichina spiralis*).

The new "measle-worm" of the sheep (*C. bovis*), which is supposed to be dangerous to health and concerning which Cobbold has assumed that it develops into a new tapeworm (*Tænia tenella*) in man, has been declared by the Paris Academy of Sciences to be *C. tenuicollis*. The frequent occurrence of tapeworm among the Arabians, who use mutton as their chief meat food, has no connection with this food. The Algerian tapeworm is, in fact, *T. saginata*, and comes from cattle. Leuckart considers that the bladder worm found by Cobbold in mutton is *C. cellulosæ* (with twenty-six hooks). This assumption is, according to the latest discoveries concerning *C. cellulosæ* in sheep, to be considered as well founded (Olt. Bongert), despite the fact that Leuckart did not succeed in artificially rearing *C. cellulosæ* in sheep.

Beef Bladder Worm (*Cysticercus bovis*).—NATURE.—The beef "measle-worm" is the larva of *Tænia saginata* of man. This tapeworm is 7 to 8 metres long and possesses mature proglottides which resemble pumpkin seeds and of which the uterus shows 20 to 35 lateral branches on each side. The beef measle worm, like the tapeworm which develops from it, is unarmed and has therefore also been called *C. inermis* to distinguish it from the armed pork measle worm.

Hog Bladder Worm (*Cysticercus cellulosæ*).—NATURE.—The hog "measle-worm" is the larval stage of a thin tænia of man, erroneously considered a solitary tape worm (*Tænia solium*, Rudolphi). *T. solium* (fig. 39) is about 3 metres long; the mature proglottides are provided with a uterus which sends out from seven to ten lateral branches on either side. On account of its location in the connective tissue which lies between the muscle fibres, (fig. 40), the hog "measle-worm" is given the name "connective tissue bladder worm" (*Cysticercus cellulosæ*). *C. cellulosæ* is provided with a double row of hooks.

Fig. 39.—Head of Tænia solium. (Simpson).

Fig. 40.—"Measly Pork" showing (diagrammatically) its appearance to the naked eye.
(*Parkes and Kenwood's Hygiene and Public Health*).

Trichina Spiralis.—ZOOLOGICAL POSITION.—According to the classification of Schneider, trichina belongs to the third group of nematodes, the Holomyaria. It is the only representative of its genus. Other nematodes have been erroneously considered to be trichinæ. Distinction is made between sexually immature individuals located in the intestines and the larvæ which are found in the musculature. It is only the latter, the so called muscle trichinæ, (fig. 41) which possess sanitary interest, for they

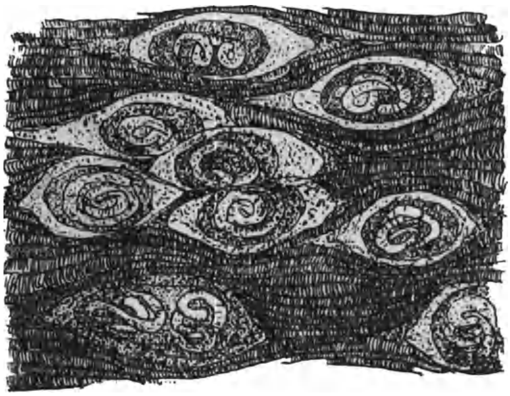


Fig. 41.—Trichinella spiralis. (Stitt).

occur spontaneously in one food animal, the hog, and may be transmitted through the meat to man and cause a serious disease, viz., trichinosis.

Bacteria.—Meat may also become infected by the organisms to which attacks of food poisoning are attributed. These organisms are bacilli of the Gaertner group which are aerobic coliform organisms closely allied to the bacilli of the typhoid group. The symptoms are either produced by the organisms themselves or by their toxins and such poisoning is usually known as *ptomaine poisoning* the symptoms of which are colic, diarrhœa, cramps, cold sweats and collapse, and the disease may often be mistaken for cholera.

Botulism is another disease caused by the *B. botulinus*. This is an anaerobic, motile, spore-bearing organism, which produces severe symptoms such as dryness of the mouth and throat, ptosis, double vision, paralysis, etc. It may be rapidly fatal in some cases. As a result of the recent fatality from Botulism at Loch Marree in Scotland, enquiries have been instituted in India in order to ascertain whether this disease is prevalent or not, but up to date no conclusive proofs have been produced establishing its prevalence in this country.

CHAPTER X

THE COMMON COMMUNICABLE DISEASES OF THE TROPICS—EPIDEMIC AND ENDEMIC—AND THE CHANNELS BY WHICH THEY ARE COMMUNICATED.

Many diseases in the tropics and in more temperate climates are transmitted to man by the agency of verminous and other insects. These animals may transmit the disease by direct inoculation through the skin such as by mosquitoes, or by infecting food by defæcating on it, or carrying pathogenic germs on their legs and bodies from infected material to the food supply. They may also in this way mechanically infect man through abrasions in the skin.

The following are the commoner insects which are known to carry the germs of infectious diseases :—

Ticks, fleas, flies, mosquitoes, lice, etc.

Ticks belong to the Phylum Arthropoda, class Arachnoidæ, order Acarina, sub-order Metastigmata, family Ixodoidea.

Ixodoidea have a large hypostome armed with many recurved teeth. They have become important in Tropical Medicine because they spread disease, as for example, the tick fever of Africa, Tsutsugamushi disease, the tick fever of the Rocky Mountains, etc. They are parasitic on birds, mammals and reptiles, but are not strictly confined to one host. The adults have eight-jointed legs, four on each side; the female is much larger than the male, and they live on blood. Larvæ have only six legs. Ticks which are known to spread disease are :—

1. *Ornithodorus moubata* which carries the *Spirochæta duttoni* and causes African tick fever or Dutton's relapsing fever in man.

2. *Eurhipicephalus sanguineus* which carries the *Babesia canis* and causes the tick fever of dogs, etc.

3. *Dermacentor occidentalis* causes Rocky Mountain fever.

4. *Argas persicus* causes a disease in Persia.

Bugs.—Bugs belong to the Arthropoda, class Hexapoda, order Hemiptera, sub-order Heteroptera, family Cimicidæ.

The *Cimex lectularius* and *Cimex rotundatus* have been proved to be the intermediate hosts of the *Leishmania donovani* which causes Kala-Azar.

Flies.—Class Hexapoda, order Diptera.

1. Sub-order Orthorrhapha, section Brachycera.

There are several sub-families :—

TABANIDÆ.—Flies with broad flattened bodies and large heads. Proboscis strong and prominent. The tabanidæ are blood-sucking flies and there are some 2,000 known species. Like mosquitoes, only the females suck blood while the males live on the juice of plants.

2. Sub-order Cyclorrhapha.

Contains the family :—

MUSCIDÆ.—Among these is the *Musca domestica* or common household fly.

STOMOXYS or stable fly.

GLOSSINA of which the *Glossina palpalis* and the *Glossina morsitans* are the causes of the two types of sleeping sickness of Africa.

Of the above flies the one that concerns medical officers of health in India most is the *Musca domestica.*

These flies have been proved to carry many pathogenic organisms on their legs and bodies and also in their intestines. Their fæces have been shown to contain virulent pathogenic organisms after feeding on infected material.

Organisms have been shown to remain virulent on the legs and bodies of the flies for several hours, which would give them plenty of opportunity to infect the food supply subsequent to contact with infected stools, vomit, sputum, etc.

The organisms they have been shown to carry are: *V. choleræ*, *B. typhosus*, *B. paratyphosus*, *B. gærtner* (food poisoning), *B. morgan* (diarrhœa), *B. shiga* and *B. flexner* (dysentery), *B. tuberculosis*, etc., and in addition various *amoebæ* and the eggs of many of the parasitic worms. They also transmit *Leishmania tropica*, the organism of oriental sore.

The enormous potentiality of these insects in the spread of disease in view of the above facts is sufficiently obvious to justify the initiation of almost any measures which would tend to effect their extinction.

The household fly lays its eggs by preference in human fæcal matter when somewhat decomposed, in horse manure, goat manure, cowdung and in fermenting vegetable matter. It also works its way into rubbish heaps to lay its eggs.

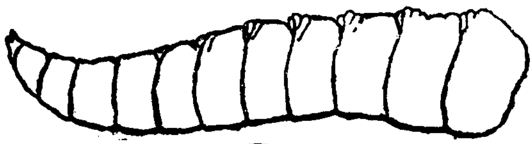
The time of development varies with the temperature and the full time necessary for an egg to become an adult fly is usually 12 to 30 days and never less than 8 days. The different stages of their development are shown in fig. 42.

Medical officers of health will therefore see the necessity for expediting the removal and destruction of rubbish, street sweepings, night-soil, etc., in order to reduce the fly population. Mere removal from the inhabited area to the outskirts is of no use as the breeding can be continued there and as flies can travel long distances it is necessary to ensure the destruction of the eggs, larvæ and pupæ in the rubbish. To dump rubbish in depressions for the purpose of filling them up will not prevent the breeding out of flies, as these have been known to work their way to the surface through 5 feet of sand. If the rubbish is dumped anywhere in a depression each layer one foot deep of rubbish should be immediately

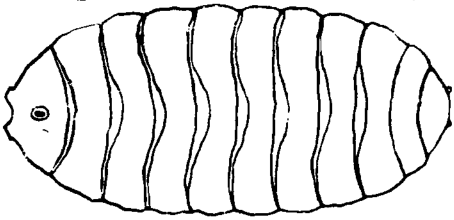
MUSCA DOMESTICA (AFTER HEWITT).

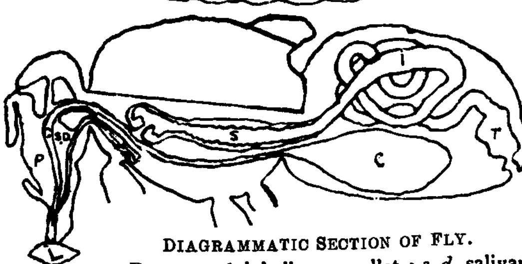
EGG.

LARVA HATCHED FROM EGG.



LARVA.

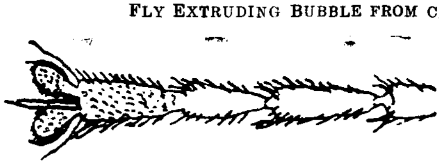




DIAGRAMMATIC SECTION OF FLY.

P. pump ; *l.* labella ; *g.* gullet ; *s. d.* salivary duct ; *s.* stomach ; *c.* crop ; *i.* intestine ; *r.* rectum.

FLY EXTRUDING BUBBLE FROM CROP.



LEG AND FOOT OF FLY.

Fig. 42.—The different stages of the development of fly.

(*Parkes and Kenwood's Hygiene and Public Health*) covered with a layer of fresh earth closely packed at least one foot in thickness, through which the flies that have bred out cannot reach the surface. If this is not done the flies will emerge and invade the nearest houses in search of food and perpetuate the nuisance. As these provisions are seldom properly carried out, it is inadvisable to use this method of disposal of street refuse. It is much better to incinerate all the street sweepings and to use the ash thus produced as manure as it contains all the necessary elements of a good manure. Night-soil should be properly trenched so as to prevent the access of flies for the purpose of laying eggs.

Fleas.—The rat flea *Xenopsylla cheopis* is dealt with under "plague" and at present it is the only known carrier of the organisms of the disease. The rat flea belongs to the family Pulicidæ, sub-family Pulicinæ, as does the *Pulex irritans* or human flea. They have 6 legs and a biting proboscis.

Lice (*Pediculi corporis*) are probably the infecting agents in Indian relapsing fever. Mackie has carried out researches which appear to incriminate these vermin, but a sexual cycle of growth has not been traced in these organisms. They also transmit Typhus fever.

The great epidemic of Typhus fever in Serbia in 1915 was certainly due to the infestation of the people with lice and the great campaign for delousing the troops effectually brought the epidemic to an end.

Mosquitoes.—The anophelinæ mosquitoes are the carriers of the malarial parasites and are dealt with in detail under "Malaria."

Culex fatigans is supposed to be the transmitter of the organism of dengue fever, which has not yet been isolated, but mosquitoes fed on patients suffering from dengue have been proved to be capable of transmitting the disease to others. It also is the vector of filarial worms.

Stegomyia calopus (fig. 43.) have been proved to transmit

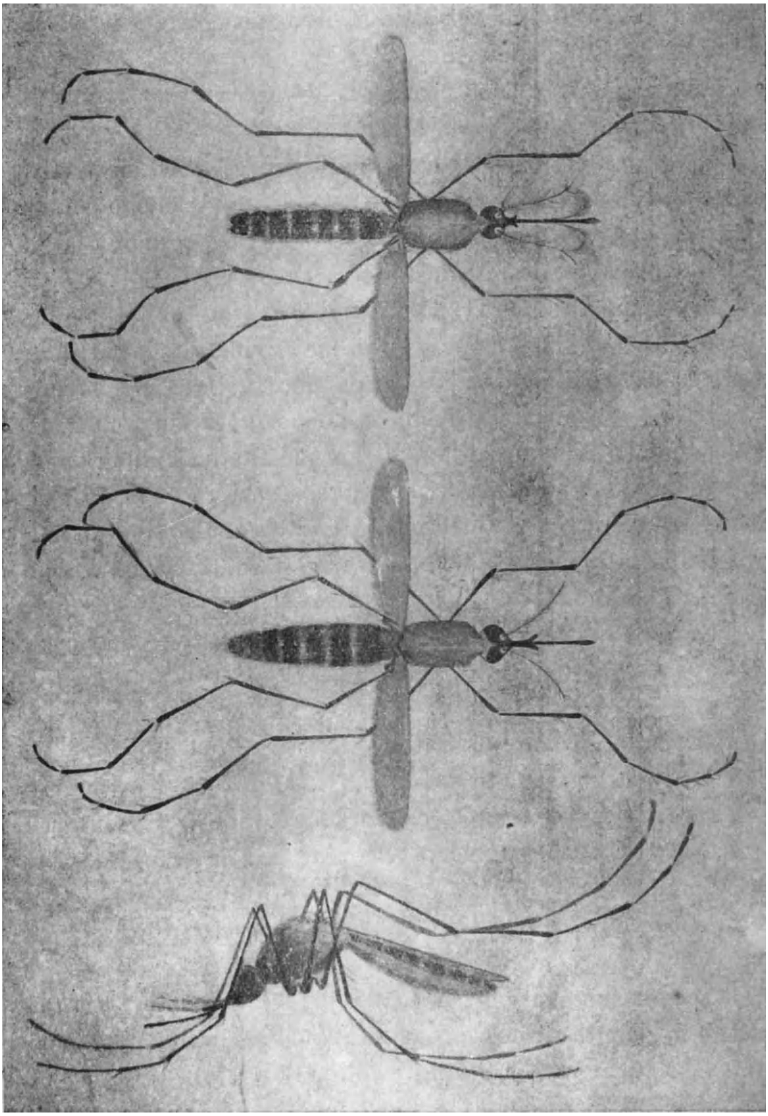


Fig. 43.—Stegomyia calopus, male and female (dorsal and lateral view).

yellow fever from man to man in the West Indies and measures instituted for their destruction have resulted in the practical eradication of this disease from many areas in which it was previously endemic.

Sand Flies have been proved to be the infecting agents in sand fly fevers in India and Malta.

We have mentioned above only the ticks, fleas, flies, etc., which are known to carry diseases which attack human beings but there are probably many others which do so and a large field for investigation remains.

Trypanosomes.—Trypanosomes are protozoa belonging to the Phylum Mastigophora, order Binucleata and the family Trypanosomidæ. They are characterised by having a more or less centrally placed trophonucleus, a kinetonucleus at the anterior end and an undulating membrane ending in a flagellum. The undulating membrane commences in a small basic granule near the kinetonucleus, with a connecting thread to it called rhizoplast. There is usually a contractile vacuole near the kinetonucleus.

The best known trypanosomes are :

T. lewisi of the rat. It does not appear to cause any disease.

T. evansi, the cause of Surra.

T. brucei, the cause of a cattle disease in Africa.

T. equinum, causes a disease in horses.

T. gambiense, the cause of sleeping sickness in Gambia and Uganda.

T. rhodesiensi, the cause of sleeping sickness in Rhodesia, etc.

Trypanosomes vary from 2.0 to 2.5 μ in breadth and 16 to 24 μ in length in case of the *T. gambiense* and other forms also vary greatly in length and breadth.

Under the microscope the above mentioned Trypanosomes vary little in appearance and in many cases can only be distinguished by their serum reactions. The usual method of their being carried from animal to animal is by the agency of biting flies.

Leishmania are herpetomonidæ ; a trypanosome stage has not been seen by any observer.

The *Leishmania donovani*, the cause of Kala-Azar, can be recognized in the blood in the stage of the small rounded binucleate parasite usually in the large mononuclear leucocytes or free in the blood stream.

Leishmania tropica is an organism similar to the above and is the cause of Delhi boil, tropical sore or frontier sore.

Leishmania infantum, the third known species in this class, is the cause of the infantile Kala-Azar of the Mediterranean littoral. It is possibly identical with *L. donovani*.

Spirochaeta are another family belonging to the protozoa. They are characterized by the diffuse character of their nuclei, in some of which they are very diffuse and in others fairly condensed. There is a difference of opinion as to whether they are really protozoa or bacteria. They vary in size from the *Spirochæta recurrentis* or the organism of English relapsing fever which is 8 μ in length to the *S. balbianii* (found in oysters) which may be 150 μ in length and 2 to 3 μ in thickness. They are more probably protozoa because

1. They have an undulating membrane.
2. They divide longitudinally.
3. They do not dissolve in distilled water.
4. They will not grow on media.

The best known are :

Spirochæta recurrentis, which causes English relapsing fever ;

Spirochæta duttoni, which causes African relapsing fever ;

Spirochæta carteri, which causes Indian relapsing fever ;

Spirochæta can be distinguished by agglutination and by immunisation tests, and by Pfeiffer's reaction. These tests are also used with Trypanosomes.

Treponemidæ.—These are Spirochæta without any undulating membrane ; very delicate, thread-like bodies which are cylindrical on section, not flattened.

The best known are :

Treponema pallidum, which causes syphilis.

Treponema pertenue—cause of yaws or Frambœsia.

Treponema pertenue varies in length from about 8 to 18 μ. It is not easy to stain, prolonged immersion in Giemsa's stain being necessary. It can be distinguished from *T. pallidum* by animal and agglutination tests.

Yaws is very common in Upper Burma and Ceylon, but rare in India. It is conveyed by direct contact, but not through the unbroken skin, abrasions and cuts being necessary. There is little doubt that flies carry the organisms from infected sores to uninfected abrasions in other people. Frambœsia patients should therefore be isolated and their open sores properly dressed.

MALARIA.

Malaria is a term used to designate a group of fevers caused by a family of protozoal parasites which are closely allied.

These parasites are plasmodia which go through a definite cycle of life in the blood of man and also an extra-corporial cycle in certain varieties of mosquitoes.

The fevers included in the term Malaria are :—

(*a*) Benign tertian fever.
(*b*) Malignant tertian fever.
(*c*) Quartan fever.

The parasites of these fevers gain access to the body in the form of sporozoits, which pass from the salivary glands of the mosquitoes down the proboscis when an infected anopheline bites a man.

In the blood all the entering parasites may be killed by the phagocytes or may develop and multiply in the blood until they are sufficient in number to cause fever. In some cases the parasites may lie dormant in the spleen for long periods in numbers so small as to prevent the occurrence of febrile attacks until some lowering of the vitality or body resistance gives them an opportunity.

The interval between the entrance of the parasites to the body and the attack of fever varies with the intensity of the original infection, the nature of the particular parasite and the body resistance to the parasite. The rise of temperature occurs when a sufficient number of the mature parasites sporulate.

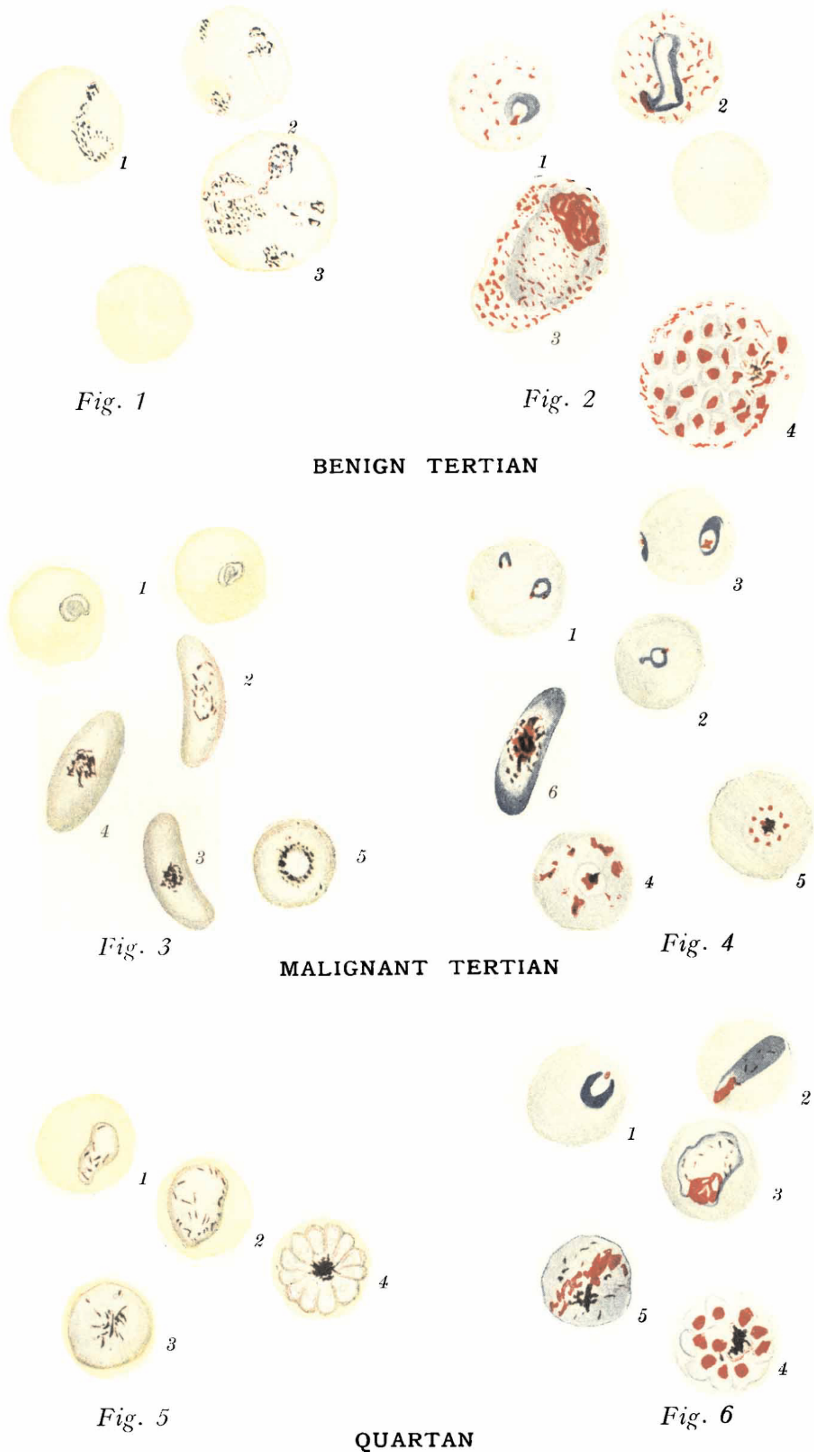
1. **The Parasites.**—(*a*) *Benign tertian fever* The parasite of this fever is called the *Plasmodium vivax* (figs. 44-i & ii).

In the sporozoit form in the salivary glands of the mosquito the parasites are fine fusiform bodies 10 to 20 μ in length and 1 to 2 μ in breadth.

They contain a central nucleus of chromatin. On entering the blood stream of man they attack the red blood corpuscles and are called trophozoites.

The trophozoites live in the substance of the red cells and grow. A vacuole appears in their substance and they assume the characteristic ring form which gradually increases in size; the vacuole, however, remains more or less small, and pigment granules begin to appear in the body of the parasite. These pigment granules have been named "hæmozoin" by Sambon. The parasites throw out pseudopodia which aid their activi-

Fig. 44—Malarial Parasites. [To face page 175.



ties but on attaining full size they are no longer amæboid. The fully developed parasite is called a "schizont."

The nucleus of the schizont divides up into segments. The cytoplasm segments also and surrounds these nuclei and forms what are called "merozoites." A portion of the cytoplasm containing pigment is always left unsegmented. The blood corpuscle breaks up and the merozoites are set free ; this is called sporulation. The merozoit then endeavours to enter a red blood corpuscle and starts again as a trophozoit. Many, however, are taken up by the phagocytes and destroyed.

This cycle of the parasite is called "schizogony" or the asexual cycle. During sporulation toxin is liberated from the parasite and it is the accumulation of toxin which, by acting on the human organism, causes the changes in metabolism productive of rises of temperature. In addition, each merozoit destroys a red cell and when many of these are destroyed anæmia results. In the absence of treatment this process apparently can go on indefinitely, being only kept in check by phagocytosis. Usually in an untreated case the attacks of fever gradually cease only to commence again in a condition of lowered vitality caused by a chill or other predisposing cause. It seems therefore that the toxins must be neutralized eventually by the formation of antitoxin in the blood.

In cases treated by quinine the attacks are rapidly terminated owing to the destructive action of the quinine on the young merozoites during sporulation.

Sexual forms also occur in the blood stream but these in their earliest forms cannot be differentiated from ordinary merozoites. The sexual form grows slowly and does not develop a vacuole. The female develops a larger amount of pigment than the male. When full grown the female parasite is called the macrogamete and the male, the microgamete. The macrogamete has a small rounded nucleus which is often laterally placed and contains a large amount of irregularly disposed pigment ; the microgamete has a larger nucleus, which is more diffuse, stains less deeply and has less pigment than the female.

These sexual parasites come to occupy the whole of the red corpuscle at full growth and are found as large bodies in the plasma. The microgamete dies off if not able to reach the mid-gut of the mosquito, but it is thought that the female may persist for long periods in the human organism and reproduce merozoites by parthenogenesis and thus may account for relapses after long periods. In reproduction by parthenogenesis, the nucleus divides into two parts. One is rich in chromatin and becomes surrounded by deeply pigmented cytoplasm ; the other becomes absorbed. The former becomes a schizont and reproduces merozoites.

If a female mosquito belonging to certain species of anophelines ingests the blood of a person suffering from malaria and both the macro and the microgametocytes are ingested, a cycle of life in the mosquito may be started. This is the sexual cycle or *sporogony.*

The nucleus of the macrogamete divides once or twice and polar bodies are extruded. The microgamete also changes and portions of its nucleus travel to the periphery and are extruded surrounded by cytoplasm as flagellae. These lash about and finally break off to form the microgametocytes which have a close resemblance to spirochætes as their nuclei are very diffuse. They have, however, no undulating membranes.

The microgamete now conjugates with the macrogamete and their nuclei fuse together. The fertilised cell is called the Zygote or Ookinet. This rounded body becomes elongated and its pointed end pierces the wall of the stomach of the mosquito and becomes encysted as a spherical or ovoid body in the muscular coat where it is known as the Oocyst. This grows quickly and by division of the nucleus forms sporoblasts.

The nuclei of the sporoblast masses again divide into a number of fine, curved, thread-like bodies, the sporozoits, so that eventually the Oocyst is full of them. The Oocyst bursts and an enormous number of these sporozoits are extruded into the body cavity of the mosquito. Thence they gain access to the lympho-circulatory system and find their way into the salivary glands.

The whole process of sporogony takes place in 10 to 12 days. From the salivary glands the sporozoits can gain entrance into the blood stream of man again when the mosquito host is feeding. When a sporozoit of benign tertian fever enters a red cell it feeds on the substance of the red cell which becomes pale and degenerates, and owing to the absorption of the fluid, gradually enlarges. The degeneration is said to be shown by the appearance of red dots in the cell protoplasm when the film is stained by Leishman's method These are known as Schüffner's dots. It is possible, however, that these may be entirely due to the staining reaction.

The *P. vivax* sporulates in about 48 hours and forms 18-24 merozoites.

(*b*) *Malignant Tertian Fever* (fig. 45—3 and 4)—The *Laverania malariæ*, the parasite of malignant tertian fever, differs from the plasmodium in the fact that the gametocytes are crescentic in shape.

The ring forms are very small and the fully grown schizonts are rarely seen in the peripheral blood. The red cell does not enlarge.

The parasite usually sporulates in the internal organs, splitting up into 6-12 merozoites ; they are rarely seen in the peripheral circulation.

The macrogamete has a compact nucleus with the pigment gathered round it and is long and slender. The microgamete is shorter and broader in shape with a more diffuse nucleus and scattered pigment.

(*c*) *Quartan Fever* (fig. 44—5 and 6).—The *P. malariæ*, the parasite of quartan fever, attains maturity and sporulates in 72 hours. The trophozoit is smaller than that of the *P. vivax* and not so active.

The containing red cell remains unaltered in appearance and size or may even appear smaller and Schüffner's dots are never formed.

The granules of pigment are coarser and more abundant than in *P. vivax*.

The nucleus splits up into 8-12 merozoites only and the pigment gathers in the centre of the cell. A ribbon form across the red cell is characteristic of this parasite.

The annexed table issued by the Central Malaria Bureau, Kasauli, India, gives the character of the 3 parasites and a close study of this table will usually enable the observer to differentiate between them.

The respective developments of the three parasites in the mosquito differs very little. The same process takes place in each case, there being a slight difference in the time taken over the various stages of development.

In examining the peripheral blood for malarial parasites films should be made and the specimens should be examined both stained and unstained.

The stains chiefly in use for this purpose are Leishman's and Giemsa's. Each slide should be examined for at least ten minutes and failure to find parasites does not justify a negative diagnosis. The edges of the film and the fingerlike processes should receive special attention. Often pale and broken cells indicate a malarious condition in the absence of parasites and malarial pigment can sometimes be seen in the mononuclear leucocytes.

Previous quininization will almost surely cause the disappearance of all ring forms and schizonts from the peripheral blood ; gametes, however, may be found in the peripheral blood even after prolonged quininization, especially in malignant infections.

II. The Extra Corporeal Hosts.—The classical researches of Sir Ronald Ross established beyond doubt the fact that certain kind of anopheline mosquitoes were the infecting agents in malaria and the extra corporeal life or sexual cycle of the parasites was completely worked out by him, just as the intra-corporeal or asexual cycle had been previously by Golgi.

The anophelinæ belong to the order Diptera, class Hexapoda, with two well developed transparent wings and two rudimentary wings or halteres, sub-order Orthorrhapha, section Nematocera and family Culicidæ.

The most important genera of the family are the Culicinæ. Anophelinæ and Stegomyia.

Theobald's monograph on the "Culicidæ of the World" is the standard work on the subject of mosquitoes and their classification. Some flies, such as Midges, Sand flies and Owl-midges are often mistaken at first for mosquitoes but examination of their wings shows that they are devoid of scales in most instances.

The following description of the anatomy of an anopheline mosquitoe (fig. 45) is after Theobald.

The body consists of :—

(*a*) head (*b*) thorax (*c*) abdomen.

(*a*) *The Head.*—Two large facetted brilliantly coloured eyes occupy nearly the whole of the anterior portion of the head. Dorsally the eyes nearly meet. In front of the eyes on the frons are carried the proboscis, palpæ and antennæ. The antennæ are segmented and plumose, the male antennæ being longer and more plumose than the female. The palpæ are five-jointed and as long or nearly as long as the proboscis, being club-shaped at the ends in the male. The proboscis projects between the palps from beneath the

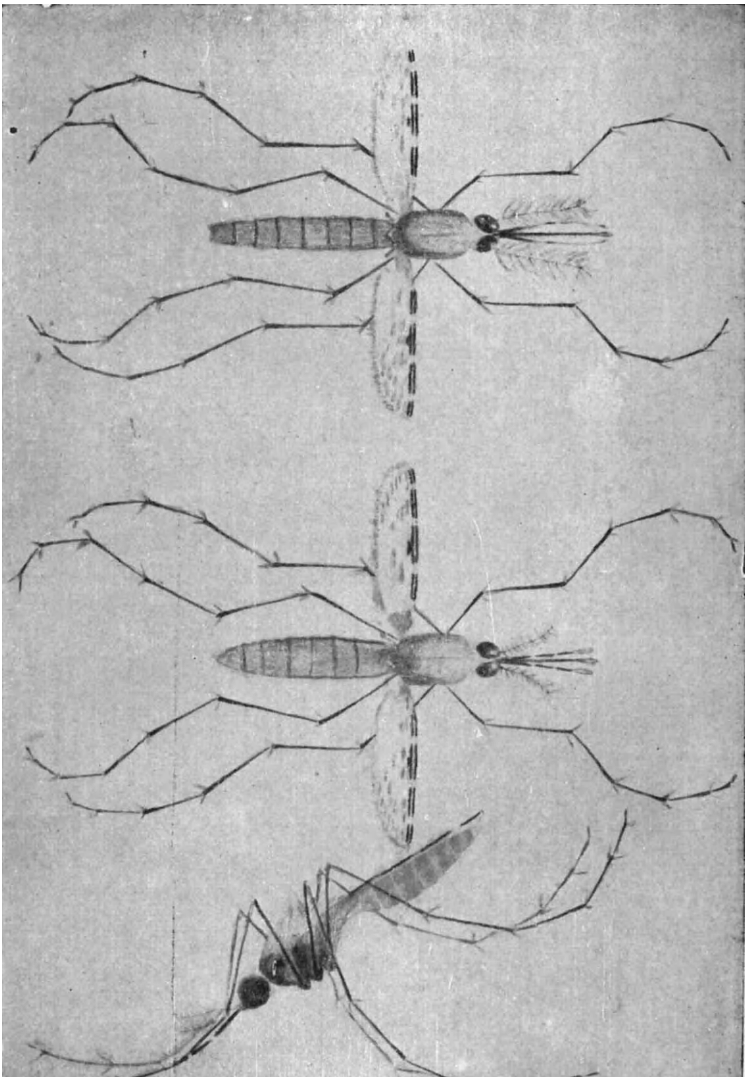


Fig. 45.—Anopheles. [To face page 180

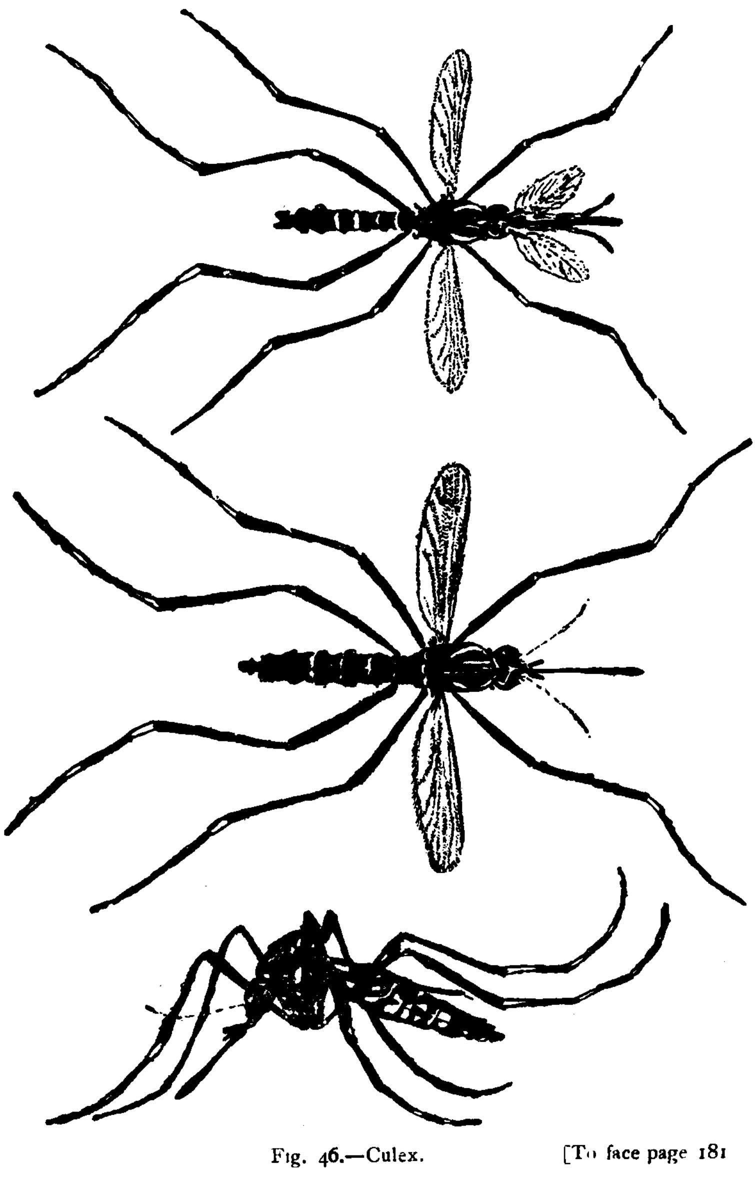


Fig. 46.—Culex. [To face page 181

(Stephens and Christophers).

clypeus, which is of chitinous material and projects forwards from the frons..

(*b*) *The thorax.*—The thorax consists of three divisions, the prothorax, mesothorax and metathorax. The mesothorax is much the largest portion. The six-jointed legs arise from the thorax and also the two wings. There are projections from the prothorax called prothoracic lobes or patagia and some varieties have tufts of scales on them which are useful in diagnosing the species. Behind the thorax is the scutellum which carries the halteres. Behind this again is the abdomen with eight segments the terminal one of which carries the genitalia and anus. The genitalia vary in many species and may be used in classification.

The anophelinæ differ from the culicinæ in several important particulars.

(1) Attitude when resting on the wall. The body of the anopheline when resting on a wall is always at greater or less angle with the wall according to species and the head, thorax and abdomen are in a straight line. The body of the culicine is usually parallel with the wall and is also bent, or hunch-backed, the head and thorax not being in a straight line with the abdomen (fig. 46).

(2) The wings of the anopheline are nearly always spotted although there are a few varieties with unspotted wings, *e.g.*, *M. culiciformis* and *A. barianensis*.

(3) The palpi in the female anopheline are similar in length to the proboscis, whereas the palps of the female culicine are very short. In the male the palpi of the anophelinæ are club-shaped while those of the culicinæ are pointed and bent upwards somewhat like a scimitar.

As male mosquitoes live on vegetabe juices only and are not blood-suckers, it is not as necessary to classify the males into their genera and species as it is for the females; the difference, however, are mainly confined to the antennæ, palpæ and genitalia.

The anophelinæ have been classified into species in various ways by various workers. Theobald's classification, based on the scale structure and the position of the scales being the most accurate as well as the most scientific.

Nearly all the Indian varieties, however, can be classified with the aid of a hand lens only by studying the markings on the last pair of legs and the palpæ. In a very few cases only would it be necessary to examine the wings or the scale structure to differentiate between two species.

The annexed synoptic table issued by the Central Malaria Bureau, Kasauli, gives the identification in detail of the Indian species.

Anophelines have been classified by Christophers into the following groups, based as regards the main divisions on the male genitalia (fig. 47).

Tribe Anopheline
Genus Anopheles
Subgenus Chagasia
Subgenus Bironella
Subgenus Anopheles
Subgenus Nyssorhynchus
Subgenus Myzomyia

CHAGASIA is represented by a single species from South America and BIRONELLA by a single species from New Guinea. The subgenus NYSSORHYNCHUS is entirely confined to South and Central America. The Indian species fall into the two genera Anopheles and Myzomyia, and are to be distinguished and grouped as follows :

Subgenus Anopheles

Wings spotted or unspotted, but if spotted there are less than 4 main dark costal spots. The male genitalia have two parabasal spines only on each sidepiece. The larvæ have a

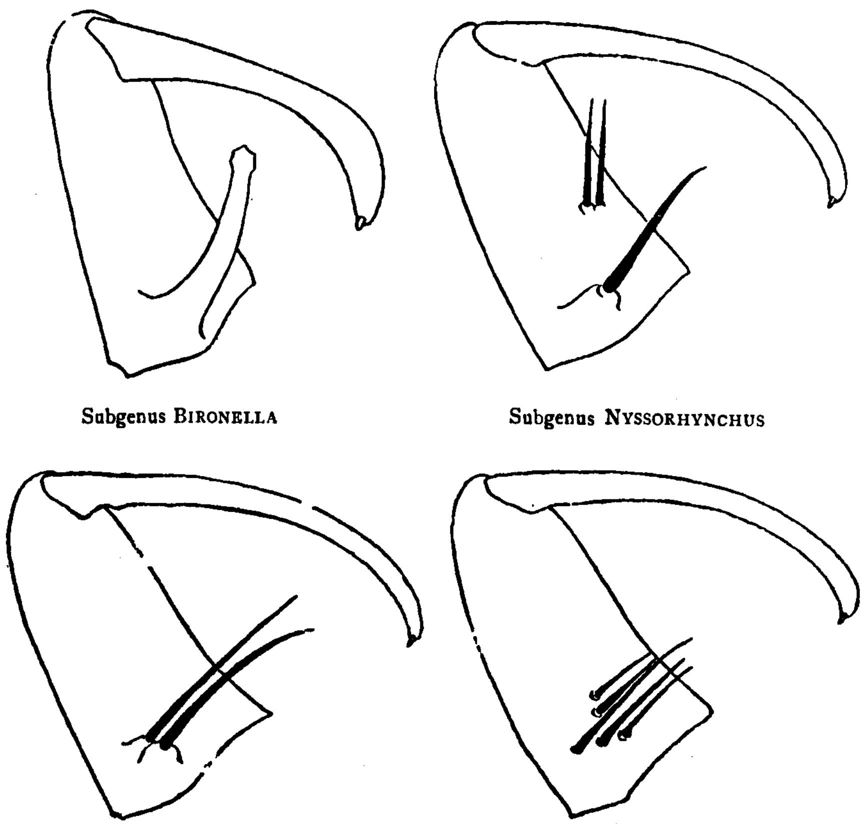


Fig. 47.—Christophers' classification of anophelines into groups based on the main differences of the male genitalia.

[To face page 182

branched hair on the antennæ and the leaflets of the palmate hairs are lanceolate in shape (except in *aitkeni*).

Species: *aitkeni*, *annandalei*, *lindesai*, *lindesai* var *nilgiricus*, *gigas*, *gigas* var. *simlensis*, *hyrcanus* (*sinensis*) var. *nigerrimus*, *barbirostris*, *umbrosus*.

Subgenus MYZOMYIA.

Wings spotted with four main dark costal spots. The male genitalia have 4 or 5 parabasal spines on the sidepiece. The larvæ are without a branched hair on the antennæ and the leaflets of the palmate hairs are truncated with a filament.

Species:

Group Myzomyia. Legs unornamented except in some cases with narrow and inconspicuous tarsal bands.

Culicifacies, *multicolor*, *turkhudi*, *listoni*, *aconitus*, *minimus*, *minimus* var. *varuna*, *superpictus*, *jeyporiensis*, *jeyporiensis* var. *moghulensis*.

Group Pseudomyzomyia. Legs with broad pale banding front tarsi. Mesothorax without vestiture of broad scales. Speckling of femora and tibiæ present in some cases but tips of hind tarsi not white.

Subpictus (*rossi*), *vagus*, *ludlowi*.

Group Neocellia. Legs with broad or conspicuous pale on banding on front tarsi. Mesothorax with vestiture of broad scales. Female palpi with normally three pale bands. Except in *stephensi* tips of hind tarsi white.

Stephensi, *fuliginosus*, *pallidus*, *theobaldi*, *jamesi*, *maculipalpis* var. *indiensis*, *maculatus*, *maculatus* var. *dravidicus*, *willmori*.

Group Cellia. Legs with broad pale banding on front tarsi. Mesothorax with vestiture of broad scales. Female palpi with normally four pale bands. Abdomen with projecting lateral scale tufts.

Pulcherrimus.

Group Neomyzomyia. Legs with broad pale banding on front tarsi. Mesothorax with or without broad scales. Female palpi with normally four bands or more. Abdomen without lateral scale tufts.

Karwari, kochi, leucosphyrua, tessellatus.

Many of these species are very rare, the commonest being *N. fuliginosus, M. culicifacies, Nsm. rossi, M. listoni, N. maculatus, Ne. willmori, N. maculipalpis, N. stephensi* and *M. barbirostris. N. fuliginosus, M. culicifacies, Nsm. rossi* are practically universal in India. *N. maculatus* and *Ne. willmori* are commonest in the foothills of the Himalayas and *N. maculipalpis* in the Terai.

Pt. lindesayi, N. maculatus and *Ne willmori* are common hill varieties. *Pt. gigas* is a rare hill variety. *P. nigrifasciatus* is rare in India in general but has been found in numbers in the vicinity of Quetta.

Ne. stephensi is very common in Bombay where Dr. Bentley found it breeding in large numbers in the wells of the city and they also are found in many wells in the United Provinces, *e.g.*, in Lucknow and Rai Bareli. *Ch. halli* has only been found in Assam and *P. jeyporensis* is a common mosquito in Jeypore (Madras).

Of the above-mentioned mosquitoes only seven have been proved to be carriers of malaria in nature, *viz.*, Fuliginosus, Culicifacies, Stephensi, Listoni, Maculipalpis, Willmori and Ludlowi.

Ross states that the following are described in literature as carriers :—

Fuliginosus, Culicifacies, Stephensi, Listoni, Maculipalpis, Maculatus (Theobald), Sinensis (Wiedman), Barbirostris (van-der Wulp), Ludlowi.

Christophers has in the laboratory artificially infected 18 species and observed the whole extra-corporeal cycle of the life of the parasite in each. Culicines have been artificially infected in the laboratory but no life cycle takes place in them.

The disease is transmitted by the mosquitoes to man in the following manner.

The female mosquito, in feeding on a human being suffering from malaria and in whose peripheral blood sexual forms are circulating, imbibes these forms with the blood. The extra-corporeal cycle takes place as already described and when the sporozoits have entered the salivary glands, the mosquito becomes infective.

The mosquito in piercing the skin of man with its proboscis moistens it with saliva, which gains access to the blood-stream of the man the mosquito is feeding on, and the intra-corporeal cycle is set up.

If small numbers of sporozoits gain access to the newly infected man they may all be destroyed by phagocytosis and no infection may take place. If, however, the phagocytes are unable to cope with the invading sporozoits and they come to maturity and sporulate, the number of parasites is largely increased. The number of parasites by successive sporulations goes on increasing until febrile symptoms are produced owing to the large biochemical changes produced in the system.

Life History of the Mosquito.—Mosquitoes undergo complete metamorphosis, *i.e.*, they go through the stages of egg, larva, pupa and imago or full grown insect.

The female adult is probably fertilized shortly after hatching and it deposits its eggs, when mature, on the surface of the water. Anopheline eggs are usually found in star and triangle patterns and culicine eggs are laid in rafts $\frac{1}{5}$ to $\frac{1}{8}$ of an inch long.

The eggs of anopheles are from ·5 to 1 millimetre in length, having a flat upper and a concave lower surface. They are in a chitinous covering and at the sides this is thrown into folds which contain air. These are known as the floats. The egg stage lasts two or three days in the tropics, but in more temperate climates eggs can hatch out that have been in ice all winter. The larva escapes from the egg by pushing off a cup-like piece at the end of the egg.

The larvæ (fig. 48-i) of anopheles have head, thorax and

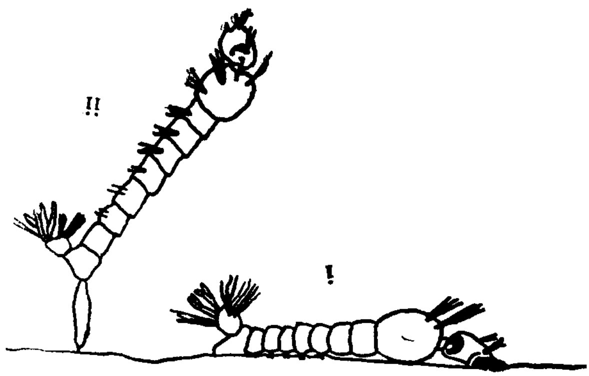


Fig. 48.—Larvæ of an Anopheline (i) and Culex (ii). (Stephens & Christophers).

nine abdominal segments. The head is armed with antennæ which sometimes have a branching hair.

There are also basal hairs at the base of the antennæ and two pairs of frontal hairs. The shape and appearance of these hairs and the absence or presence of the branch hairs on the antennæ are of specific importance. The mouth parts consist of feeding brushes, palps and mandibles. The thorax is large and has numerous hairs on each side. On the abdomen posteriorly and laterally are a series of fan-like processes called palmate hairs, which may vary from one to five pairs and which are attached to the upper segments of the abdomen. The segments have besides numerous other hairs. The eighth segment is distinguished by having dorsally placed tracheæ by which the animal breathes. The palmate hairs are the agency by which the larva keeps its horizontal position on the surface of the water when breathing.

The larval stage varies with the temperature from 10 to 20 days.

The pupal stage lasts about 48 hours, the pupa being a comma-shaped tadpole-like object. It splits up at the back with a T-shaped fissure and the imago escapes.

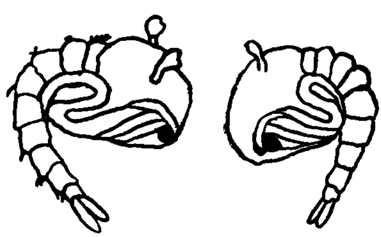
Pupæ do not eat and are easily killed in this stage.

Culicine larvæ (fig. 48-ii) have no palmate hairs and do not lie horizontally under the surface of the water. The eighth segment is provided with a long stigmatic syphon by which it breathes and from which it hangs at an angle from the surface of the water.

Behind this syphon is a characteristic structure consisting of long parallel hairs called the pecten or comb, which is highly specialised in the anopheline. The larvæ of the two families are therefore easily distinguished.

Until recently, sex was not thought to be distinguishable in larvæ but Mrs. Adie has now shown that testes are quite distinguishable in the sixth segment in larvæ a few days old.

The nymphæ of anophelinæ (fig. 49-i) lie less vertically



i — Anopheles   ii — Cullex

Fig. 49.—Nymphæ of Anopheline and Culex. (Stephens & Christophers).

in water and are more elongated antero-posteriorly and compressed laterally than those of culex (fig. 49-ii).

Prophylaxis.—This may be divided into :—

1. Personal prophylaxis.
2. General prophylaxis.

As prophylaxis by means of quinine enters into both (1 and 2) and is of great importance, it is considered here separately.

QUININE PROPHYLAXIS.—If quinine is administered prophylactically, it poisons all or the great majority of the young forms so that very few or none may reach maturity. The continued administration of quinine thus eventually frees the system from the parasites. It has a much slower and less powerful effect on mature forms or sexual forms. The drug appears to be able to attack and kill young forms when circulating in the blood stream but does not appear to be able to kill them so easily, effectively and rapidly when in the spleen. Latent malaria may therefore be kept up by the continuation of the sexual cycle in the spleen where the quinine fails to destroy the young forms.

Malaria may also exist in latent forms in the human organism for long periods owing to normal phagocytosis keeping the number of parasites below the ratio necessary to cause febrile symptoms and will not become patent until phagocytosis become less active owing to lowered vitality, cold or some intercurrent malady. The amount of quinine necessary in order to keep the inhabitants of malarious countries free from infection during the malarial season varies with the numbers of infected mosquitoes which have access to these inhabitants, and also with the degree of infection of each carrying mosquito.

In epidemic years, when many mosquitoes become infected and receive at each feed a very heavy infection, they may have their salivary glands swarming continuously with sporozoits, and consequently large and frequent doses of quinine are necessary.

In some epidemics, *viz.*, Amritsar—1908, the number of sporozoits which gained access to the blood-stream was so great that severe febrile symptoms were produced in two days *i.e.*, at the first period of sporulation and at the end of the first intra-corporeal cycle of life of the parasite. In the course of such an epidemic nothing short of 15 grains of quinine daily would be an efficient protection so that quinine in sufficient quantities might be continually circulating in the blood. Normally 5 grains daily is a sufficient prophylactic dose. Quinine taken by the mouth appears in the blood stream in the cou.se of about 5 hours and can be detected in the blood up to 24 to 36 hours.

The bi-weekly method is not now recommended by the best authorities but it is better than the single weekly dose which was based on the theory that after a dose, quinine would still be circulating in the blood after 24 to 36 hours and if taken in the morning would protect until the next day. If on the evening of the second day, infected mosquitoes were to bite the individual in question, sporulation would not occur till at least 48 hours later, *i.e.*, 3½ days after the first dose was taken, so that a dose taken then would kill the newly formed merozoits and keep off the infection. As, however, some of the sporozoites would sporulate in the spleen their spores might escape destruction and an attack of malaria be produced in spite of the bi-weekly dose of quinine.

In the case of the daily dose the newly entered sporozoits would be destroyed and never reach maturity. During an attack of fever, quinine should be administered immediately the nature of the attack is suspected no matter what stage of the cycle is in progress. 5 to 10 grains three times daily, according to the severity of the attack are sufficient.

This treatment should be continued for at least one month even in the absence of fever if it is desired to eliminate the parasites. After one month the dosage can be reduced, but to effect a complete eradication of the parasites, quinine should be taken for at least three months in all (Ross), though owing to digestive difficulties it is sometimes impossible to carry this out.

If this routine is carried out the patient's system will in most cases be free from parasites at the end of the treatment. In intense infections when it is considered necessary to bring the quinine in contact with the parasites at the earliest possible moment, it should be administered hypodermically or even intravenously.

Owing to some deaths having occurred from tetanus after hypodermic injections of quinine, medical officers in the army were forbidden to administer quinine hypodermically as a routine procedure, it being thought that such practice was unjustifiable.

Sir David Semple attempted to prove that the injection of the quinine *per se* has nothing to do with the production of tetanus. He stated that if the patient injected with quinine had any encysted and inactive tetanus spores in any old scars, these were liable to be reactivated by the quinine and an attack of tetanus was produced.

One of us (C. L. D.) had the privilege of seeing with him all the stages of his experiments before the publication of his valuable report and his conclusions appeared to be founded on most convincing results.

In order, however, to avoid any accident of this kind happening in cases in which it is urgently necessary to inject quinine hypodermically the patient might be given an injection of of anti-tetanic serum after which the quinine could be administered in this way with perfect safety,

All medical officers of health should endeavour to impress on the inhabitants of the area in which they are working the advantages of taking quinine when suffering from fevers.

The malarial season in the United Provinces lasts roughly from August till December.

The following is a leaflet on malaria, copies of which should be distributed and the contents explained to the people :

Malaria or ague is a dreadful disease. It kills thousands of men, women and children every year and renders millions of them unfit for work.

It is caused by the entrance into the human body of an exceedingly small living germ which grows in the human blood and multiplies in the body of a special kind of mosquito. It enters the human body through the bite of an infected mosquito and causes shivering, fever, enlargement of spleen, with the result that the blood is impoverished and vitality lowered, thus preparing the way for other fatal diseases. Fortunately it has been proved beyond the shadow of a doubt that the disease can be prevented and even cured with proper treatment.

The best way to cure malaria is to take a good purgative and thereafter one powder of 9 grains of quinine twice a day or three tablets of 3 grains each twice a day, until one is free from fever. Children above five years of age can take one-third of a powder or one tablet thrice daily, and under 5 years of age, once daily. After the fever has left, half of the above doses should be taken daily for 3 weeks so that the blood may be thoroughly cleared of the germs.

Many persons think that no food should be taken during fever. This is a great mistake. Milk or sago boiled with milk is very beneficial aud where there is no caste objection, soup shouid also be taken.

It should be remembered that quinine is a harmless remedy and nothing better than this drug is known for the prevention or cure of malaria and its effects such as paleness, enlarged spleen, aching of bones, and weakness.

The Government, with a view to bring this most useful drug within the reach of the poorest, have made arrangements for the sale of the drug at a nominal price. It is easily procurable from the post offices, vaccinators, tahvildars, patwaris, stamp vendors, landlords and their agents, station masters, officials of the Court of Wards aud of the irrigation department and from teachers of board and aided schools. One packet of 9 grains each or three tablets containing three grains each can be bought from any of these for one pice. This drug will cost much more than this if purchased elsewhere.

The drug may also be used as a preventive against malaria and for this purpose a daily dose of 5 grains for an adult will be found effective.

That quinine is a good prophylactic against malaria has been amply demonstrated in case of schools where this measure has been adopted on a large scale.

The following two tables (figs. 50 and 51) show the excellent results of quinine prophylaxis in schools in the Budaun, Meerut and Aligarh districts of the United Provinces.

1. PERSONAL PROPHYLAXIS.—During the malarial season every effort should be made to avoid being bitten by mosquitoes.

In the Panama Canal zone, the American authorities have gradually replaced the old type of houses with others which are mosquito-proof, all the windows and doors being protected by wire gauze, as in fig. 52, which, while allowing the free percolation of air, prevents the entrance of flying insects.

Mosquito curtains around beds also prevent mosquitoes biting the occupant of the bed when resting or asleep. The application of certain oils such as citronella, etc. whose odour is offensive to mosquitoes, also prevents them from biting.

Most Europeans in India take some precautions to prevent being bitten, but as yet the Indians themselves make very little effort to attain this object. They however usually sleep with a sheet covering the whole body.

2. GENERAL PROPHYLAXIS—Under this head may be included all the measures taken to exterminate mosquitoes in general by abolishing all possible breeding places from the vicinity of human habitations. In order to take effectual steps to attain this object it is necessary to become intimately acquainted with the habits of the adult females of the various species of anophelinæ.

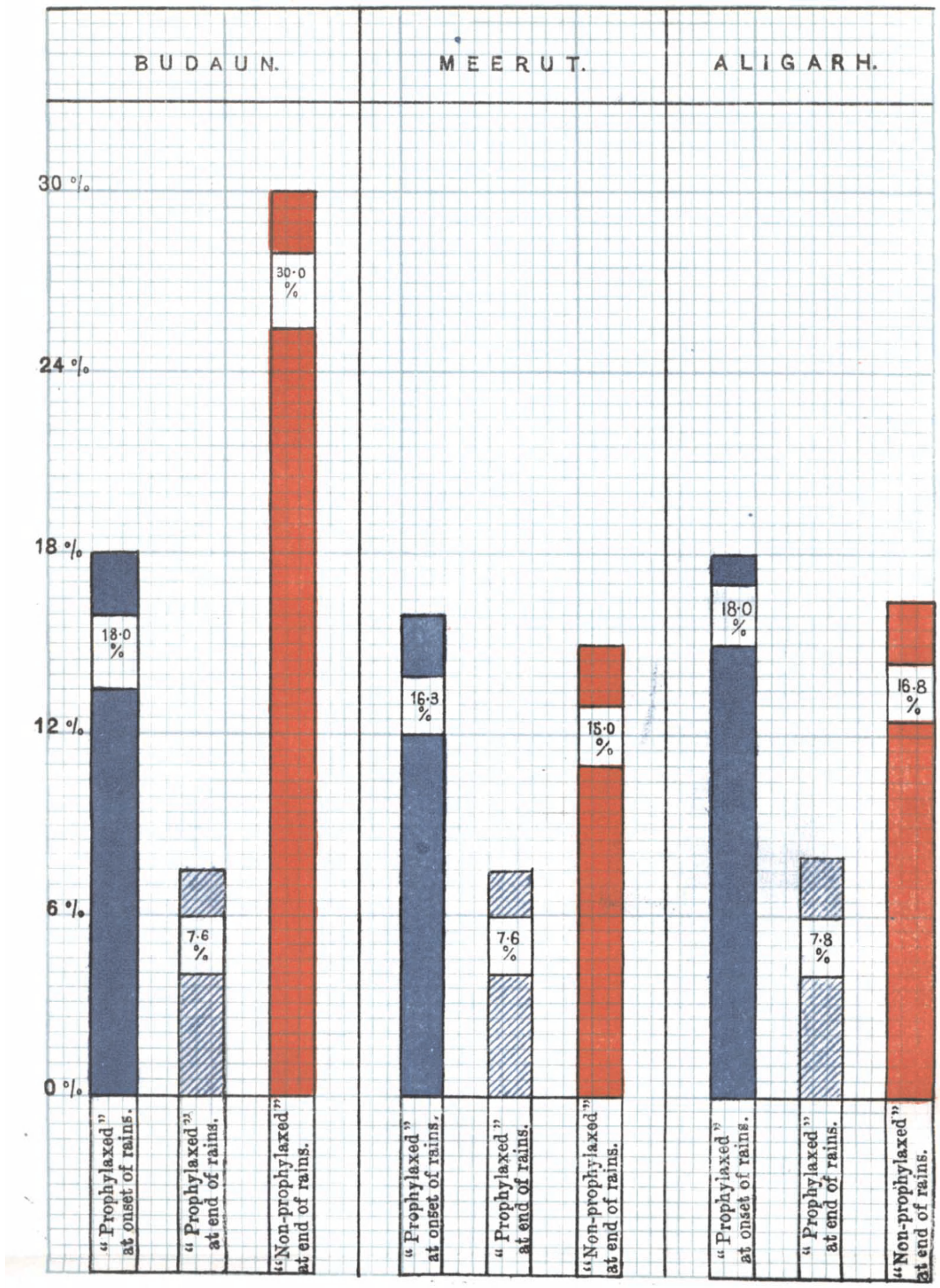


Fig. 50.—QUININE PROPHYLAXIS IN SCHOOLS IN FEVER SEASON

Showing

Percentage spleen rate of Budaun, Meerut & Aligarh schools before and after prophylaxis, with control at end of fever season.

REFERENCES.

Before ------ After ------ Control ------

Photo. Zinco. February, 1925.—No. 1211-5 2060.

EXPERIMENT	Number of scholars.	Duration of prophylaxis (months).	% SPLEEN RATE IN			% available quinine consumed.	% failure to prophylax. (Fever cases)	Average cost per head.
			Prophylaxed before rains.	Prophylaxed after rains	Non-prophylaxed after rains.			
			%	%	%	%	%	Annas
BUDAUN ...	2881	$3\frac{1}{2}$	18·0	7·6	30 0	80·1	10·6	6·5
MEERUT ...	2648	3	16·3	7·6	15·0	81·3	8·6	6·2
ALIGARH ...	3254	3	18·0	7·8	16 8	76·5	9·4	7 0

Fig. 51.—Table showing results of quinine prophylaxis in schools in fever season in 1910-1911 in Budaun, Meerut and Aligarh, United Provinces, India.

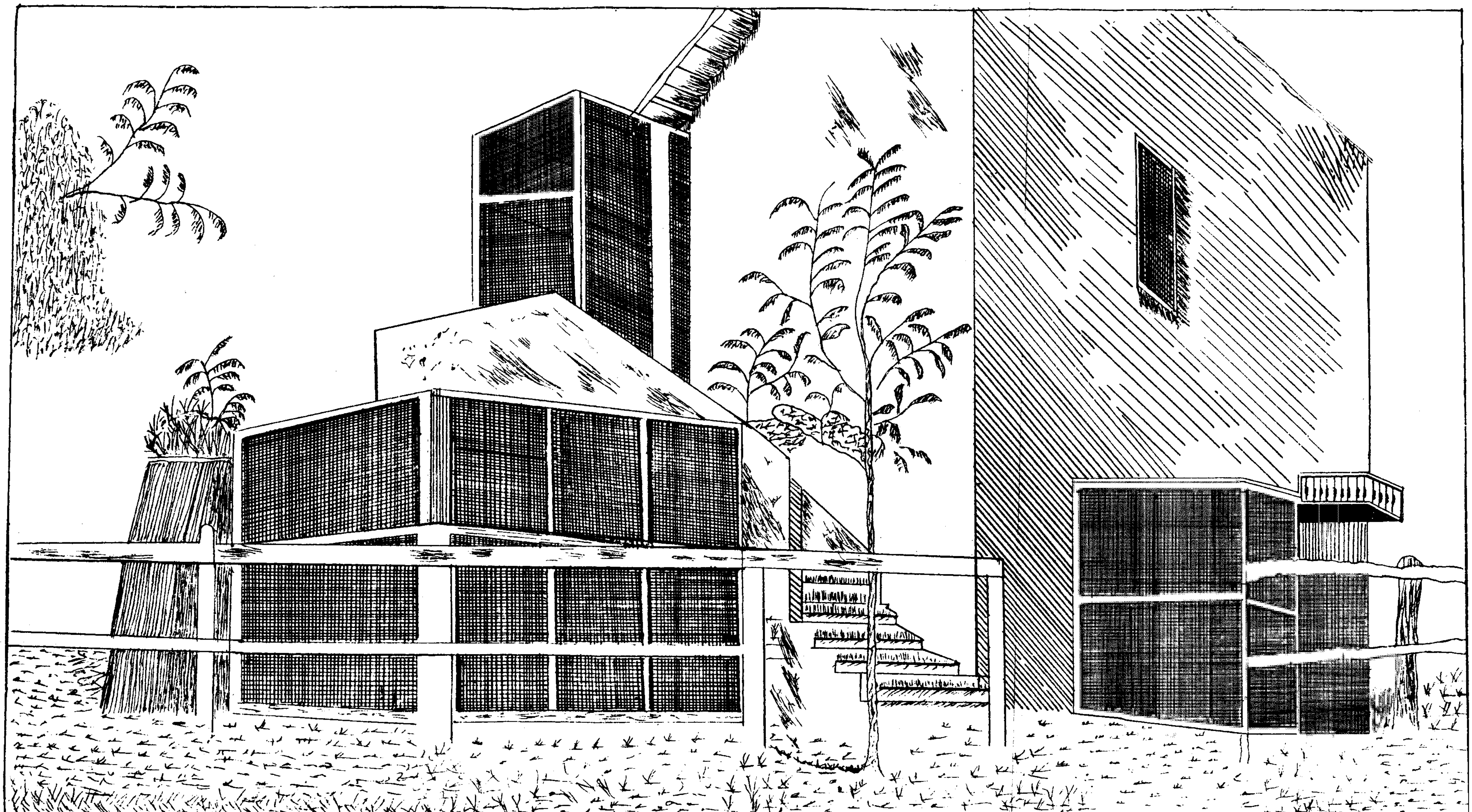


Fig. 52.—MOSQUITO-PROOF HOUSE.

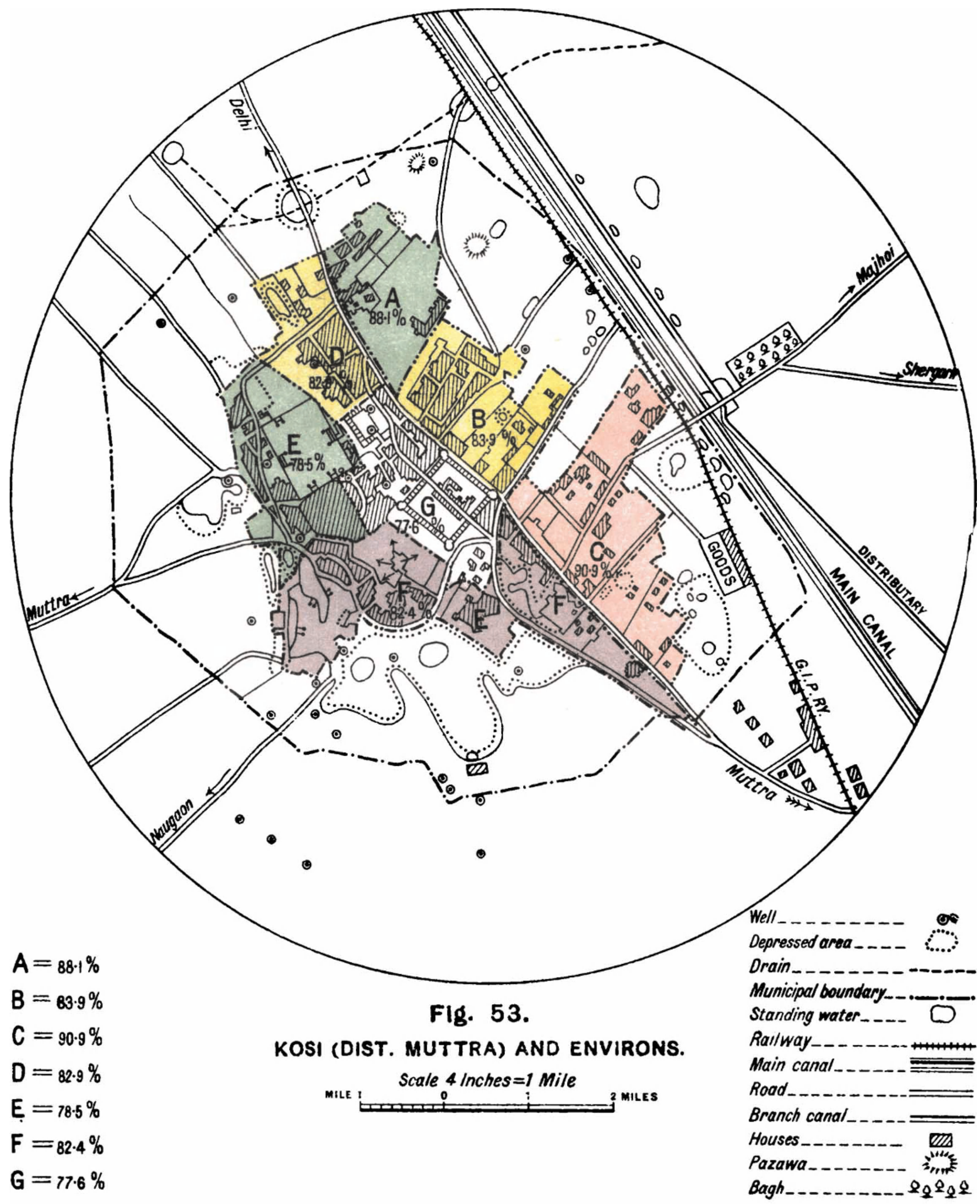


Fig. 53.

KOSI (DIST. MUTTRA) AND ENVIRONS.

Scale 4 Inches = 1 Mile

MILE 1 0 2 MILES

Photo. Zinco. February, 1925.—No. 1211-12-2060.

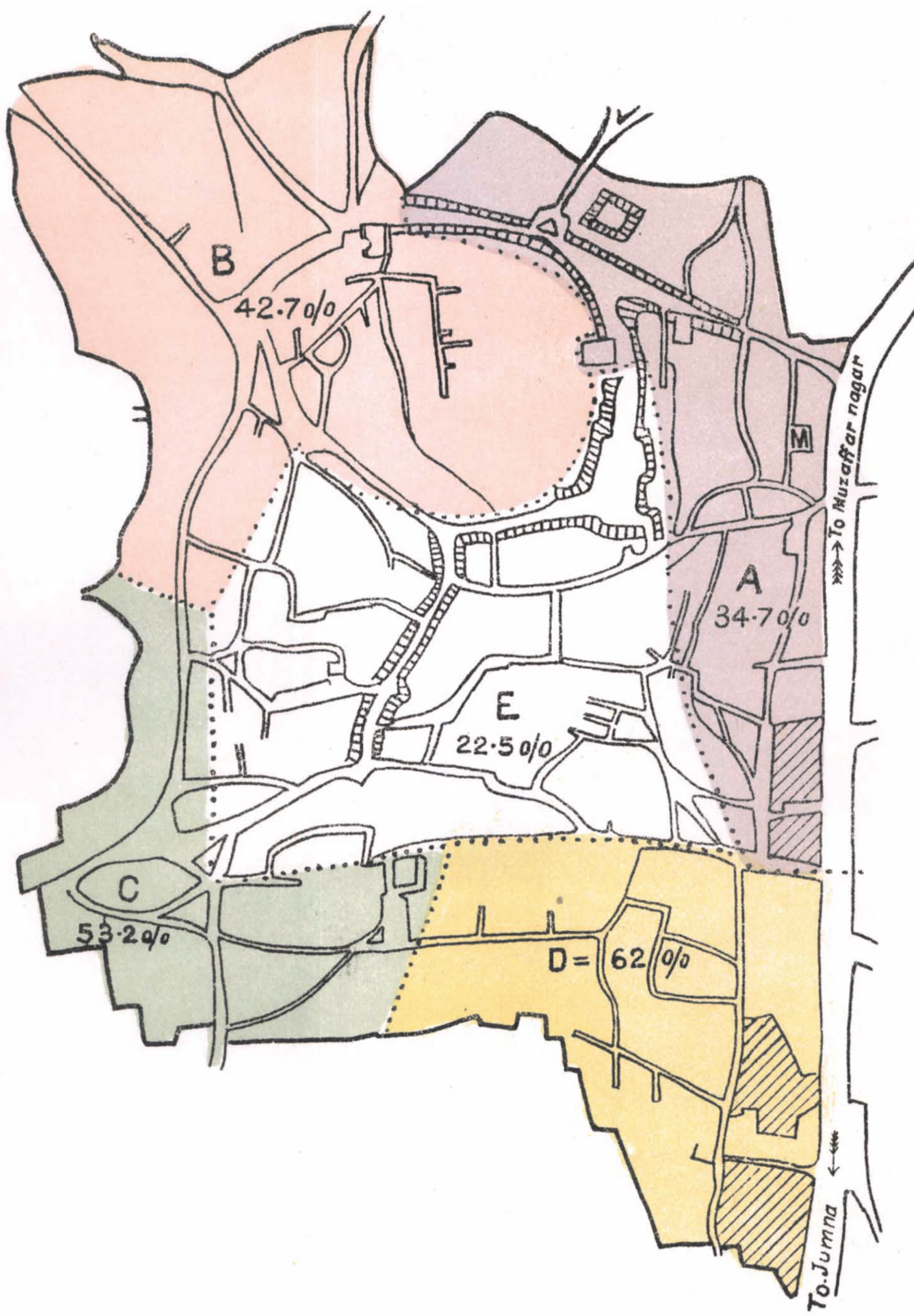


Fig. 54.

KAIRANA SHOWING DISTRIBUTION OF MALARIA BY SPLEEN CENSUS.

AUG. 21–30, 1910.

Scale - 1 Inch = 176 Yds

10 Inches = 1 Mile

No. 1211-13

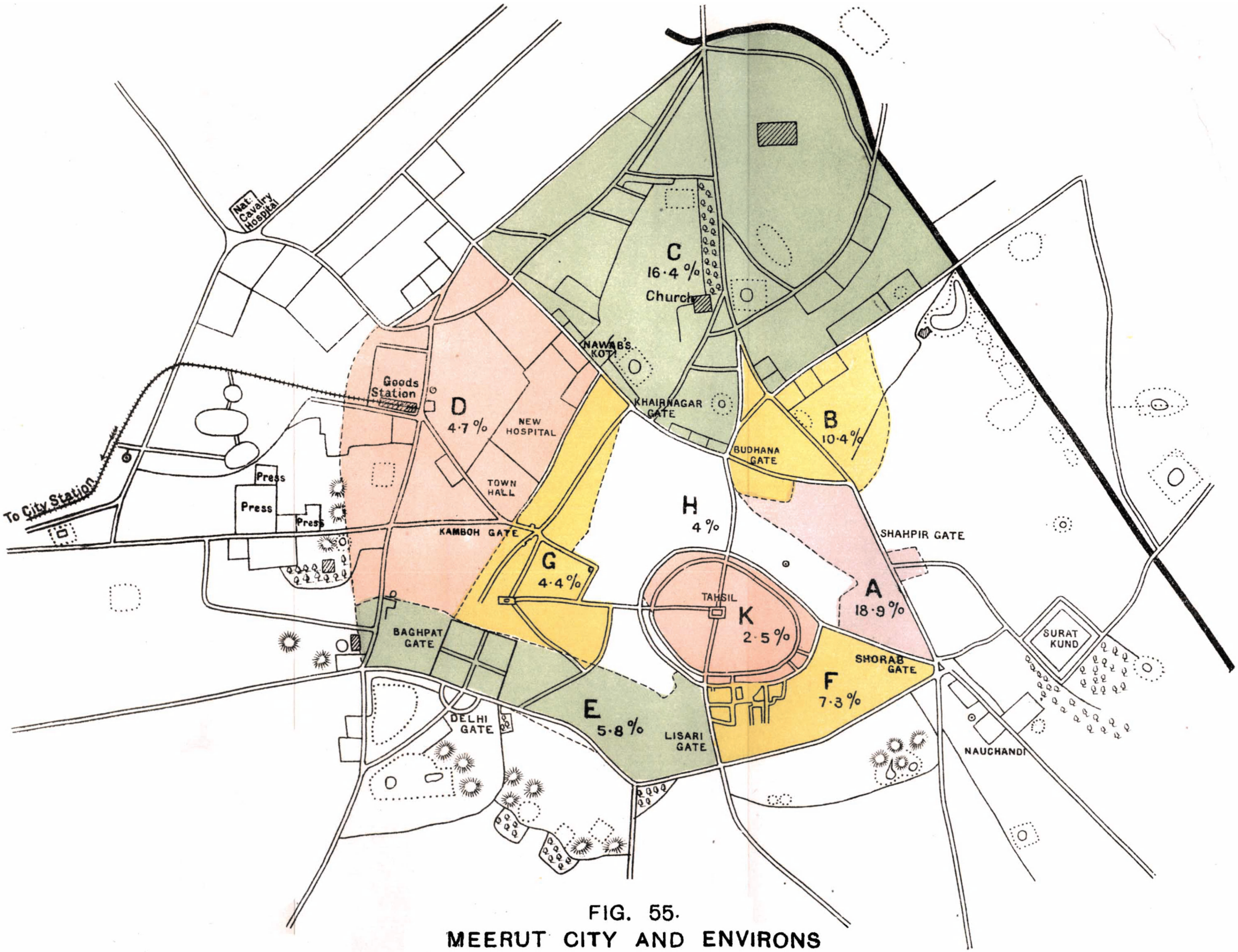


FIG. 55.
MEERUT CITY AND ENVIRONS
SHOWING SPLEEN CENSUS—AUGUST 1911.

All species do not lay their eggs in the same places ; all, however, do lay their eggs in collections of water, either temporary or permanent.

In order therefore to become acquainted with the malariology of any particular town or tract of country it is necessary to make a malarial survey of the locality.

In making this survey :—

(1) A sketch map of the locality and its surroundings should first be made and all permanent and temporary collections of water entered on it.

(2) All the collections of water should be fished for larvæ and eggs and their presence marked in the map.

(3) The eggs and larvæ should be bred out and the species of anophelinæ noted.

(4) Adult females should be searched for all over the locality and their species and relative prevalence noted.

(5) Large numbers should be dissected and the absence or presence of zygotes in the mid-gut or sporozoits in the salivary glands noted in order to gain some idea of the percentage of mosquitoes infected.

(6) Films from the blood of children in various sections of the area under survey should be made and the percentage of children examined showing infection with the various parasites noted.

The spleens of a number of children should also be examined in order to arrive at some idea of the number suffering from previous infections with malaria.

(7) The varieties of fish in the water round the area should be noted and those which feed on larvæ should be classified. Often in collections of water which appear as ideal breeding places for mosquitoes, no eggs or larvæ are found and the reason often is that fish which are larva feeders abound in the water.

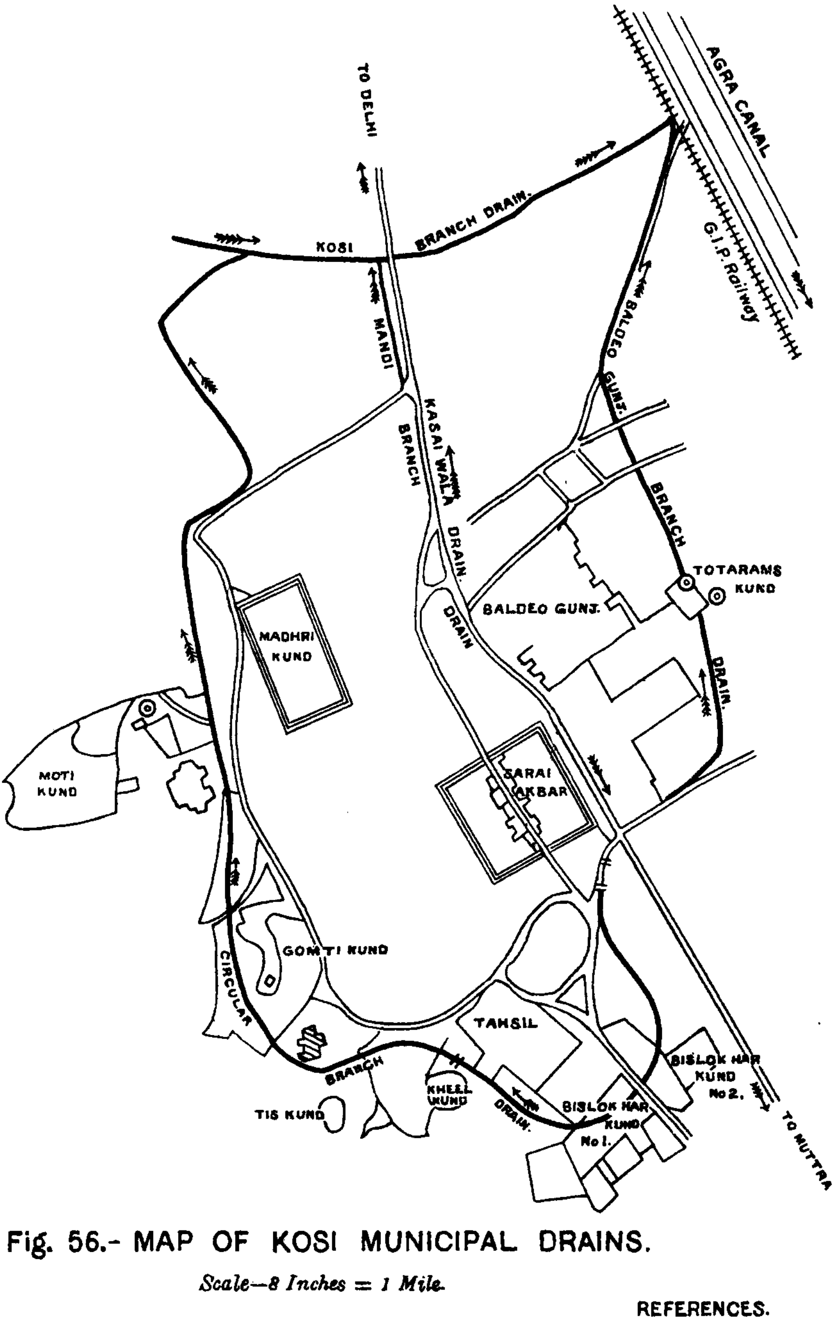


Fig. 56.- MAP OF KOSI MUNICIPAL DRAINS.

Scale—8 Inches = 1 Mile.

REFERENCES.

Kachha drain =

Pakka drain =

Well =

January, 1925 —No. 1211-15.2060.

(8) Mosquitoes do not breed in collections of water containing certain weeds such as duck-weeds, their presence being inimical to the life of the larvæ.

All the above information can be entered on the sketch maps by using conventional signs and thus a complete statement of the malariology of the area is available.

The following are the abbreviations and signs used in map making by Lt.- Col. J. D. Graham, I. M. S., late Special Malaria Officer, U. P.

The illustrated maps (figs. 53, 54 and 55) show many of the above abbreviations and also the spleen census in the towns of Kosi, Kairana and Meerut in the United Provinces at the time they were taken. The Kosi map (fig. 53), shows a very high spleen census taken in spring 1909, after an intense epidemic in the autumn 1908. A map of the Kosi drains (fig. 56) is also shown.

Measures for the temporary and permanent amelioration of conditions likely to favour outbreaks of malaria should be devised and the local authority should endeavour to carry out as many of these measures as are financially possible.

Such measures are :—

(1) Filling up small hollows and depressions likely to contain water after heavy rain.

(2) Draining of marshy areas.

(3) Filling up or draining large tanks which are not necessary for public use and training the banks of such as are in use.

(4) Removal from the inhabited area of all contrivances for holding water to which mosquitoes have ready access.

(5) Covering, screening or filling up of wells not in use.

(6) Covering or screening wells in use to prevent the access of mosquitoes.

(7) The introduction of larvæ-eating fish into permanent collections of water which cannot be filled up or drained.

(8) The cleansing and levelling of banks of rivers and canals in which mosquitoes breed owing to the presence of indentations in the banks and vegetation which harbour larvæ.

(9) The prevention of over-irrigation of fields in the vicinity of inhabited areas.

The application of the above-mentioned measures to heavily infected areas has in many cases resulted in the incidence of the disease being reduced to ordinary proportions in the area dealt with, viz., the Panama Zone, Ismalia and Mauritius.

These principles have been partially applied to the towns of Saharanpur, Nagina and Kosi in the United Provinces in accordance with the proposals of Lieut.-Cols. Robertson and Graham, who carried out detailed malarial surveys in these and other areas and submitted proposals to Government with a view to reducing to a minimum the inefficiency and deaths caused by malaria in these areas.

RELAPSING FEVER (Indian).

This fever is one of the endemic fevers of India. It is caused by the *Spirochæta carteri* and the parasite is transmitted by the agency of some intermediate host not at present definitely known. The disease has been known for a long time but was not clearly differentiated until the middle of the 19th century. In 1877 Vandyke Carter found Spirochætes in the blood of patients suffering from relapsing fever. The disease is common in the Bombay Presidency, but has been recorded in epidemic form in the Punjab and United Provinces. Since 1911 an epidemic has been going on at intervals in the districts of Meerut and Muzaffarnagar and the adjacent districts. It is also very prevalent in the Kumaun hills. A bad outbreak occurred in the Government Bovine Lymph Depôt at Patwa Dangar in the United Provinces in 1919, all the coolies being attacked, and

3 deaths occurred. The disease quickly disappeared when thorough methods of delousing were carried out. Carter proved that it can be inoculated into man by inoculating himself. The organism has been found in the alimentary tract of bugs, mosquitoes and lice. Mackie is of the opinion that the *Pediculus corporis* is the usual intermediate host. Mackie's work was confirmed by Bissett in Muzaffarnagar and Cragg, as the result of investigations carried out in the United Provinces in 1922, is of the same opinion. S. carteri is differentiated from *S. duttoni* and *S. recurrentis* by immunisation and agglutination tests.

Diagnosis.—A fever with a sudden onset, without any definite rigors, without intermissions temperature remaining at 103° to 104° F. for six or seven days and then falling to normal, leaving the patient often extremely weak and even collapsed, is the diagnostic symptom of this disease. The tongue is thickly furred, vomiting is a fairly constant symptom and jaundice is often present. The intermissions usually last for about seven or eight days when the temperature may suddenly rise again. The second attack is usually shorter than the first and is usually the final attack. Third and fourth attacks, however, may occur, each relapse being shorter in duration but the severity may be as great as the primary relapse. Rogers gives the following table of percentages of relapses.

No relapse	23·8
1 relapse	49·2
2 relapses	20·0
3 relapses	5·0
4 relapses	2·0

The prognosis is bad in a prolonged primary attack with hepatic symptoms. The mortality is about 18·0 per cent., but in the recent epidemics in the United Provinces it was considerably higher than this.

Prophylaxis.—Medical officers of health must impress on the people that the only way to avoid infection from this disease is cleanliness and freedom from vermin. They should be advised to attend to bodily and household cleanliness and to make a free use of pediculicides in their houses. From observations made of the epidemic in these provinces, it appears that the mosquito in all probability has little or nothing to do with the spread of the disease. Although more prevalent in the spring and hot weather, the disease continues throughout the year and does not vary with the prevalence of mosquitoes of either the culicinæ or anophelinæ variety. In some villages large numbers of the population have been infected but the spread has not been as rapid as one would expect it to be if mosquitoes were the common carriers.

The rate of infection, spread and prevalence of the disease appear to justify the assumption that body vermin are carriers and measures aimed at ensuring bodily cleanliness should rapidly stamp out the disease.

The spirilla are rapidly killed by subcutaneous injections of novoarsenobillon and other such preparations.

Delousing.—First—lousing by mechanical means, and
Second—lousing by pediculicides.

As regards the first of these, in mild cases of pediculosis lice and their nits (eggs) may be removed by combing with a fine comb. This is a common practice among civilized people, has been coming down from time immemorial, and should be encouraged. To be effective it must be frequently repeated. If a comb is warmed and then used, the warmth will make lice abandon their positions and come out easily. The lice removed from head, clothing, etc., should not be killed by crushing them between finger nails. They should be drowned in a little water contained in a vessel or burnt. A better method than combing is to wash the head with soap and water and unless religious prejudices prevent this being done, the shaving of the head or hairy parts of the body should be recommended. Frequent bathing of the whole body should be encouraged and when possible soap should be used for this purpose. Clean linen should be used and underclothing frequently changed.

Second—"lousing by pediculicides." The use of petrol is the most effective way of killing lice, but unless it can evaporate freely it is painful when applied to the skin. Besides this, there is risk to the user if there is a fire or a lighted cigarette in the neighbourhood. Kerosine oil is also useful but it has the above drawback besides the smell.

Ointments containing a small percentage of mercury or of any salt of mercury are extremely effective as louse-killers, but numerous cases of mercurial poisoning from their use have been reported and such preparations cannot be recommended for general use.

Naphthalene powdered, and naphthalene combined with other drugs, especially the combination known as "N. C. I. powder" (naphthalene 96 parts, creosote 2 parts and iodoform 2 parts) is an effective louse-killer but expensive.

An emulsion consisting of equal parts of kerosine oil, mustard oil and soap solution, to which a little camphor is added to minimise the unpleasant smell, is very useful. This emulsion should be used at intervals of a week or two or three weeks.

The custom of oiling the body regularly with mustard or some other oil, which is largely prevalent in India, when combined with regular bathing, is to a great extent effective in keeping the body free from lice.

As regards the method for freeing the clothing, bedding, etc., from lice, the following suggestions will be found useful :

Clothing, especially that worn next to the skin, and bedding should be daily exposed to the influence of sunlight. While thus exposed the articles should be frequently turned—coats, trousers, etc., being turned inside out—and they should be frequently beaten with a stick. It is probable that exposure to the strong rays of the Indian sun in the way above described is sufficient to kill lice, if not their eggs, and if regularly carried out, it will keep the clothing and bedding free from the parasites.

Washermen should be instructed to soak all wearing apparel, etc., in water for a few minutes before undertaking the actual washing. If this method of washing clothes is adopted, the lice will ultimately be killed. For rapidly killing lice and their eggs on clothing and bedding, especially those of patients, the most effective method is undoubtedly to immerse the article in boiling water. Water, which is really "boiling", kills lice and nits practically instantaneously. The boiling should be repeated at intervals of a week for two or three weeks and on each occasion the articles should remain in the boiling pan for 10 minutes. A simple steam disinfector known as the "Serbian barrel" (fig. 57), could also

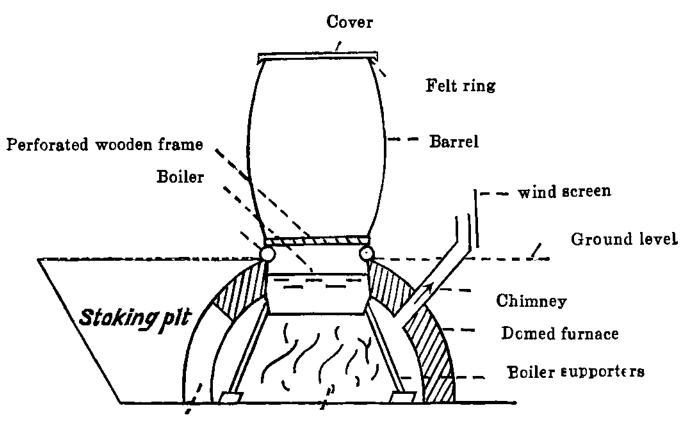


Fig. 57.—Serbian Barrel.

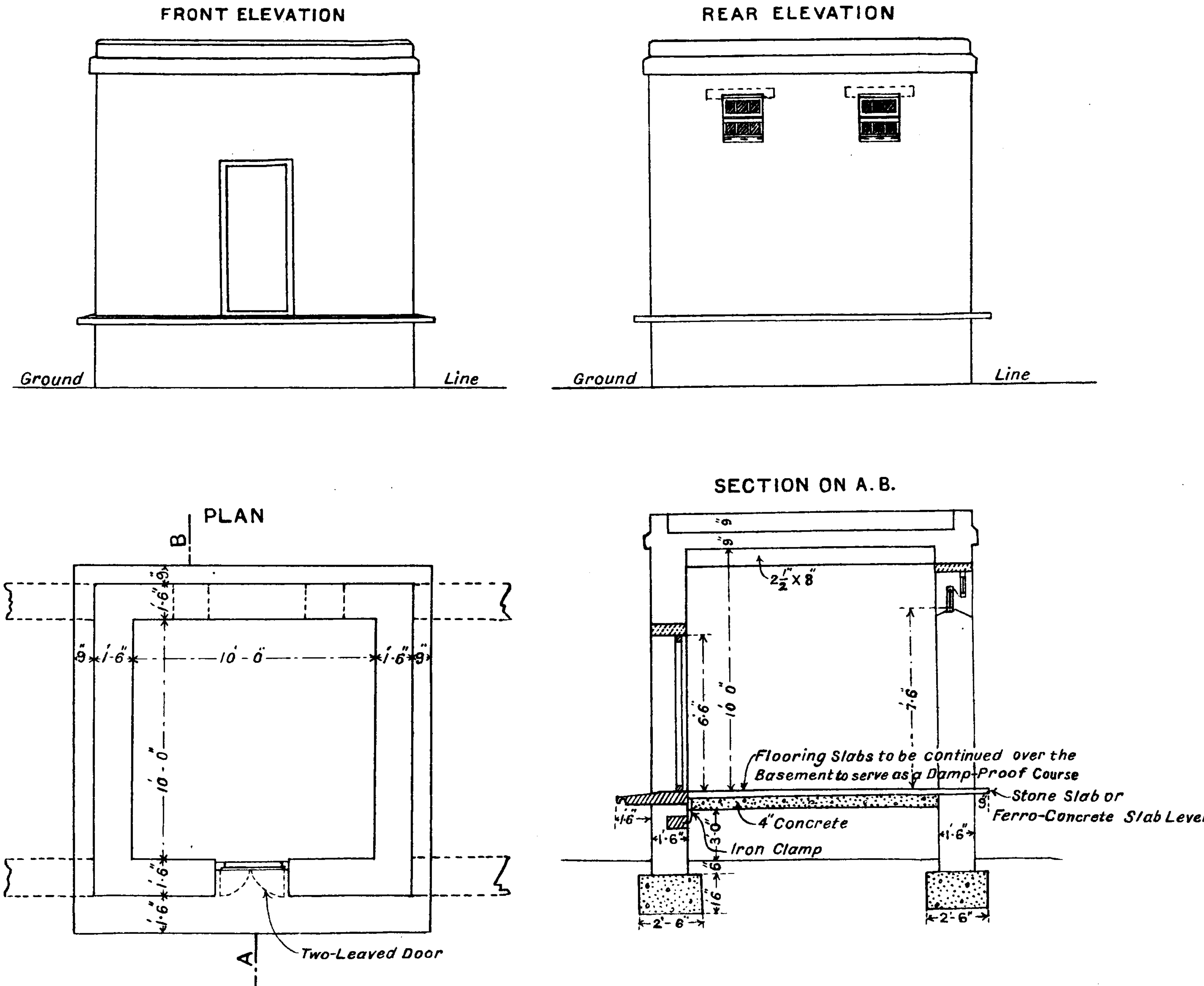


Fig. 58.—DESIGN OF A RAT-PROOF GRAIN GODOWN.

Zinco. December. 1924.—No.1211-16-2060

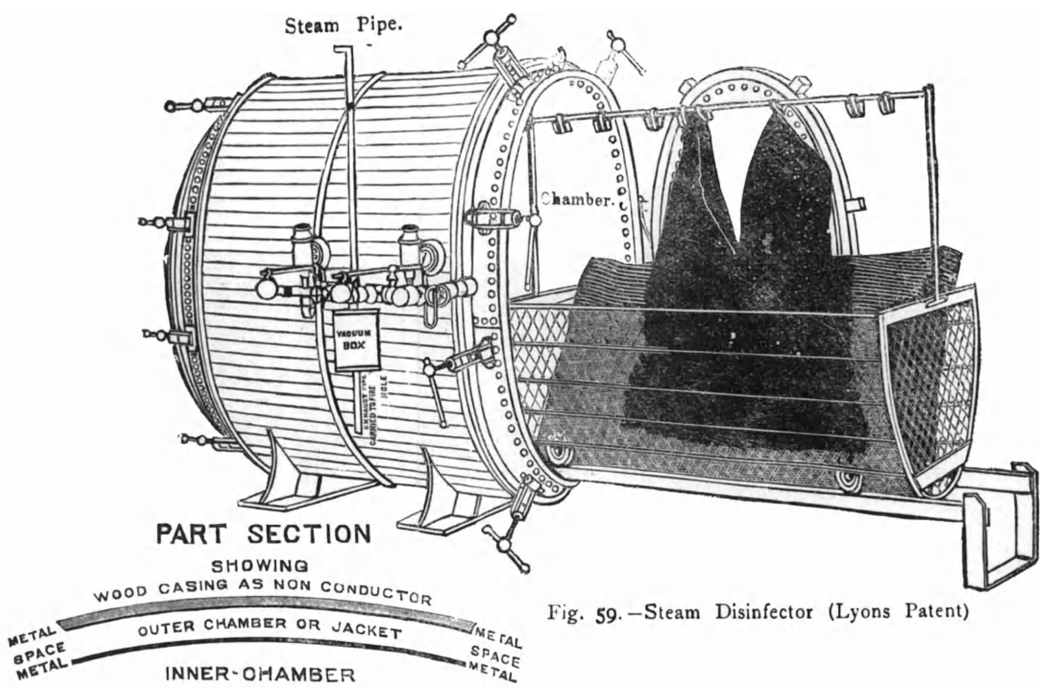


Fig. 59.—Steam Disinfector (Lyons Patent)

Breeding grounds.	= Dots. (Larvæ).
Adult mosquitoes.	= Crosses.
Fuliginosus	= Red
Culicifacies.	= Green
Rossi.	= Yellow.
Stephensi.	= Black.
and so on.	
Water standing	= Single lines.
Depressed ground (dry in hot weather)	= Dotted lines.
Well.	=
$\frac{35 \text{ Children examined}}{20 \text{ Enlarged spleen}}$:	= $\frac{35}{20}$.
Water channel.	=
Drain.	=
Cultivated area or garden.	=
Trees.	=
Pazava.	=
Stand pipe.	= SP
Municipal boundary pillar.	=
Houses.	=
Road.	=
Canal or river (in blue).	=
Railway.	=

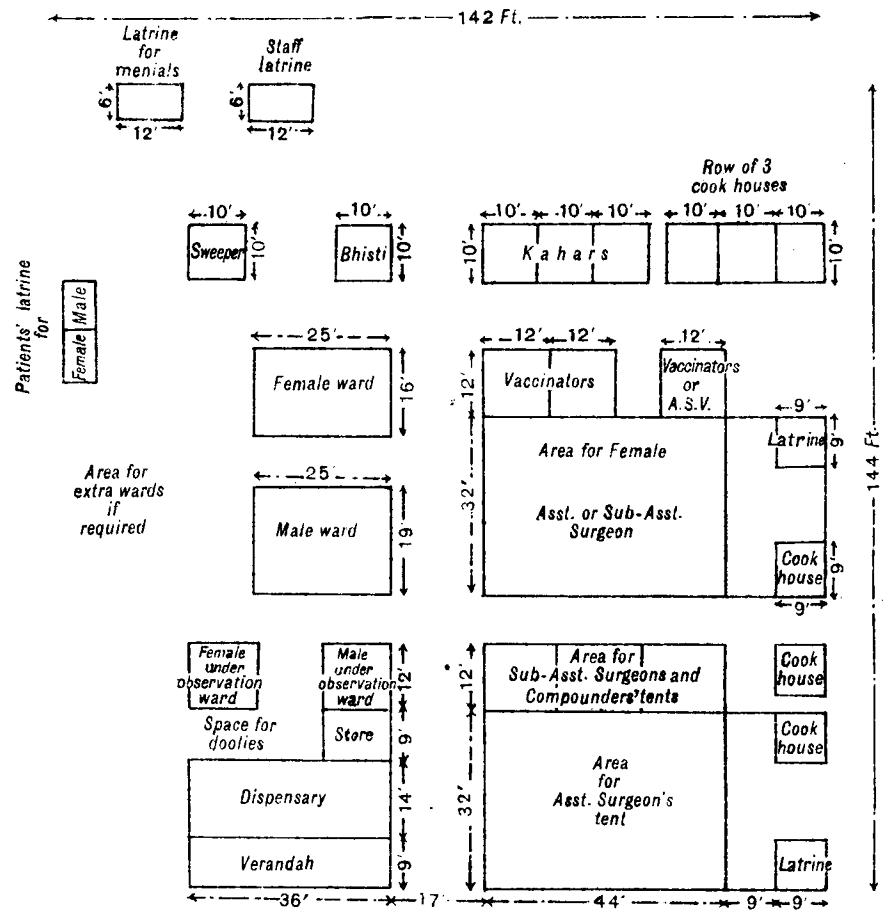


Fig. 61.—SITE PLAN OF HOSPITAL FOR IMPORTANT FAIRS IN THE UNITED PROVINCES.

Scale of Feet

Feet 20 10 0 20 40 60 80 Feet

Photo. Zinco. February, 1925.—No. 1211-17-2050 be erected without much trouble for the use of people in infected villages. This disinfector consists of an ordinary barrel the top and bottom of which should be knocked out ; a wooden grating should be substituted for the bottom of the barrel and a flat wooden lid which can be weighted if necessary with stones should be substituted for the top of the barrel. The barrel rests on a boiler provided with a metal stand which is placed in a pit surrounded by a dome-shaped layer of mud or kuchha bricks. The boiler must be of a diameter corresponding to that of the bottom of the barrel which rests on the top of it, and the top of the barrel should be flush with the level of the ground or slightly higher.

To use the Serbian barrel the boiler should be filled to about two-thirds of its height with water and the furnace lighted. When the water is boiling and the steam is passing freely through the grating into the barrel the articles to be disinfected should be placed loosely in the barrel and the cover put on the top of the barrel and weighted with a few stones. It is essential that the articles to be disinfected should not be tightly packed in the barrel. They should be placed in it loosely so that the steam passes freely through and among them. In order to test whether the barrel is working properly or not a potato or an egg can be placed in the centre of the articles in the barrel and if the potato at the end of the process is found to be "cooked", it may be concluded that the barrel is working properly. The articles should be kept in the barrel for about half an hour.

As regards killing lice and bugs in infected rooms and houses the following is the best method to be adopted :—

All doors, windows and ventilators should be, as far as possible, closed and sulphur in the proportion of 1 lb. for every 1,000 cubic feet of space burnt in the closed room. The room should be kept closed for two hours at least. The floor should then be sprayed, so as to make it damp all over, with cheap kerosine oil.

KALA-AZAR (Indian).

This disease is a chronic specific fever caused by *Leishmania donovani* and it is probably spread by members of the Cimicidæ.

This disease was at first supposed by various observers to be a malarial cachexia and until Leishman found the parasite described by him, in the spleen of a patient who contracted the disease at Dum-dum and died at Netley in 1900, nothing more definite was known about it. Donovan in 1903 found the same parasite in a film made from a splenic puncture of a patient suffering from the disease in Madras.

Christophers did some valuable research work in Assam and published full descriptions of the parasites found by him in the spleen, liver and blood. Patton states that the parasite can be found in the peripheral blood in the leucocytes in nearly all cases. The large mononuclear leucocytes are the ones most usually affected but they only contain a few parasites while endothelial cells and microphages may contain large numbers.

The parasites as seen inside leucocytes are circular or oval, $2{\cdot}5$–$3{\cdot}5\,\mu$ in diameter, clearly outlined and contain two chromatin masses whch are very characteristic.

One of these chromatin masses is larger than the other and does not stain so deeply ; it is always at the periphery of the parasite.

The smaller chromatin mass stains more deeply than the other and lies usually opposite the larger mass in the short axis of the parasite with its long axis at right angles to the larger mass. The parasites also usually contain one or two vacuoles in the cytoplasm.

Rogers cultivated some of the blood taken from a splenic puncture in sodium citrate solution in a test tube at a temperature of 22°C. The parasites increased in size and from the fourth to sixth day showed flagellae growing from the smaller chromatin mass. These forms either developed directly from an enlarged parasite or from the fission of enlarged parasites. At this stage the parasite resembles the Herpetomonads.

Patton has recently traced the extra-corporeal life of the parasite, through its incomplete cycle, in the *Cimex rotundatus*. It appears that in order to see these flagellate forms, the bug must only receive one feed from a patient having the parasite circulating in the peripheral blood. If a subsequent feed is given the development of the parasite ceases about the fourth day and the parasites degenerate into typical round masses. On the other hand, if no such feed is given, the parasite develops into a fully fledged flagellate and reproduces the small forms of the parasite found in the blood of man.

Nicolle has found in Tunis that dogs are the reservoir for the parasites and that they are chiefly to be found in the bone marrow ; in India Patton has examined many dogs in Madras and has failed to find any naturally infected, though they can be infected artificially.

The disease is endemic in Assam, Madras, Calcutta and in other parts of India. It is also found in Ceylon, Egypt and the Mediterranean littoral.

The parasite cannot be differentiated microscopically from *Leishmania tropica*, the parasite of Oriental Sore, or from *Leishmania infantum*, the parasite of infantile Kala-Azar, which is met with in Sicily, Southern Italy and the Mediterranean coast in general.

Mackie investigated this disease and it appears that in India its incidence is much greater in children than in adults.

It is possible that the Indian disease and the Mediterranean disease are the same.

The disease is very fatal, the death rate being 98 per cent. in the untreated. If treated by quinine the death rate is less. Manson has cured two cases with atoxyl. Recently Rogers has proved that intravenous injections of Tartar Emetic are most efficacious in curing this disease and this is now the generally accepted treatment.

Prophylaxis.—Bug extermination appears to be the only thing that can be done. Fumigation with sulphur will kill all the bugs in a room if thoroughly carried out. Acetic acid is said to be fatal to bugs if beds are disinfected with it. Strict cleanliness should be enjoined.

CHOLERA.

Definition.—Cholera is an acute specific endemic or epidemic disease caused by the *Vibrio choleræ* (Koch), and characterized by violent purging, vomiting, muscular cramps, suppression of urine and collapse. Cholera has been known in India from the most ancient times. In 1434 it decimated Ahmed Shah's army, and between 1435 and 1817, 66 separate observers mention the disease. Since that date there have been several recorded pandemics in various parts of the world.

Most of these pandemics, in fact all of them, appear to have originated in India and speard to Europe through Persia and Arabia.

Etiology.—The cause is undoubtedly Koch's vibrio but this alone may not produce the disease, as in Hamburg in 1892 many people who did not show any sign of the disease were passing virulent vibrios in their stools. It is evident therefore that these people lacked some predisposing condition and they must also have been fruitful sources of infection. On the other hand these people may have had a high immunity, naturally acquired, which protected them and which others lacked. The vibrios can live in fæces for 163 days and owing to this fact they can infect such insects as flies. Vibrios have often been found on the legs and the exteriors of the bodies of flies as well as in the alimentary canal and in the excrement.

The well-known habits of flies such as invading houses and settling on food make them a wide-spread source of infection.

Fæcal matter also gains access to water or to milk and thus spreads the disease.

Raw vegetables grown on ground on which fæcal matter in a fresh state or fresh sullage or sewage is used to manure the ground are also a cause of infection, if the manure used is infected. Greig has shown that Cholera carriers are very numerous in the endemic areas and has isolated the vibrio in pure culture from the intestines, the gall bladder and the lungs.

The principal endemic centre is lower Bengal from which it spreads at intervals in pandemic form all over the world. The factors governing this pandemic spread are not at present well understood. It may be confined to the endemic area for years when it apparently has the same chances of spreading as it has when a pandemic occurs. It always adopts in its spread the channels of human intercommunication.

There appears to be little doubt that epidemics are set up in the first place by the advent of a carrier or carriers of the vibrio to the area and that the water and food supply become infected either by direct pollution or by the agency of flies. The sanitary authorities should therefore make every effort to permanently diminish the fly population, protect the food and milk supply and ensure the provision of an efficiently protected pure drinking water supply.

Medical officers of health are not concerned with the symptoms of the disease and the clinical treatment ; they are concerned chiefly with the bacteriological diagnosis of the organisms and the prophylaxis—private and public.

Diagnosis of the organism.—The organism can be recovered in large nnmbers from the fæces but is not found in the blood-stream.

Post-mortem.—The vibrios are to be found in Lieberikuhn's follicles, the epithelial cells and mucosa of the intestines and stomach. They have, however, recently been found in many cases in the gall bladder by Lt.-Col. E. D. W. Greig, I. M. S., at Puri. The disease is therefore not a general infection but a *general intoxication.*

The diagnosis, of course, is simple in the middle of an epidemic but may be difficult at the beginning of an outbreak.

The following method may be adopted :

1. Make films from rice-like flakes in the rice water stools and stain with Loeffler's blue for five minutes. If a large number of curved rods are present, suspect cholera.

2. Take a rice-like flake and smear direct on to a series of Mc. Conkey's lactose agar plate and incubate. Colonies of cholera and cholera-like vibrios develop on this medium as small, delicate, yellowish, roundish dots in 12 to 18 hours. Pick off some of these and investigate them.

The cholera vibrio has the following characteristics :

(*a*) Actively motile.

(*b*) Often bent, but may be straight rods.

(*c*) Agglutination. A strong anticholera serum should be used. 1-5,000 dilution should agglutinate stock cholera. Any vibrio found, which is agglutinated by a 1-4,000 dilution can, as a rule, be considered to be the true germ of cholera.

(*d*) Inoculate peptone-water with the suspected stools ; if cholera, a scum will form in 8 to 10 hours and a pellicle depending in the fluid will be present.

(*e*) Test the peptone-water for Indol by adding a few drops of strong sulphuric acid. If cholera is present, a red colour appears (cholera-red reaction).

(*f*) Inoculate serum tubes and incubate at 35°C. If no liquefaction occurs in 16 hours, cholera can be excluded.

(*g*) *Pfeiffer's reaction*. Give a guinea-pig a dose intra-peritoneally of anticholera serum mixed with 10 times the lethal doze of living vibrios. If cholera, they will be found after several hours to have lost all shape and appear as granular masses.

(*h*) Dieudonne's strongly alkaline blood agar may be used to isolate the vibrio in fæces. On this cholera grows well and coli-like organisms do not. The most recently recommended media for isolating cholera vibrios are Gibson's and Aronson's. Gibson's media is slightly alkaline agar containing starch and litmus. Cholera vibrios ferment starch which very few other organisms do, so that red colonies can be picked out and examined. Aronson's media is more strongly alkaline agar and contains Dextrin and Saccharose, the media being coloured with basic fuchsin. This is a very good media and cholera grows on it more rapidly than any other organism, while it inhibits nearly all fæcal organisms.

(i) *Hæmolysis*. True cholera organisms do not hæmolize red blood cells, while other cholera-like vibrios do. This is a most important differential test.

The organism is aerobic, does not stain with Gram, has a single flagellum and does not form spores.

These tests are not all necessary except in doubtful cases; one can usually be certain of one's diagnosis if the vibrio is morphologically a cholera vibrio and if it agglutinates in a 1-4,000 dilution of a highly immunised animal's serum and gives the cholera-red reaction.

Having established the fact that the disease is cholera, stringent prophylactic measures must be adopted, based on the knowledge that the disease is carried by man and that it is spread from one man to another by water, milk, contaminated food, flies and other insects.

Preventive measures.—Pamphlets should be circulated to every householder warning him that cholera is in the vicinity and that the following measures should be adopted :

1. His house and compound should be kept in a clean and sanitary condition and that there should be no heaps of rubbish in which flies could breed and no food exposed to flies.

2. All plates and cooking utensils that come in contact with food should be washed in boiling water.

3. All water and milk should be boiled and stored in covered vessels.

4. No uncooked food should be eaten at all.

5. Cholera vibrios are easily killed in acids and in alcohol, so if weak acids or alcohols are added to any doubtful water, it would be an additional safeguard.

Haffkine's prophylactic provides some protection during an epidemic. It is made by intensifying the strain of vibrios by passing them through a series of rabbits and growing on agar. Wash off the agar growth in 8 c.c. sterile broth, add ·5 per cent. carbolic acid to kill the vibrios. 1 c.c. of this vaccine is the dose. Haffkine claimed that this vaccination confers immunity which lasts for about 14 months. There is usually some local pain and redness and a slight general reaction. According to Powell in 6,549 non-vaccinated there were 198 cases and 124 deaths, and in 5,778 vaccinated there were 27 cases and 14 deaths. Haffkine afterwards introduced a vaccine of smaller doses of the living vibrio.

These vaccines have, however, never become popular ; the vaccine now in use in India is a 24 hours' growth on agar of several strains of the vibrio killed and standardized. The first dose is ½ c.c. followed by 1 c.c. after 10 days.

In Mesopotamia, during the War, however, cholera vaccines proved of great value as prophylactic agents and this vaccine is strongly recommended for use in cholera infected areas.

It is the duty of the Government to try to ward off cholera by preventing human beings introducing the germ. Frontiers, along lines of intercommunication, should be watched and suspicious cases quarantined for 5 days. When an epidemic begins, a special staff must be provided to deal with it, and all cases should be removed to isolation hospitals. Arrangements should be made for the prompt bacteriological diagnosis of the disease and the prompt treatment of cases.

All fomites should be carefully disinfected by boiling or with cyllin 1—100; formalin sprays for the room, walls, etc. are useful. The disinfection of clothing, etc., should be carried out by steam under pressure in all places where steam disinfectors have been erected. Dejecta should be at once mixed with a disinfectant and burnt or buried with quick lime. The sanitary authorities should institute a thorough cleansing of the whole town and outskirts in order that all the possible breeding places of flies may be abolished. Conservancy must be strictly attended to and strong disinfectants used in all public and private latrines. The water supply should be inspected, and if from wells, they should be permanganated and kept free from cholera germs in this way until the epidemic is over.

The results of some experiments carried out by the writers show that $\frac{1}{8}$ of a grain per gallon of permanganate will kill cholera vibrios in 1 hour and that permanganate has a direct bactericidal effect on the vibrios. 1 oz. of permanganate in an average-sized well every second day should keep it free from vibrios.

All sanitary defects found out during the epidemic should be at once permanently remedied and not left until another outbreak occurs.

In towns in India with well water supply it is essential that the mouths of all wells should be provided with parapets in order that the well may be protected from water, which has been spilt, getting back into it. The objectionable cross gratings seen on most Indian wells should be abolished. The provision of a hand pump to the well and closing the mouth altogether is a better measure. Fulminating outbreaks are always due to an infected water supply, dropping cases being due usually to man and fly infection, and with an improperly protected water supply in the presence of dropping cases, a fulminating epidemic may arise at any moment.

The best way to prevent cholera epidemics is to permanently abolish all the possible breeding grounds of flies by maintaining an efficient system for the disposal of refuse and excreta by the methods described in the chapters on these subjects and to efficiently protect the drinking water supply of the people. Until these two objects have been attained, towns and villages in India will always be liable to epidemics of cholera, introduced by carriers, but with a pure water supply and an efficient system of refuse disposal in force, the prompt identification and isolation of carriers and the disinfection of fomites and dejecta of patients will speedily bring the epidemic to an end.

PLAGUE.

Plague is a septicæmia caused by the *Bacillus pestis*, which produces an epizootic in rats from which it spreads by the agency of fleas to man and other animals.

Pneumonic forms can spread from man to man by aerial convection. The disease has long been known in India and in fact all over the world. The disease was practically endemic in Europe for many years until about 250 years ago and has been mentioned by Indian writers in past ages. The first mention of plague in India will be found in the "Bhagawat Purana."

We are, however, not concerned with the history of the disease but with its etiology, bacteriological diagnosis and its prevention.

Etiology.—The disease is caused by the *Bacillus pestis* of Kitasato and Yersin. It is found in the fluid of the initial cutaneous vesicle, the buboes, the spleen, the blood and in the sputum in cases of pneumonic plague. Injected into monkeys, cats, rats, guinea-pigs, squirrels, mongooses, bats, etc., it causes the typical disease. In bovines and in equines it only causes local reactions. Canines, birds and reptiles appear to be immune. In rats it causes a natural epizootic and the bacilli can be found in the blood.

The epizootic seems to be profoundly altered by temperature, being diminished by extreme heat and extreme cold. All species of rats are not equally susceptible, the Mus rattus, or black rat being much more susceptible than the Mus decumanus or brown rat. The Mus rattus is the principal domestic rat in Northern India.

The disease is spread in bubonic plague solely by fleas. The blood of the ordinary plague rat in $\frac{2}{3}$ of the cases examined by the Plague Commission contained 100,000,000 bacilli per cubic centimetre. The flea's stomach can contain ·5 cubic millimetre of blood so that when gorged with plague blood a flea's stomach can contain 5,000 bacilli. The bacilli are passed in the fæces of the fleas and infection to man is caused by fæcal pollution of the wound made by the proboscis. The flea most commonly found on rats by which infection is usually spread is the *Zenopsylla cheopis* but the *Ceratophyllus fasciatus* and the *Pulex irritans* (human flea) have also been found capable of causing the disease. On rats dying of plague and the clotting of the blood in the veins of the rat the food supply available for the flea being at an end, the flea leaves the rat and preferably finds another rat as its host. In an epizootic, however, as rats become few, the fleas perforce have to feed on other animals and on man and as man is usually the most easily available the disease is easily transmitted. The rat flea is capable of living for 3 to 4 weeks on man's blood.

Plague is not carried by migration of rats but by the fleas on the bodies of men and in grain and other merchandise and in bales of cotton, rags, etc.

In pneumonic plague, which only forms 2.5 per cent. of total cases, the bacilli are carried direct from man to man in the air ; in all other cases the disease is carried to man from the rats by means of the flea. This etiology explains fully the predisposing causes of sex, of house, of season, of climate, etc.

Pathology.—Plague is a hæmorrhagic septicæmia in the rat. The site of inoculation by the flea bite in man is often the site of a vesicle in which *B. pestis* is found in considerable numbers. The bacilli travel through the lymphatics to the nearest lymphatic glands, which they may traverse, and passing through the thoracic duct enter the blood stream and cause a septicæmia. More usually they do not pass the lymph glands but grow in the ducts and produce toxins, which cause cell degenerations and degeneration of the walls of blood vessels, hence hæmorrhage. The effect of these serous exudations may be seen in almost any organ. In the pneumonic type the lungs are affected and bacilli are found in the lungs.

Diagnosis.—In doubtful cases, bacteriological methods should be used. Draw off a little fluid from the suspected bubo and make films. Stain with methylene-blue, carbol-fuchsin or Leishman's stain. The presence of bi-polar staining bacilli is sufficient for all practical purposes, though it may be desirable to complete the investigation by cultural methods. In pneumonic plague, the sputum should be examined and the bacilli may be easily differentiated from pneumococci by their being Gram-negative.

Prophylaxis.—From the etiology, it is obvious that the prophylaxis should take the following lines :—

(a) avoidance of rats, therefore their fleas.

(b) protection of the human organism.

In India the destruction of rats on a large scale has been tried by poisoning, trapping, etc., but we think the general consensus of opinion now is that the rats can breed faster than we can kill them. The most efficient destroyer of rats is plague itself and if it cannot eradicate the rats sufficiently to stop the disease, nothing else will. However, by improving the sanitation of towns and villages and protecting the food-supply of the people from rats, the permanent rat population can be much reduced.

It is an axiom that the rat population of a village or town varies directly as the *available* food-supply. If the available food-supply is suddenly reduced in any town, a struggle for existence immediately ensues among the rat population ; the weaker members of the community die off, and in the absence of their natural food, rats become cannibals and eat their young and each other. The logical conclusion is that if the food-supply is nil there will be no rats. To make the condition of a town such that the rat population will be reduced to a minimum, the energies of the medical officers of health should be directed to

(*a*) thorough and efficient removal of all organic refuse, garbage, etc. from the streets and houses of the town ;

(*b*) efficient protection of the food-supply in houses, shops, grain godowns, etc.

The first is a general sanitary measure which should be as thorough as possible in all towns. The streets, lanes, and surface drains should be thoroughly swept daily and the surface sweepings daily removed and either incinerated or otherwise disposed of outside the municipal area.

Byelaws should be passed to ensure the thorough cleanliness of private premises and arrangements should be made for the speedy and complete removal of such sweepings by the municipal authorities. Such measures are in force in nearly all towns, but they are not properly carried out and until they are, this source of food supply for the rat will perpetuate the danger of plague epidemics.

The second measure requires also the passing of byelaws to enforce the proper storage of food in houses, shops and grain godowns. In houses, the food of the inmates should be kept in metal-lined or tin receptacles which are impervious to rats or in cupboards the shelves of which are inaccessible to rats. In most European houses these desiderata are carried out, but in Indian houses they are not.

In shops also all comestibles should be locked up in rat-proof receptacles during the night when not exposed for sale. In sweetmeat shops glass cases are the most convenient, and in grain and vegetable shops metal-lined boxes with lids are necessary. Grain godowns in most towns usually swarm with rats as they mostly have kutcha floors and walls and ramshackle roofs. Grain godowns for the prolonged storage of grain should have pucca floors in which rats cannot make holes. The floor should therefore be made of concrete and cement or pucca bricks pointed with cement.

The walls should be pucca and the roof of pucca brick (jack-arched), so that there is no wood work through which the rats can make holes. The windows and doors should be of sheet iron and fit exactly into the lintels so that there is no possible chance of a rat getting in. These godowns should only be opened in the day time to take out grain and immediately closed again so that rats may not gain access to them. For the design of a rat-proof godown see fig. 58. Grain kept like this keeps better in any case than grain stored in a haphazard manner. It is well known that grain which is stored in pucca dry godowns with air excluded will not become weevily, whereas grain stored in damp kutcha godowns with many holes allowing the access of air gets rapidly weevily and deteriorates in quality.

In European houses where the walls, floors and roofs are pucca, plague is a much rarer disease than in Indian houses. The above are permanent measures which would eventually banish plague from the land. In England where plague was endemic for years it is now non-existent, mostly for the reason that these measures are carried out.

Rats certainly do exist in England in large numbers but in towns their food-supply is confined mostly to the underground sewers from which they cannot gain access to houses owing to intercepting traps, and other devices of that nature to exclude sewer air from the houses. When imported by ships, however, they cause great havoc and the disease is difficult to eradicate in docks and wharves owing to the large inefficiently protected stores of food stuffs which are to be found there.

In the event of a town or village becoming infected with plague the only thing to do is to evacuate the village or town until the epizootic has ceased or to protect the inhabitants by anti-plague inoculation.

Evacuation should be into the fields at a considerable distance from the houses as the rats do not then follow as they would if the distance was very short. After evacuation a few cases may occur owing to infected fleas being brought with the inhabitants, but bodily cleanliness will soon end these dropping cases.

On the outbreak of an epidemic the whole population should undergo inoculation with anti-plague vaccine. The vaccine consists of an emulsion of dead plague bacilli which have been grown 4 to 6 weeks in broth and sterilized by heating at 65°C. to 70°C. for one hour. 5 per cent. Carbolic acid is then added to kill any pathogenic organisms which may accidently gain access to the vaccine, which otherwise would be an ideal medium for its growth. This is only a precautionary measure to guard against a remote chance.

A dose of 4 c. c. for an adult varying down to ½ c. c. for children under one year will give a high degree of protection against the disease for a year and a modified protection for perhaps another year. The reaction is not severe and no ill effects are produced. The negative phase is practically nil so that even persons in the incubation stage of the disease derive benefit from it and the attack of the disease which ensues is modified. We cannot impress on medical officers of of health too strongly the necessity for their using their utmost endeavours to popularize inoculation in their towns. When a house is threatened with plague or during an epidemic, it is practically unnecessary for inoculated persons to evacuate their houses and they are thus saved considerable inconvenience and pecuniary loss.

The following is the technique of plague inoculation issued by the Public Health Department, United Provinces for the guidance of the inoculators.

The apparatus required consists of :—

(1) Inoculation syringes.
(2) Spirit lamp, a box of matches, and apparatus for heating the vaseline.
(3) A small bowl containing a few pieces of lint soaking in 1 in 40 carbolic acid lotion.
(4) Bottles of prophylactic.
(5) A small bottle of tincture of Iodine, with a probe for making swabs, with which to sterilize the skin at the site of inoculation.
(6) A pair of dressing or dissecting forceps, for fixing on needles etc., lying on a piece of lint soaked in carbolic lotion.
(7) Soap, water and towels for washing hands.

Sterilization of apparatus.

II. Kapadia's lamp is used for sterilizing the syringes and needles in hot vaseline. The apparatus consists of a spirit lamp, a metal bowl for vaseline, a block tin stand for holding this, and a thermometer fixed in a holder attached to the stand. Vaseline is very convenient, as it becomes solid when cold, and the needles can, with advantage, be left in it. It should be heated to a temperature of 160° Centigrade (320° F.). In an emergency sweet oil, or even country oil may be employed. If no thermometer is available a piece of bread crumb may be dropped into the vaseline; it will turn brown at 160° C. A syringe should be rinsed out with the vaseline when the temperature reaches 90° C, if there is any suspicion of moisture in it. It should be filled three times with the heated vaseline and emptied, when the temperature has reached 160°C. This efficiently sterilizes it. Then with the forceps a needle should be fished out of the heated vaseline and firmly fixed on to the nozzle of the syringe. A little vaseline may be drawn through the needle to see that it is not blocked. When the syringe is cool it is ready for use. While the syringe is cooling it should be placed so that the needle does not come into contact with anything. Just before use the syringe should be washed out with a little of the prophylactic.

Treatment of prophylactic.

III. The box containing the bottles should be kept in the coolest place possible. The bottles should be inverted and well shaken just before use. This should thoroughly mix the sediment, seen at the bottom of the bottle, with the fluid and will also show whether there is any leakage from a crack or flaw in the bottle.

This sediment consists of dead bacteria and is an essential constituent of the vaccine. Occasionally it is so hard that it cannot be broken up by shaking; in this case, and in case there is evidence of a flaw or crack in it, the bottle should be discarded.

Method of opening the bottles.

IV. To open the bottle of prophylactic hold the neck in the flame, turning the bottle round all the time so as to sterilize every part of the neck. When the glass is sufficiently heated, jerk up a little of the fluid and the neck will crack. The tip may be knocked by a sharp blow by a pair of forceps sterilized in the hot vaseline.

After opening the bottle the contents must be sucked into the sterilized syringe. The contents of a bottle once opened must be used within half an hour or thrown away. Any fluid left in the bottle after filling the syringe must be at once thrown away.

V. Regulate the tightness of the piston by the screw in the handle.

Method of filling the syringe.

Dip the needle into the vaseline at 160°C. Then insert the needle in the bottle. Withdraw the piston-rod slowly, taking care to keep the point of the needle covered, so as to avoid getting air into the syringe. Should any air enter, it should be got rid of by holding the syringe vertically upwards and pressing the piston-rod. When the air is ejected the syringe should be filled with prophylactic.

VI. The most convenient site for the operation is the back of the

The operation of inoculation.

left upper arm about midway between shoulder and elbow. The skin being puckered up between the thumb and fingers of the left hand, the needle of the syringe is passed into the subcutaneous tissue, with a quick stabbing motion, and the dose at once injected. On withdrawing the needle the forefinger of the left hand may be pressed for a moment over the puncture to prevent oozing.

The needle should be pushed through the skin in a sloping direction, more or less parallel to the surface, carefully avoiding the big vessels and not penetrating the muscles.

The usual dose for an adult man is 4 cubic centimeters (1 c. c. = 17 minims), but the label on the bottle should be consulted on this point, *and in case less than three months has elapsed since the date of manufacture only three-fourths of the usual dose should be given, i.e., 3 c. c. for an adult man.*

Taking the dose for an adult man as 4 c. c. the following table shows the doses to be given to persons in good health at various ages :

To individuals	of	from	10 days	to	1 year	give	0·2 c.c., or 1-25th	of	full dose.
"	"	"	1	to	2 years	"	0·8 c.c., or 1-5th	"	"
"	"	"	2	to	5 years	"	1·6 c.c., or 2-5th	"	"
"	"	"	6	to	11 years	"	2·4 c.c., or 3-5th	"	"
"	"	"	12	to	15 years	"	3·2 c.c., or 4-5th	"	"
"	"	"	16	to	50 years	"	4·0 c.c., or full dose.		

If the dose for an adult man is less than 4 c.c., the amount to be given at various ages is to be calculated in the same proportion as above.

Women of all ages over 14 years should get $\frac{1}{10}$th less than men of corresponding ages.

Pregnant women may be inoculated up to the seventh month, inclusive, without making any special reduction of dose. After the seventh month, the dose should be given in two instalments, separated by an interval of a week or so. Miscarriage has never been known to result from inoculation; and the danger from plague to lying-in women is so great that a special effort should be made to induce pregnant women to be inoculated.

Persons over 50 years of age should get $\frac{1}{10}$th less for each decade above that age.

Children stand inoculation well, and no fear need be felt in giving the doses above-mentioned.

The symptoms caused by inoculation commence, as a rule, in 3 to 5 hours, and consist chiefly of swelling and pain at the seat of inoculation and of a rise of temperature. The fever is accompanied by the general discomfort usual to this condition, and no treatment of symptoms is required beyond applying ice for the relief of headache or lead and opium lotion to the arm if necessary, and rest. General symptoms subside after 24 to 36 hours as a rule, but, if not, a purge will give relief. The pain at the seat of inoculation lasts for three or four days, disappearing gradually, but a painless induration may remain for some little time.

It is not known whether there is any relation between the presence of high temperature after inoculation and the degree of protection acquired thereafter by the individual; so an absence of reaction does not mean that the inoculation has not "taken," as would be said in similar circumstances after vaccination for small-pox.

In performing the operation of inoculation there are certain essential details which must be scrupulously observed:—

(1) The site of inoculation should be sterilized by rubbing it with a swab dipped in tincture of iodine. Should blood ooze from the puncture on the withdrawal of the needle, a piece of lint, soaked in 1 in 40 carbolic lotion, may be pressed over the spot for a few minutes.

(2) Before each inoculation the needle must be dipped into vaseline at 160° C. There is no necessity to remove it from the nozzle of the syringe.

(3) There are five screw-marks between every two lines, marking c.c. on the stem of the 20 c.c. inoculation syringes. A full turn of the stop from one screw-mark to the next will therefore indicate one-fifth of a c.c.

(4) At the conclusion of each day's operations, the inoculator should rinse out with hot vaseline all syringes and needles which he has used, and the latter may subsequently be left in the metal bowl embedded in solidified veseline, which will protect them from rust.

The operation of inoculation.

VII. Different operators may have different methods of performing inoculation, but when large numbers of persons present themselves for inoculation, it will be found convenient for the operator to sit and to arrange that the person to be inoculated be instructed to sit on the ground and to place his left elbow on the operator's right knee, which should be covered with a towel.

There are several advantages in making persons sit, both while waiting for their turn and during the operation. In the first place, it is less tiring to the operator and to applicants for inoculation to sit than to stand ; while the latter when sitting are much easier to manage, both as a crowd and as individuals, than when standing. There can be but little jostling by people waiting for their turns when all are seated, and a person seated on the ground, with his arm in the grasp of the operator, is less able than one standing up to jerk himself from the prick of the needle.

Persons who should not be inoculated.

VIII. No person in a bad state of health should be inoculated. The only exception to this rule should be that during an epidemic of plague, when there is considerable danger of a person contracting the disease, he may on his express request be inoculated, if the operator considers that his life is not endangered thereby.

Great care should be taken to refrain from inoculating any person who has contracted plague before presenting himself for inoculation. A few persons have been inoculated during the very early stage of plague without the course of the disease being prejudicially affected thereby, but the Indian Plague Commission (Report, paragraph 462) recorded their opinion that "it seems to us unlikely that the anti-plague inoculation can exert any favourable influence on persons who are already incubating plague." If plague, contracted before inoculation, develops afterwards, the people will become suspicious of the measure.

IX. It is not uncommon for a person to ask to be inoculated over some painful spot or rheumatic joint, with the hope of obtaining relief from the pain of sciatica or rheumatism.

Life of Prophylactic.

X. The material may be expected to retain its original efficacy for at least eighteen months, if protected from light and stored in a cool place. Old prophylactic had better be destroyed.

Treatment of Syringe and special precautions.

XI. Whenever the syringe has to be laid on the inoculation table, it should be placed on one piece of lint and covered with another piece, both pieces of lint being thoroughly soaked in 1 in 40 carbolic lotion.

Should any forceps, needle or syringe become contaminated, by falling on the ground or in any other way, it must be re-sterilized in the vaseline heated to 160° C. Pieces of lint which have fallen on the ground should not be used again in any circumstances.

The most rigid asepsis is always to be observed in performing inoculations.

SMALL-POX.

This disease has been known from the earliest times and records of its existence are to be found in India and China many centuries before the Christian era. It was not known in Europe until about the 6th or 7th century. It was first recorded in England in the 9th century. Climate and soil appear to have little effect on the virulence of the disease, it being met with at all times of the year in all countries. In India, however, the monsoon appears to check its ravages.

The death-rate from small-pox in ancient times was very high. In England, from returns made since 1629 in London, it appears that 70 to 90 per thousand of all deaths were from small-pox. The incubation period of the disease is about 12 days and the period of infectivity appears to last for about 6 weeks. Isolation should be maintained for at least three weeks in the mildest cases and always until every scale has disappeared. After exposure to infection, quarantine for at least 14 days should be observed. Second attacks are rare but even third attacks are known ; in general the immunity conferred by one attack is very high. Some few persons appear to be immune from the disease and from the mean of many observers, these appear to be about 1-20 adults and 1-60 children.

The etiology of this disease is still regarded by the profession as unknown. Many investigators have published results claiming to have isolated specific organisms, but none up to date have answered to Koch's axia.

One school of observers believe that the organism is an ultra-microscopic germ and have founded their belief on the fact that the virus of small-pox is filterable through the finest Pasteur-Chamberland filter.

In the pocks a very large variety of organisms, named and unnamed, are to be found, such as staphylococci, diplococci, coliform organisms and larger rod-shaped bacilli. As a rule streptococci are absent.

Another school of observers maintain that the organism is a protozoon, in fact the organism of small-pox is the organism isolated by Guarniéri in 1892.

These bodies were observed by Guarniéri in the lesions of small-pox and also in those produced by vaccinating the cornea of rabbits, etc. These findings were confirmed by Pfieffer in 1893 and subsequently by other observers. In 1903, Councilman, Magrath and Calkins published the full account of the life history of the parasite and their findings were in part confirmed by DeKorte in 1905. The organism has been named by these observers the "*Cytoryctes variolæ.*"

In its youngest form as seen in the cells of the skin it is a small spherical homogeneous body $\cdot 7\mu$ in size. No differentiation into cytoplasm and nucleus can be seen. The parasite, as it grows, increases in size to about 3μ and becomes vacuolated. The periphery shows green staining and the rest of the cell reddish staining. The parasite goes on increasing in size to 10 to 15μ and the red staining material is distributed throughout the body of the parasite as minute spherical granules from ·7 to 1μ in diameter. These granules, which appear like the chromatin granules of other parasites, have been named by Calkins "*protogonoplasm*." The adult parasite then breaks up and the granules are liberated.

The organism can change its shape and throws out pseudopodia in its adult form.

The granules which escape from the disintegrated adult cell can start the life cycle of the organism again. Calkins says that if the granules reach the nucleus of the cell they stain uniformly and become minute, clearly defined, homogeneous bodies. If they fail to reach the nucleus and remain in the cytoplasm, they cannot develop. Calkins also says that in the nucleus they form male and female gametocytes. No conjugation has, however, been observed. The zygote, in this case is an amœboid body lying in the nucleus of the cell. This zygote becomes a sporoblast the spores of which are very minute and contain a vacuole. From this spore are formed secondary sporoblasts. Those who believe that this organism is the true cause of small-pox hold that the virus is filtrable because the minute granules in their earliest stages can pass through the pores of a Pasteur filter.

Since the great advance made within recent years in our knowledge of the mechanism of immunity, several observers have experimented with small-pox and cow-pox virus with a view to throwing some light on the nature of the organism. One of the writers (C. L. D.) carried out some experiments with calf lymph on vaccinated and unvaccinated calves in 1911, the results of which were published in the Indian Medical Gazette. The experiments showed that the immunity caused by vaccination could be demonstrated by the Bordet-Gengou reaction. They also showed that the organism of cow-pox was rendered inactive as an antigen by heating to 100°C. or by heating to 37°C. for seven days. The experiments on filtered and unfiltered virus were inconclusive as, when first done, the filtrate functioned as an antigen as well as the residue ; when done again only the residue functioned as an antigen. We can only explain this by suggesting that on the occasion of the second experiment none of the minute forms of the organism could have been present, whereas both minute and older forms were present when the first experiments were done. Further work on the subject is necessary and would give valuable information.

Diagnosis.—The diagnosis of the disease is very simple, though it may be mistaken for chicken-pox at the beginning of an outbreak ; the different distribution of the eruption, the fever, etc., should, however, very quickly demonstrate the nature of the disease.

Prophylaxis.—To prevent the spread of this most infectious disease, immediate isolation of patients at a considerable distance from the rest of the community should be enforced. All contacts should be at once vaccinated and quarantined. As the mode of invasion of the organism is not at present well understood, it is necessary to take all precautions. The general belief is that the organism obtains access through the pores of the skin, being carried from person to person by means of the air. If this were so, why should not the skin eruption in each and every case vary with the site of the infection ? As this is not the case and the skin eruptions appear to be fairly similar in distribution in all cases it is probable this is not the channel of entrance to the body. It is much more likely that the disease is a *general intoxication.*

Vaccination, however, is the most necessary prophylactic measure. When one looks around in India at the present day and sees that the majority of the older inhabitants of the country are pitted with small-pox with a fair percentage of partial and total blindness, when one reads of the awful scourge that this disease was in former times and compares these with the present freedom from the disease that we are enjoying, the absence of facial disfigurement and other sequelæ, one fails to understand how any reasonable being, who has seen the results of vaccination in India, can possibly advocate the relaxation of the provisions of the Vaccination Act. In consonance with the theory of the channels of infection which are enumerated above, in countries in which bodily cleanliness and individual and general sanitation have reached a high standard, there is no doubt that the necessity for vaccination would not be as great as in countries where such standards have not been reached, but when it is taken into consideration that the process of vaccination is harmless as carried out nowadays and gives very little inconvenience, that it confers immunity for about 7 years and that a re-vaccination then protects as a rule for life, it is a measure that should be strictly enforced upon the whole population until small-pox as a disease has disappeared from the land. Then and only then would be the time to relax the rules and provisions laid down in the Act and until then no exemptions from its provisions should be permitted.

Vaccination.—Protection against attacks of small-pox can be acquired by an attack of the disease, inoculation of virus and by vaccination with the virus of cow-pox. The ravages of small-pox were so extensive in the past that in Europe as well as in India inoculation was practised in order to induce a mild attack of the disease, in spite of the fact that many people thus inoculated died and a focus was established to start the disease again. The degree of protection varies greatly ; a severe attack of small-pox gives much more prolonged immunity than a mild attack, and single vaccination is far less efficient than double or multiple vaccination.

Multiple vaccination, *i.e.*, the production of 3 vesicles on each arm, is the most efficient method of protection, and re-vaccination after 7 years will render one practically immune for life.

Inoculation was made illegal in England in 1840 and similar legislation was subsequently introduced into India, but even to this day, in spite of the safety of vaccination and the small amount of physical discomfort caused by it, inoculation still exists in out-of-the-way places in India.

Vaccination was introduced by Jenner over 125 years ago. The material used was the contents of the vesicles of cow-pox or small-pox in the cow. There appears to be no doubt that the diseases are identical and that the vaccinating of calves with small-pox virus produces cow-pox or vaccinia in the calf and if human beings are vaccinated with cow-pox, it protects them against small-pox. In other words, the virus of small-pox becomes so altered in the calf that it produces a very modified form of small-pox, its passages through calves modifying the disease into one with a local reaction only instead of a general reaction. In 1838 vaccination was introduced by the Vaccination Act in England and inoculation was forbidden. In 1854 vaccination was made compulsory and has systematically been enforced since the time of the pandemic in 1871. Vaccination was introduced into India in the middle of the 19th century. Children coming out from Europe to India were vaccinated by the arm-to-arm method during the whole period of the voyage so that on arrival at Bombay the strain was still going, and children in Bombay were vaccinated. As there were no railways at this time, the strain was gradually carried to other parts of India by vaccinating children and then taking them to other villages and vaccinating other children from them. In this way the strain was gradually spread all over the country—a process which took years to accomplish.

The various provinces introduced Vaccination Acts which are adoptive but they have been adopted by all municipalities. Vaccination is not, however, compulsory in districts, but the benefits accruing from vaccination are so obvious that at the present day in India very few parents neglect to have their children vaccinated in accordance with the provisions of the Act.

Every district board entertains the services of several permanent vaccinators and also some probationary and temporary vaccinators. These are under the orders of the District Superintendent of Vaccination. The administration of the department is under the provincial Directors of Public Health and Assistant Directors of Public Health who are Superintendent-General and Deputy Superintendents-General of Vaccination.

These officers, when on tour, inspect vaccinations and the work of the vaccinators and check their returns in order to test their accuracy. The Assistant Superintendent of Vaccination tours continuously in the cold weather, inspecting the work of the vaccinators and the Civil Surgeons go on occasional ten-day tours for the same purpose. In municipalities these duties of inspection and checking devolve on the medical officers of health, so that it is necessary for them to know the methods in vogue.

Vaccination in the plains is done only in the cold weather as the strain of lymph deteriorates so much in high temperatures that many unsuccessful results are obtained. Arm-to-arm vaccination was the only kind of vaccination practised for a long time or vaccination direct from the calf, but investigators soon found that excellent lymphs which were uniformly successful could be made by mixing the crude lymph from the vesicles on the calf with other substances, and issuing the mixture in tubes for the use of vaccinators, these lymphs being veseline lymph, lanoline lymph, glycerine lymph, chloroform-glycerine lymph, etc.

Opinion is divided as to which of these lymphs is the best. In the United Provinces they have all been tried and it is found that the least expensive and the most efficacious is glycerine lymph. Glycerine is a mild antiseptic, and, when mixed with crude lymph, gradually kills off all the usual extraneous organisms found in lymph and at the end of about a month the lymph is a practically pure cow-pox vaccine and smears made on an agar plate will show no growth. Chloroform attains the same desideratum much more quickly but it increases the expense of the manufacture very much, whereas keeping the lymph attains the same object in time. Lanoline and veseline do not have any effect in reducing the number of extraneous organisms in the same way.

The method of preparing calf lymph at the Government Bovine Lymph Depôt at Patwa Dangar in the United Provinces is as follows :—

The abdomen of a calf is shaved and thoroughly washed with soap and water and dried. 20 to 40 vaccinations are made with a scarifier, using glycerine paste as a vaccinifer. It is 50 per cent. glycerine and crude lymph.

Vesicles are produced and the lymph is taken from these after 120 hours in winter and 96 hours in summer as the lymph loses strength in the vesicles in high temperatures after 96 hours. This crude lymph is ground up in a lymph grinding machine with glycerine and distilled water in the proportion of 1 part of lymph to 2 parts of distilled water and two parts of glycerine. This is then kept in the cold weather for at least three weeks and then issued for use in either glass capillary tubes containing one dose or in collapsible tubes of mixed metals containing 25 doses. Only good vesicles are used and a stock of glycerine paste is kept up at the same time. The whole vesicle is scraped off with a Volkmann's spoon, drawing as little blood as possible. The wounds are dressed with boracic and zinc powder and the calves are kept till the scales have dried. In England each calf from which lymph is taken is killed and a post-mortem examination is made and the lymph is not issued if the calf is found to be diseased. It is found that this is an unnecessary precaution as calf lymph practically never contains any pathogenic organisms except staphylococci. Tetanus has been reported on one or two occasions in America but the percentage of cases in which it is found must be infinitely small, when one considers that out of the many millions of vaccinations done yearly, this disease has never been reported anywhere except on a very few occasions in America. Streptococci are found in lymph but these disappear with keeping.

In arm-to-arm vaccination several diseases have been and can be transmitted from child to child such as syphilis, tetanus, scarlet fever, staphylococcus and streptococcus infections and even tuberculosis. Hence the necessity of abolishing arm-to-arm vaccination and substituting vaccination with calf-lymph. Of course, if only healthy children were used for arm-to-arm vaccination, many of the dangers of this form of vaccination would disappear, but it is impossible to be certain that the child used is not suffering from some disease which can be transmitted, although it may appear healthy.

Calf lymph will keep and retain its potency for months at a low temperature. If stored at 4°C. it will keep for long periods. Lymph stored in tubes for 6 months at an average temperature of 20°C. is perfectly good at the end of that time.

Lymph issued from the depôt at Patwa Dangar is issued with instructions as to when it should be used. In the hot weather it should be used at once as lymph rapidly loses its potency at temperatures over 75°F. and, the higher the temperature, the quicker is the loss of potency. The strain of lymph at the Patwa Dangar lymph depôt is constantly tested by vaccinating rabbits on the ear. If a good vesicle does not form, it indicates that the strain is becoming weak. A rabbit is less susceptible to cow-pox than a man ; therefore only good strains of lymph give good vesicles on rabbits. The strain can also be improved by vaccinating rabbits and passing the strain through a series of these animals and then vaccinating calves with this strain. A strain of lymph can be kept potent without resorting to this method by choosing only perfect vesicles for stocking lymph and taking the lymph out at the right time. In addition, by alternating between cow calves and buffalo calves the strain of lymph retains its potency, and, if it is found to be weakening, it can be improved by this method alone.

At the Patwa Dangar lymph depôt it is found, however, that inspite of the greatest care in choosing vesicles and alternating between cow and buffalo calves the strain becomes weaker in summer. The depôt is 5,300 feet above the sea level and the temperature rises to over 90°F. in the shade. In the months of June and July when we used to keep the lymph in an underground chamber with a spring in it, the temperature rose as high as 77°F. and the strain of lymph deteriorated. The result of this is that lymph issued at the beginning of the vaccination season in September and October gives a fairly large percentage of unsuccessful results while lymph issued from November to March gives excellent results. The strain deteriorates in the vesicles before it is taken from the calf so that lymph taken from the vesicles in summer even if immediately put in cold storage is always weak. In Madras where they have a cold storage installation, the results are inferior owing to this reason.

In view of the above a cold storage chamber has been installed at the Government Bovine Lymph Depôt at Patwa Dangar and all lymph preparation is being done in the winter months and the lymph stored for issue. In this way the necessity of having to nurse the strain of lymph every autumn is avoided. The stock lymph from one season is stored until the next season at 4°C. so that it will not lose its potency.

Calves should be used for the manufacture of lymph when young. Cow calves from the ages of 6 months to 1½ years and buffalo calves 6 months to 2½ years are well suited for this purpose. At Patwa Dangar it is found that on an average 25 grammes of crude lymph can be got from healthy cow calves and 40 to 50 grammes from healthy buffalo calves. The maximum amount obtained from a buffalo calf is 90 grammes.

It is not the practice to vaccinate the calves on the groins, mammary glands or scrotum nor above the edge of the ribs, all the marks being made on the abdomen proper. Vaccinating on the three former situations gives an unnecessary amount of pain to the calves and the quality of the lymph above the line of the ribs is not so good as the lymph obtained from the abdominal surface.

The better condition a calf is in, the better the quality of the lymph ; calves in poor condition give bad lymph.

Notes for guidance in inspecting vaccination and the work done by vaccinators in towns and villages of the U. P.

1. Each vaccinator keeps a diary of the mohallas or villages he has visited and the number of children he has vaccinated in each. He also notes the number of children born in these places and the time of their birth and the date by which they will become available for vaccination. This he does by taking extracts from the birth registers and also

by personal enquiry. He also notes the numbers of children born who die before they become available for vaccination. It is his duty to vaccinate all the available children and if any, who are entered in his books as born and who have not died have not been vaccinated by him, he must state the reasons for it, such as "left the locality", "not in a fit condition to be vaccinated," etc.

A scrutiny of these diaries and a comparison of these diaries with the birth and death registers will give the inspecting officers full information of the work done by vaccinators.

2. The diaries of vaccinators should also be compared with the general vaccination register, in order to see if the entries tally.

3. Vaccinators should not vaccinate children except in the village or town in which their parents or guardians reside, otherwise there is a loophole for the entry of fictitious names in order to return a large number of children vaccinated and verification of such entries is difficult.

4. When inspecting vaccination work in a town or village the number of children present should be noted and also the number of absentees entered as unknown. By personal enquiry it should be established that the children whose names are entered actually exist.

5. When inspecting the children present it should be noted whether the vaccination marks indicate a good vesicle and the number of vesicles. Each child should be vaccinated in at least two places on each arm, as the degree of protection induced by four vesicles is deemed sufficient, whereas the degree of protection induced by less than this number is not considered sufficient. Six vesicles in all would be better still. The following table given by Manson will make evident the reason for this :—

Case mortality from small-pox in relation to the number of vaccine cicatrices per cent. :—

Unvaccinated	35·5%
Stated to have been vaccinated but without cicatrices	21·75%
One cicatrix	7·5%
Two cicatrices	4·125%
Three cicatrices	1·75%
Four or more cicatrices	0·75%

6. Entries in the vaccinators' reports often bring to light omissions in the reporting of births which are then noted and reported.

7. Entries for any month should be compared with the entries in previous months as vaccinators have been known to make entries of the same vaccination in two or more months to increase the numbers.

The number of children available for vaccination during a vaccination season are roughly the number of children born between October 1st of the previous vaccination season and September 30th of the current season less the number of those children who have died. This does not take into account emigration or immigration but if the inspecting officer makes the above calculation and compares it with the number of children vaccinated he has a rough idea of the number of children remaining to be vaccinated before the end of the season.

TYPHOID FEVERS.

It used to be thought that the Indian was practically immune to these diseases and that the European was peculiarly susceptible. It is now known that these diseases are much more common among Indians than was thought previously. There is no doubt, however, that the Indian has a large amount of hereditary immunity conferred on him and that the death rate among Indians is much lower than among Europeans. Both typhoid and paratyphoid A are being constantly diagnosed beyond a doubt in Indian patients and many foci of both diseases exist in many parts of the country. We may say that both diseases are endemic all over India. Paratyphoid fevers of the B variety has not until recently been diagnosed in India. It was imported from Iraq during the war by returning troops.

The symptoms of these diseases are well known, but in India they are very liable to be accompanied by malarial fever which disguises the symptoms and makes accurate diagnosis from symptoms only a matter of difficulty. These diseases, however, appear to be more prevalent in the hot weather before the monsoon and not after the monsoon, as is the case with malarial fevers. In Lucknow, in 1911, many cases of paratyphoid A fever occurred during April, May and June, the epidemic dying down with the advent of the rains. Some of these cases were diagnosed beyond a doubt bacteriologically. In 1921 an extensive epidemic of paratyphoid B occurred in August and September which was at first mistaken for cholera. Many cases were diagnosed in the laboratory and the presence of the disease in epidemic form was established beyond a doubt.

When an outbreak of a fever occurs in any locality, having clinical symptoms resembling those of the typhoid fevers, medical officers of health should endeavour to get blood cultures taken from patients about the 4th to 8th day of the fever. About 10 c. c. of blood should be withdrawn from a vein with aseptic precautions in a syringe and injected into a bottle of sterile oxbile and the mouth of the bottle protected by an Indiarubber cap. On reaching a laboratory the bottle should be incubated for 24 hours, and some of its contents spread on Conradi-Drigalski plates. If any growth is obtained, the colonies of bacteria of the typhoid group will be small, translucent, dew-drop like colonies which do not redden the medium. Some of these should be picked off the plate and tested for agglutination with high titre sera of typhoid—para A and para B. A drop from each bottle of the serum should be transferred to a glass slide with a platinum loop and colonies picked off the Conradi-Drigalski plates should be emulsified with these by mixing with the platinum loop. If clumping occurs with any of the sera, then confirmatory tests in the sugar media, litmus milk, etc. should be proceeded with.

The typhoid fevers give the biochemical reactions shown in the following table in the sugar media. The reactions given below are sufficient for an accurate differential diagnosis. Further confirmatory tests may be carried out if desired but for all practical purposes the above tests are sufficient.

The sugar media are made in 1 per cent. strength in 1 per cent. peptone-water sterilized by steaming half an hour on 3 successive days.

MEDIA.	TYPHOID.	PARA A.	PARA B.
Glucose	A	A+G	A+G
Cane sugar	—	—	—
Lactose	—	—	—
Mannite	A	A+G	A+G
Dulcite	—	A+G	A+G
Litmus milk	A	A	A then Alk
Neutral-red agar	—	G	G
Inulin	—	—	—
Adonite	—	—	—
Peptone-water	—	—	—

Some strains of *B. typhosus* form acid in dulcite (*Grattan*).

Blood cultures should always be taken early in the disease as later on negative results are likely to be obtained. Widal's reaction may be used for diagnosis later in the disease; a positive result should be obtained after the 10th day of the disease. This method for the differential diagnosis between typhoid fever and its allies is not to be recommended except in expert hands, as the group reactions cause agglutination to occur in low dilutions with all the organisms of the group. Generally speaking stock typhoid bacilli should be agglutinated by the serum of a typhoid patient in dilution of at least 1-30. Stock paratyphoid A bacilli should be agglutinated by the serum of a patient suffering from that disease in a dilution of at least 1-60 while stock typhoid bacilli should not be agglutinated in greater dilution than 1-100 of this serum.

The examination of the fæces and urine of patients will also be necessary in doubtful cases. The fæces should be mixed with sterile normal salt solution and allowed to stand. Some of the supernatant fluid is then spread on Conradi plates and incubated for 24 hours. The plates will be found covered with growths some of which are lactose fractors and some not. A search should be made for typical looking colonies and these should be tested with high titre sera and rejected if clumping is not produced. Any colonies that clump in the sera should be subcultured on fresh plates until a pure culture is obtained and the confirmatory tests in the sugar media, etc. then applied.

When the diagnosis has been established the medical officers of health should turn their attention to the source of infection. These diseases may break out in epidemic form owing to importation by a person incubating the disease and subsequently falling ill or by a convalescent from the disease who is an acute or sub-acute carrier or by a chronic carrier of the disease.

Chronic carriers are very rare but sub-acute and especially acute carriers are more common. The excreta of persons carrying these diseases should always be disinfected immediately after their evacuation, and only by this way can infection from these carriers be prevented.

There is no legislation to enforce the segregation of carriers and only the spread of education and what one might call a higher plane of sanitary morality will ensure carriers taking precautions to prevent the spread of the disease they are harbouring.

Once typhoid excreta are exposed to the access of flies, the spread of the disease is rapid. Flies carry the germs from infected excreta on their legs and in their stomachs and can thus mechanically infect food by settling on it or excreting on it. There is no doubt whatever that this is the commonest way of spread. It is also spread by actual contagion from the clothes and hands of people who are carriers to others with whom they come in contact. The germs may gain access to milk by the latter being handled on its way from the cow to the consumer by a carrier and widespread outbreaks may occur. A carrier in the kitchen will inevitably infect the food of the household. The water supply similarly can become infected and a fulminating water-borne epidemic will ensue.

It is therefore necessary for a medical officer of health to see that the cleanliness of his town is such that the prevalence of flies is diminished, that the water and milk supply are above suspicion and that carriers are marked down and special measures taken to ensure the disinfection of their excreta.

The pathogenicity of the germ varies in different outbreaks ; occasionally a particularly virulent strain may cause a large number of deaths in excess of the normal. The normal death rate among Europeans varies with the conditions of nursing. It may be placed generally at about 25 to 30 per cent. but this can be reduced to 10 to 20 per cent. with good nursing. It is difficult to say what the death rate is among

Indians but it is probably much lower than this even without adequate nursing.

The preventive measures are similar to those used in cholera, which have been already mentioned.

DYSENTERIES.

Dysentery is a term given to a series of symptoms comprising chiefly the passing of blood and mucous per *anum*, diarrhœa, tenesmus and fever.

Such symptoms may be the result of a variety of causes such as the presence of certain protozoa, bacteria or higher organisms in the intestinal tract.

Dysentery may accompany malaria and be actually caused by the malarial parasite and also by heavy infection with *Leishmania donovani*, but the chief protozoal causes are amœbæ, and dysentery caused by these protozoons is known as amœbic dysentery.

Amœbic dysentery may be acute, sub-acute or chronic. The causative agent is the *Entamœba histolytica* of Schaudinn.

These organisms gain access to the body in food and water and produce inflammation and ulceration in the colon and rectum. They also invade other parts of the body and are almost invariably the cause of tropical abscess of the liver. Several other entamœbæ have been described which are found in the healthy bowel, the commonest of these being the *Entamœba coli* of Loesch.

Entamœba histolytica.—The full grown parasite measures on an average about 30 μ in diameter and consists of a clearly defined ectoplasm, endoplasm and nucleus. The nucleus is rather small and does not stain deeply. It is usually placed rather near the periphery of the cell. The cell throws out pseudopodia which consist entirely of ectoplasm.

By means of these pseudopodia the parasite is able to burrow into the sub-mucous coat of the intestine.

The parasite can reproduce by binary fission, budding and sporogony, the commonest method being by budding. The *Entamœba histolytica* changes in the bowel from the amœbic form to the cystic form and forms cysts with thick walls containing 4 nuclei. This form was called the *Entamœba tetragena* of Viereck but is not known to be the cystic form of the *Entamœba histolytica*. The *Entamœba coli's* cystic form usually contains 8 nuclei. *Entamœba coli* has been cultivated outside the body in conjunction with bacteria but *Entœmœba histolytica* has not yet been so cultivated on artificial media.

Cysts are usually found in the convalescent stages and until the motions are free from cysts, the patient is liable to relapses. These cysts are evacuated and are the cause of the spread of the disease to others.

This form of dysentery is found everywhere in the tropics and in India is wide-spread in its distribution. It is commonest in the dry hot season and usually becomes less with the advent of rains. The diagnosis clinically is fairly simple but it is not so easy to differentiate between attacks of amœbic dysentery and other forms such as bacillary dysentery. Amœbic dysentery is usually, however, more chronic and is not always associated with pyrexia. The only certain method of diagnosis is the isolation of the causal organisms from the stools. The *Entamœba histolytica* is larger than the *Entamœba coli*, has a distinctly differentiated ectoplasm, and is more actively motile and forms cysts with four nuclei only.

Prophylaxis.—As the organism gains access to the body in food and water, the oft-repeated injunctions as to protection of the food and water supply must again be emphasised. Boiling of water and cooking of food kills the amœbæ so that in the case of prevalence of the disease these precautions will remove the danger of infection.

The medical officer of health, however, is more concerned with the general rules for the protection of food and water supply already dealt with in connection with cholera, the typhoid fevers, etc. The best treatment in actual cases after the primary cleansing of the bowel with castor oil or saline purgatives is the hypodermic injection of emetine as recommended by Rogers and others. This treatment is especially efficacious in sub-acute and chronic attacks and the treatment should be continued even after all the symptoms have subsided, in order to get rid of the cysts.

The other great group of dysenteries is the bacillary dysenteries.

There are acute and chronic forms. The disease is caused by certain bacilli of the coli group which have been described by their discoverers. The following are the best known organisms that undoubtedly are the causal agents of dysentery :

B. dysenteriæ of Shiga and Kruse.—A short non-motile bacillus, Gram negative, which does not clot milk nor does it produce gas in the sugar media, but produces acid in some of them.

B. dysenteriœ of Flexner is identical with the above in appearance but has not the same sugar reactions.

B. dysenteriœ Y of Hiss is identical with the above except in the sugar reactions.

Several other bacilli have been described by Castellani, Sweet, Conradi, Strong, etc.

Hiss divides the dysentery bacilli into four different groups :—

Group I.	Glucose fermenters ...	... B. Shiga.
Group II.	Glucose and mannite fermenters	... B. Y.
Group III.	Glucose, mannite and saccharose fermenters	... B. Flexner.
G oup IV.	Glucose, mannite, saccharose and maltose fermenters......	Harris' bacillus, Wollstein's bacillus.

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The following table gives the cultural reactions of some of the commoner intestinal bacilli, pathogenic and non-pathogenic.

Bacillus.	Glucose	Lactose	Cane sugar	Mannite	Dulcite	Litmus milk 1st day	Litmus milk 3rd day	Indol	Gram	Motility	Remarks.
B. lactis ærogenes ...	+	+	+	+	–	A . C	A . C	∓	–	–	
B. cloacæ ...	+	+	+	+	–	A . C	A . C	–	–	+	
B. neapolitanus ...	+	+	+	+	+	A . C	A . C	+	–	+	
B. coli communis ...	+	+	–	+	+	A . C	A . C	+	–	+	
B. acidi lactici ...	+	+	–	+	–	A . C	A . C	+	–	–	
B. gærtner ...	+	–	–	+	+	A	A k.	–	–	+	
B. suipestifer ...	+	–	–	+	A	A	Alk.	–	–	+	
B. typhosus ...	A	–	–	A	–	A	A	–	–	+	Late acid reaction in dulcite.
B. paratyphosus A ...	+	–	–	+	+	A	A	–	–	+	
B. paratyphosus B ...	+	–	–	+	+	A	Alk.	–	–	+	
B. shiga ...	A	–	–	–	–	A	Alk.	–	–	–	
B. flexner ...	A	–	–	A	–	A	Alk.	+	–	–	
B. Y (Hiss) ...	A	–	–	A	–	A	Alk.	...	–	–	
B. morgan I ...	+	–	–	–	–	–	–	+	–	+	Milk made alkaline on the 10th day.
B. morgan II ...	+	–	–	–	–	–	–	+	–	–	
B. morgan III ...	+	–	–	–	–	–	–	–	–	–	
B. fæcalis alkaligenes ...	–	–	–	–	–	Alk.	Alk.	–	–	+	

\+ = A+G present – = no reaction

A = Acidity ∓ = usually no reaction

Alk = Alkalinity ± = usually a reaction

C = Clot

The true dysentery bacilli can also be differentiated by the agglutination tests, absorption tests and Pfeiffer's reaction. The disease is both endemic and epidemic and is spread by carriers in the same way as enteric fever and by flies, food and water, and is thus much more prevalent where sanitation is defective than in well ordered localities. It is usually acute in type but may also be chronic.

The same prophylactic precautions should be taken as in the case of amœbic dysentery.

Many sera have been made such as Shiga's serum, Kruse's serum, Lister Institute serum, etc., but a polyvalent serum such as made by Shiga is preferable. Large daily doses should be given. The saline treatment is much more efficacious in this form of dysentery than in the amœbic form and should be always tried, especially in acute cases.

Forster treated many cases in Bengal and elsewhere with a vaccine with considerable success and Kruse, Shiga and Castellani have all made prophylactic vaccines and used them with fairly good results.

In addition to the above dysenteries there are dysenteries caused by worms, larvæ of flies, etc.; and the pseudo-dysenteries. The same private and public prophylaxis is necessary in preventing the incidence of these forms as in the true types, the same, in fact, as is necessary to combat the spread of disease by any of the intestinal pathogenic organisms, and which may be briefly summarised as follows :—

1. The provision of a pure water supply.

2. The protection of the food supply from dust and flies.

3. The abolishing of the breeding places of flies by ensuring the rapid and efficient removal of street refuse and an efficient system of sewage and night-soil disposal.

4. Personal prophylaxis in epidemics.

LEPROSY.

Leprosy is a disease which is caused by the introduction into the system of specific organism the *Bacillus lepræ*. It is not clear how the bacillus gains entrance to the body, but it is probable that it does so through abrasions in the skin. It is a disease which is not easily communicable to others, as individuals have often lived in close contact with lepers without acquiring the disease.

The incubation period is apparently very extended, instances being on record of the disease appearing many years after exposure to infection. The disease is not hereditary—all children of leprous parents being apparently free from infection at birth.

For many years no treatment for leprosy attained any measure of success until Lieutenant-Colonel Sir Leonard Rogers, I. M. S., introduced treatment by Chaulmoogra oil and subsequently introduced treatment by the Ethyl Esters of the fatty acids. By this treatment in certain cases he obtained a fair percentage of successful cures and in many cases much improvement was noticed although complete cures were not effected.

The recent investigations of Dr. E. Muir of the Tropical School of Hygiene, Calcutta, have increased our knowledge of the treatment of this disease. Dr. Muir has found in his clinic that about 40 per cent. of his cases were suffering from syphilis and that leprosy treatment was unsuccessful in every case unless anti-syphilitic treatment was primarily undertaken. He has also found that other maladies such as kala-azar, chronic malaria, etc., are common in those suffering from incipient leprosy and that these diseases must first be treated before any results can be obtained from anti-leprosy treatment. He is of opinion that the perfectly healthy body is very difficult to infect with leprosy and that in most cases some predisposing malady exists.

He divides leprosy cases into A, B, C and D classes.

A. Cases of incipient leprosy. These are most amenable to treatment and are infectious.

B. Cases of nodular leprosy which are highly infective but still amenable to treatment.

C. Cases usually still infective but not amenable to treatment, the disease in such cases being self-curing leaving only the malformations caused by the disease.

D. Cases which are burnt out cases of leprosy in which lepra bacilli cannot be found.

These findings are of great interest to all those in charge of leper dispensaries, hospitals, asylums, etc., and indicate that institutions for dealing with leprosy should be divided into these categories, dispensaries for the treatment of A cases, hospitals for B and C cases and asylums for the maintenance of mutilated and deformed D cases, who are unable in any way to support themselves. In the Straits Settlements a new treatment of leprosy in which inoculations are unnecessary has been tried for some months and the results up to date would appear to indicate that this method of treatment is successful in curing a large number of cases.

It consists in administering the ground up kernels of the Chaulmoogra nut, *Hydnocarpus Anthemintica.* The kernels of the Chaulmoogra nuts are carefully selected, all rancid nuts being rejected ; these are bright yellow or black and can be easily distinguished from the sound kernels which are light grey in colour. The nuts are crushed in a mortar and the pulpy powder is passed through a coarse sieve, the residue being again crushed and sieved.

A small measure of aluminium or tin to contain exactly 20 grains by weight is used to give out the dose.

A measureful of the drug is put into the hand of each patient who jerks it into his mouth and swallows it down with a little water.

The treatment is given twice daily, preferably after food. In the case of young children half a dose is given.

At the leper asylum Kuala Lumpur, Selangor, where this treatment has given excellent results, the preparation of the mixture as well as the administration and registration of the dose is done by the lepers themselves, and it takes on an average 20 minutes to treat 250 lepers. The cost comes to just under five pence per patient per month.

It is advisable for the mixture to be made fresh once a week, if kept for a longer period it is apt to become rancid and grow a mould.

Hydnocarpus Wightiana seeds although much cheaper than *Hydnocarpus Anthelmintica*, are not suitable owing to the extremely volatile nature of the oil contained in them. If kept for only three days the mixture becomes quite dry and powdery. The results of a year's treatment at the Kuala Lumper Asylum have been most encouraging. 81·5% of cases (54) which were treated for the whole year shewed improvement, and of these 30 patients who took 95% or over of the maximum number of doses 93·3% improved, of 56 cases which were under treatment for over three months but under one year 74% improved. Several cases have been discharged with no sign of leprosy either visible to the naked eye or by bacteriological examination.

There are now in the asylum some 30 cases which shew no outward signs of leprosy and which are being kept under observation.

The advantages claimed for the treatment are as follows :—

(1) The whole Chaulmoogra nut is used.

(2) A large quantity of it can be taken by the mouth twice daily without inconvenience whatever (not one per cent. of the cases complain of gastric irritation and in these five grains of Soda bicarb taken with the dose is effective).

(3) It is very popular and is thoroughly believed in by the lepers, who observe results very keenly.

(4) It is inexpensive, the cost averaging five pence per patient per month.

(5) It is as easily taken by children and women as men, which is not the case with the various treatments by injections.

(6) No skill is required in its administration, and no instruments of any kind are necessary.

(7) There is a great saving of time in institutions.

(8) The general physical condition of the lepers is greatly improved by the treatment. In nearly all cases they regain their normal strength and put on weight.

As a rule, after a few weeks' treatment a marked reaction will be noted. This is characterised by a rise of temperature to about 101°-102° F. and is accompanied by an apparent recrudescence of the disease, nodes and discoloured patches swell up and become bright red, resembling erysipelas. This is invariably a favourable sign and is followed by a rapid improvement. During a reaction the treatment should be stopped and recommenced only when the temperature is normal and the redness and swelling disappearing.

TUBERCULOSIS.

Tuberculosis is a disease which attacks various animals and man. It is common in the bovine tribe and also affects pigs, rabbits, guinea-pigs and fowls.

It manifests itself in various parts of the body. It may be limited to the lungs when it is known as phthisis or pulmonary tuberculosis or it may be present in the lymphatic glands only or in conjunction with a general tuberculosis may attack bones, joints, liver, kidneys, genito-urinary system, etc.

Tuberculosis used to be considered chiefly a disease of temperate climates but it is now well known that the disease is exceedingly common in India especially in the North-West and in sub-montane tracts.

The mortality from tuberculous diseases is enormous, but until recent years in Europe very little was done to combat its ravages. Within the last decade, public opinion has been directed to the prevention of this disease and in the British Isles a compaign, having for its object the extirpation of the disease, is being energetically prosecuted, with the result that the mortality figures are showing a gradual diminution. A commencement has also been made in India and sanatoria and tuberculin dispensaries are being started in various places in all parts of the country. That this disease is wide-spread and so prevalent has been proved from the evidence of post-mortems on persons who have died of other maladies. An enormous percentage of these show evidence of tubercular lesions—either active, latent or cured.

Etiology.—The direct cause of the disease is the invasion of the body by the tubercle bacillus first isolated and recognised by Koch. It is a cylindrical rod $1 \cdot 5\mu$ in breadth and 4μ in length, usually straight with rounded ends. The protoplasm is not homogeneous but appears to be separated into granules. These granules are, however, not spores. The bacilli are very resistent to heat and dessication but not so resistent as spore-bearing bacilli. The tubercle bacilli can resist a dry heat of 100°C. for an hour but are killed by a moist heat of 80°C. for the same duration. The bacilli may remain active in a dried tubercular sputum for two months.

Tubercle bacilli are non-motile. They grow well on blood-serum, glycerine broth and glycerine agar, 4 per cent. at 37°C. They take from 14 days to 5 weeks to develop properly, the drying up of the media being prevented by covering the mouths of the tubes with rubber caps.

Tubercle bacilli are not easy to stain but they are acid fast and retain an acid stain very firmly.

The following is the best method (Ziehl-Neelsen) of staining a film :—

1. Carbol-fuchsin is dropped on the slide and boiled for 5 minutes.
2. Decolorize in 20 per cent. sulphuric acid for a few seconds.
3. Wash well with water.
4. Wash in alcohol till all the colour is washed out quickly and replace in water.
5. Counterstain with saturated watery methylene-blue for 15 seconds.
6. Wash in water, dry and mount.

The tubercle bacilli will be coloured red and all the other matter on the slide will be blue.

The above method has to be modified if sections are being examined. For this propose watery fuchsin is better than carbol-fuchsin and dehydration in absolute alcohol and clearing in xylol are necessary after counterstaining.

Suspected sputum should always be stained and carefully examined but a negative result does not mean that tubercle bacilli are absent, so augmentation methods should be resorted to, *i.e.*, the sputum should be spread on suitable media on which tubercle bacilli are capable of rapid growth. Such a special medium is Heyden-Agar or alkaline glycerine-water-agar. The surest method, however, is the animal experiment. The suspected material should be subcutaneously injected into a guinea-pig, and if it is tubercular, the animal will die in 3 to 6 weeks, having typical tubercular infection of the glands, liver, spleen, etc.

Samples of suspected milk should be centrifugalized in a high speed centrifuge for 15 minutes and the sediment used for examination.

Method of Invasion.—Tubercular diseases used to be considered hereditary and the children of tuberculous parents were supposed to be predisposed to the disease. It is now generally accepted that this is not the case, but that the children of tuberculous parents are more readily infected with the disease owing to their proximity to the parents.

Tubercle bacilli seem to be continually inspired in the air of cities by the inhabitants who, however, do not become infected owing to their being able to resist the invasion of the organism. In diseased conditions of the lungs, such as pneumonia, bronchitis, etc., the bacilli find a lodgment and owing to the decreased resistance of the tissues form the primary foci of the disease.

In Agra, Dr. S.N. Gore, late Assistant Chemical Examiner to the Government of the U.P., examined over 500 specimens of sputum gathered in the city and found acid-fast bacilli resembling morphologically tubercle bacilli in a large percentage. This observation shows how wide-spread the bacilli are and how easily the infection can be spread by means of particles of dried sputum floating in the air.

Another common method of invasion of the body is by the eating of tuberculous meat which has not been sufficiently cooked, and hence the necessity of the careful inspection of all meat intended for human food and the rejection of all tuberculous animals.

Bovine tuberculosis is not so common in India as in England but it is common enough to render necessary rigid rules for the inspection of meat at slaughter-houses before allowing the meat to be sold.

Tubercle bacilli also enter the body in cow's milk and all tuberculous cows should be excluded from dairies.

Tubercle bacilli entering the body in meat and milk may set up general tuberculosis which usually first of all manifests itself as tabes mesenterica.

Tuberculous glands in the neck are the result of tubercle bacilli obtaining a lodgment in the fauces and throat and from thence infecting the adjacent lymphatic glands. On their gaining an entrance to the blood-stream from the lymphatic system, tubercle of the blood glands, liver, kidneys, etc. results.

Tubercle bacilli on invading the body produce in the blood an antibody which, if in sufficient quantity, antaonizes the bacilli and prevents infection. The presence of this antibody can be demonstrated by the reaction caused on inoculating a person with dried tubercle bacilli.

There are various methods in use of which the commonest are :—

(1) Von Pirquet's cutaneous reaction.
(2) Calmette's ophthalmic reaction.

(1) In Von Pirquet's reaction an emulsion of dried tubercle bacilli is made and then vaccinations are made on the arm. If no antibody is present the vaccinations dry up without showing a reaction, but if present an areola of inflammation is produced in 24 to 48 hours round the vaccinated spot.

(2) In Calmette's reaction, the emulsion is injected into the eye and an inflammation of the conjunctiva results in the presence of the antibody. This method is apt occasionally to cause a serious conjunctivitis so that the former method is usually preferred by practitioners.

Neither of these reactions are of much use for indicating the presence of active or latent tubercle in adults as many adults give a positive reaction owing to the antibody being present as the result of previous unrecognized invasions of tubercle which have been overcome.

In children, however, a positive result is usually looked on as showing the presence of active or latent foci of tubercle which have produced the antibody. The large percentage of positive results obtained in adults is another proof of the wide prevalence of tubercle in man.

Prophylaxis.—As in other diseases, the prophylaxis may be divided into the heads of private and public but they overlap more in this disease than in others.

PRIVATE.—From what we know of the disease it would not be incorrect to say that patients suffering from tubercle should be segregated as rigidly as those suffering from other infectious fevers. Their sputum (if suffering from phthisis) and the body discharges should be carefully disinfected or other members of the family will surely be infected.

In the early stages of the disease it can be cured by preventive inoculation. This is done with one of the various tuberculins. These are preparations of tubercle bacilli, either bovine or human, and they should be administered only by a physician who is in constant attendance on the patient in order that the doses suitable to each case and their frequency may be calculated from the reaction produced. The dosage may be gauged by the clinical reaction only or by this in conjunction with the opsonic index. This form of treatment is best carried out at a tuberculin dispensary to which the patients can make daily visits in order that their progress may be carefully watched. The physician in charge should devote his whole attention to this work only as the amount of individual attention which each case demands in order to obtain a successful result would preclude the general practitioner from taking up more than a few of such cases.

Tuberculin dispensaries should be started in all large towns (where phthisis and other forms of tuberculosis are most prevalent) and general practitioners should be asked to send all their suitable cases there for treatment. A tuberculin dispensary was started in 1912 in connection with the King George's Medical College, Lucknow, which became very popular.

More advanced cases should be sent to sanatoria, such as have been started at Bhowali (United Provinces) and Dharampur (Punjab). There the patients, in addition to being ensured plenty of fresh unpolluted air, have their whole daily life regulated for them in order that the body may be tuned up to prevent the spread of the disease and ultimately cure it. The diet is prescribed, the daily amount of exercise and rest, which varies constantly with the condition of the patient, are regulated, and in addition, the tuberculin treatment is carried out under strict supervision so as to ensure the best possible results.

PUBLIC.—The above may be considered more private measures of prevention than public as they deal with persons who are actually infected with the disease but they are public in the sense that the provision of the tuberculin dispensaries and sanatoria will usually rest with public bodies.

Compulsory notification of tubercular disease should be introduced by all local authorities and this has now been enforced in England. In India we will probably have to wait some years before public opinion is educated up to this standard. As we already have compulsory notification of plague, cholera and small-pox, it is not too much to hope that we will before long have the same regulation for tuberculosis. Tubercle, however, in its early stage is not at all easy to recognize, whereas in India any villager can recognize the above-mentioned epidemic diseases.

General sanitary rules applied strictly will reduce the incidence of tubercle as well as other diseases, such as prevention of dust, good drainage, town-planning in order to provide plenty of light and fresh air in cities, prevention of over-crowding, adequate ventilation of houses, etc.

Additional rules drawn up with a view to combat the habit of spitting in public places, if capable of being enforced, would largely reduce the incidence of tubercle, but this can only be attained in India, as in England, by inculcating habits of cleanliness and raising the standard of the general knowledge of hygiene and its principles and not by legislation.

ANKYLOSTOMIASIS.

This disease is found in many parts of the world within the tropics and in some countries is so common as to be a cause of inefficiency owing to marked anæmia. In Egypt practically the whole of the agricultural population is infected.

Recent investigations in India have proved that the disease is wide-spread in Bengal, Bihar and Orissa, Madras and the United Provinces. In the last named Province investigations were carried out by Drs. L.N. Rai and N.D. Banerji under the control of a committee and a report of the research has been published by Lieut.-Colonel J.W.D.

Megaw, I.M.S., late Principal and Professor of Pathology, King George's Medical College, Lucknow.

Etiology.—In India the disease is caused by the *Ankylostoma duodenale* or Hook-worm. The parasite gains access to the body either through the skin or by the mouth usually in drinking water or in eating contaminated vegetables.

The male adult worm is about 10 millimetres in length and 5 millimetres in breadth, while the female is slightly longer. It is cylindrical in shape and has a terminal mouth carrying three pairs of hook-like teeth. The adult worms are usually to be found in the jejunum of the host where they hook themselves on to the mucous membrane of the villi. The females lay their eggs in the jejunum. The eggs are oval with rounded ends and are enclosed in a colourless shell. The contents are an oval granular body between which and the shell there is a considerable space. This granular mass splits into two and then into four segments and is usually found in the fæces with four segments. The embryo develops from these four segments by further segmentation in about one day and escapes from the egg as the larval form. The larvæ is about 200 μ in length and 15 μ in breadth, with a terminal mouth. At the end of five days it ceases to grow. On evacuation from the host into earth or water it may remain encysted in a chitinous coat for months, but is active and can swim in water or move about on the earth.

It usually infects man through the hair follicles in the skin, thence gaining access to the veins and lymphatics and eventually by way of the lungs, œsophagus and stomach to the small intestine. During the journey, which takes 7 or 8 days, it is growing in size and reaches maturity in the bowel about 15 days later.

Eggs appear in the host about 5 weeks after the primary infection.

Diagnosis.—Early cases are diagnosed by the presence of the eggs in the fæces and their presence should be suspected owing to the presence of anæmia which cannot otherwise be accounted for.

Treatment.—The most recent treatment consists in the administration of thymol or chenopodium oil, both of which treatments have their advocates. Thymol in large doses is poisonous, causing cerebral irritation, cerebral paralysis and collapse. As thymol is soluble in alcohol and in oils all spirits and oils should be strictly prohibited when the patient is undergoing treatment. Adults should be given 20 grains in a cachet in the morning on an empty stomach and anothor 20 grains two hours later. No food should be taken. Two hours later a purgative dose of magnesium sulphate should be administered. This treatment should get rid of all the worms, but a second or third course may be necessary.

Chenopodium oil should be given to adults in 1 c.c. doses at 7 A.M. or 8 A.M., while a purgative is given at 9 A.M. The results obtained by the two treatments are very good, the efficacy being very similar.

Thymol, however, is very much the cheaper drug.

Prophylaxis.—Prophylaxis on a large scale has been tried in other countries and where the patients are under control, such as in the Army, Police or Jails, it is a fairly simple matter to get rid of the infection, but when dealing with a teeming agricultural population little can be done. Even if the whole population could be given a course of thymol or chenopodium oil and thus rendered free, large numbers could be reinfected from the soil and water, when the process would have to be repeated. The expense of such a campaign would be prohibitive and would in India only rouse resentment in the minds of the villagers.

A better method of prophylaxis is to prevent continuous reinfection by gradually perfecting the system of disposal of night-soil so that the soil is not continuously reinfected, but, while fresh night-soil is continually used in the fields where labourers are working, it is useless to attempt to stamp out the disease.

In towns and large villages with properly supervised conservancy, where the night-soil is either disposed of in sewers, trenches or incinerators, hook-worm disease would rapidly die out, and until such conservancy comes into existence in every village hook-worm disease will remain.

As the disease is seldom a direct cause of death, but only causes feebleness and decreased resistance to other diseases, it is practically impossible at present to induce villagers to take any active measure against it, and only advanced cases ever come to hospitals for treatment. We can only hope, therefore, that with the spread of education and improved sanitary methods in rural areas, the disease will eventually be stamped out, with benefit to the general health of the people in endemic areas.

In the meantime all medical officers of health, assistant surgeons and sub-assistant surgeons should thoroughly understand the cause of the disease, and its cure and lines of prevention, and should spread the knowledge during the course of their ordinary duties. All dispensaries should be stocked with a sufficient quantity of thymol or chenopodium oil to meet the demand.

There are many other tropical diseases of more or less wide-spread prevalence. Some of them, such as yellow fever, sleeping sickness, etc., are fortunately unknown in India and others, such as rabies, influenza, and cerebro-spinal fever are cosmopolitan in character and hence do not need to be specially dealt with in a volume of this character.

A word, however, is necessary on the subject of preventible diseases of the eye, such as ophthalmia and trachoma. These diseases are extremely common all over India and are extremely infectious. It is calculated that the blind population of India is at least 1,000,000 and that the proportion due to ophthalmia and trachoma which could have been prevented by early treatment is about 50 per cent. All medical officers of health and private medical practitioners should therefore take every opportunity of making known to their poor and ignorant neighbours the simple methods by which these diseases, which are the cause of so much suffering and inefficiency, can be prevented.

All the communicable diseases which have been described can be gradually eradicated, some, such as malaria, only by large expenditure on anti-malarial works, but others, such as small-pox, plague, cholera, ankylostomiasis, relapsing fever, etc., by the mere application of certain common sense rules which have been indicated under each disease.

The great need, therefore, is hygienic education and no effort should be spared to spread the knowledge of the elementary rules of hygiene far and wide through the country. Hygiene lessons are included in the prescribed readers in the schools, but the educational authorities consider it impracticable to introduce hygiene as a separate subject in the curricula of schools. Their reasons are, no doubt, sound and their attitude justified, but hygienic progress in India is thereby being woefully retarded. It is to be hoped, therefore, that it will in the near future be found possible to make hygiene one of the regular subjects taught in all schools in India and taught in such a way as to dissipate the prejudice and conservatism of her people, to the great benefit and economic gain of the whole community.

CHAPTER XI

DISINFECTION

A *disinfectant* is a substance which is capable of destroying the organisms it is brought in contact with; substances which inhibit the growth of organisms are known as *antiseptics*; others only absorb odorous products and are therefore termed *deodorants*.

Disinfection may be carried out by dry heat, moist heat or by the action of certain chemical substances in a gaseous, liquid or solid form.

Sunlight is well known to have a powerful disinfecting action and infected matter to which it gains direct access for a sufficient length of time is often more or less completely disinfected in accordance with the nature of the organism.

Burning is the most efficient method of disinfection and all infected matter which is of trifling value should be disposed of in this manner. This is also the safest and best method of dealing with the stools of patients suffering from such diseases as enteric fever and cholera.

Dry heat is very useful for sterilizing such articles as pipettes, test-tubes and Petri dishes in the laboratory, but it is not much used for fabrics such as woollen garments, mattresses, etc. The reason of this is that dry air is a bad conductor of heat, so that it takes the heat a long time to penetrate into the interior of such material, which also is damaged by temperatures exceeding 120°C. The glass materials mentioned above should be sterilized for 20 minutes to half an hour at 160°C. It is often used to sterilize books, rubber goods and other materials which cannot be sterilized without damage in any other way.

Boiling is also exceedingly efficient for disinfecting purposes. It is exceedingly useful for such articles as cotton and linen clothing, bed linen, etc., which are infected by contact with a patient suffering from a contagious disease. All organisms are killed by prolonged boiling, the spore-bearing organisms being the most resistant. For non-spore-bearing organisms 20 minutes' boiling is sufficient, but material suspected to be infected with such organisms as *B. anthracis*, *B. tetani*, etc., should be boiled for at least one hour.

Steam Under Pressure is a most efficient sterilizing agent as it penetrates into fabrics, mattresses, etc., much more easily than dry heat owing to its greater degree of conductivity and owing to the fact that on coming in contact with material colder than itself it causes a vacuum which is filled by the entrance of a further supply of steam. It does not, however, sterilize as quickly as boiling.

Superheated Steam is not so efficient as steam under pressure, as, owing to its superheat, it does not condense on colder articles until it has lost this superheat; so it does not possess the same penetrative qualities. The greater the superheat, the longer the period required for penetration.

Articles to be disinfected by means of steam should, as a rule, be in contact with it for 20 to 30 minutes at 115° to 120°C. but for bulky articles a longer period is necessary.

Steam at a temperature of 120°C. in the autoclave is under a pressure of two atmospheres.

In all the larger towns in the tropics some form of disinfector should be installed by the local authorities. If there is an infectious diseases hospital, the disinfector might be erected in its proximity.

There are many forms of disinfectors on the market such as the *Washington-Lyon* (fig. 59), *Equifex*, *Reck*, *Delépine-Jones*, etc., most of which are quite efficient and the prices are about the same. A good disinfector should have a double jacketted chamber in the interior of which the material is exposed to constant steam under pressure, in which a vacuum can be produced and hot air introduced for the purpose of drying the contents before removal.

A disinfecting station should be divided into an *infected* half and a *non-infected* half, the disinfector being placed with one end opening into each. It should also have a plant for the cremation of articles to be destroyed by burning. It should have floors and walls of materials that can be easily disinfected by some form of liquid disinfectant.

CHEMICAL DISINFECTANTS

Liquid Disinfectants.—The following are the chief liquids used as disinfectants :—

Perchloride of Mercury is a powerful germicide which has the disadvantage of being poisonous to human beings. It has the property of precipitating albumin, which interferes with its penetrating action, so that it is usually made up in acid solution which neutralizes this property. It is usually made up in the strength of half an ounce of perchloride and one ounce of hydrochloric acid to 3 gallons of water to which 1 grain of methylene-blue is added. This gives it a blue colour which guards against its being mistaken for some other solution. This gives a strength of 1-1,000 which is sufficient to destroy all except the spore-bearing organisms, which require a 1-500 solution to kill the spores. 20-grain tablets are very convenient as one to a quart of water will make a 1-1,000 solution. It should not be used to disinfect metal receptacles or latrines with iron seats as it has a strong corrosive action. It acts as a direct poison to bacteria and also coagulates their protoplasm.

Mercuric Iodide is a disinfectant equal in strength to perchloride and less poisonous. It is more expensive than perchloride and also has a corrosive effect on metals.

The *Phenols* are derivatives of the distillation of coal-tar and constitute a group of very powerful disinfectants. They are poisonous and coagulate albumin. *Carbolic acid* is the best known member of this group. It should be used in a 5 per cent. solution.

There are many disinfectant oils which are produced from the destructive distillation of coal. They are dark brown oily liquids which form milky emulsions when added to water. They are for the most part non-poisonous. The chief of these are izal, saprol, cresol, cyllin, lysol, hycol, sanitas, kerol, cooke's cofectant fluid, etc. They contain varying proportions of phenols, neutral oils, resins, etc.

The opinion of most authorities was that these substances derived their disinfecting powers from the fineness of the emulsion produced when mixed with water. The minute particles are continually in a state of *Brownian movement* and they surround the bacteria and destroy them. Their disinfecting power is greatly diminished when the bacteria to be attacked are in a medium containing a lot of organic matter which impedes the access of the particles of emulsion.

Chloride of Lime (bleaching powder) is a mixture of the chloride and hypochlorite of calcium and has a strong odour of chlorine. A good bleaching powder should contain about 35 per cent. of available chlorine. It is usually used in a strength of 2 to 3 ounces to the gallon, which is a 1 to 2 per cent. solution containing about 5 per cent. of available chlorine Its action is due to the formation of the hypochlorous acid in the presence of water, which splits up into hydrochloric acid and oxygen. It therefore acts by oxidation. It corrodes metals and so should not be used to disinfect any materials made of iron, etc. It should be kept in closed barrels as it very rapidly loses its strength by loss of chlorine. It is used in sterilizing water supplies and sewage effluents.

Sodium Hypochlorite acts in the same way as bleaching powder as an oxidising agent. It is the active principle of *chloros* which contains about 10 per cent. available chlorine and is a valuable disinfectant.

Chloramine-T.—Recently a disinfectant known as Chloramine-T which is a fine crystalline powder has been greatly used but chiefly in connection with surgery and dressing wounds. It contains 12½ per cent. of available chlorine, is stable and soluble in water.

Halazone is another recently manufactured disinfectant of the chlorine group. It is very useful for sterilizing water in small quantities or in bulk. It is made up into tablets of various sizes and is very efficient in sterilizing power.

Sulphate of Copper is a direct poison to bacteria and coagulates albumin. It is, however, a very poisonous substance and for this reason it is not much used. In a 5 per cent. solution it is strongly disinfectant and deodorant. A solution of 1 part per 1,000,000 will kill algæ and produce no ill effects in a drinking water supply.

Potassium Permanganate is not much used as a disinfectant in its proper sense. It acts chiefly through its oxidizing power. It kills cholera vibrios in one hour in a strength of ⅛ of a grain per gallon and *B. coli* in a strength of ½ a grain per gallon. It is very largely used for the sterilization of wells in India.

Formalin is a liquid with an irritating odour containing 40 per cent. of formic aldehyde. It is a powerful and rapid disinfectant and deodorant. It is very cheap and its powers of disinfection are equal to carbolic acid which is much more expensive.

Chinosol is a soluble yellow powder which is non-corrosive and non-poisonous and which does not coagulate albumin. It is claimed that it has a higher disinfecting action than perchloride of mercury. It is used chiefly in surgical practice for instruments and the hands.

Standardization of Disinfectants.—It is difficult to state definitely the comparative disinfecting powers of the various disinfecting solutions owing to the different methods employed by observers in attempting to standardize them.

Rideal-Walker Method.—Rideal and Walker were the first to propose a routine method of establishing standards. They took pure phenol as their standard disinfectant and compared the bactericidal power of other disinfectants with that of phenol in the following way:—

A 1 per cent. solution of pure phenol in sterile distilled water is taken as the control to compare dilutions of other disinfectants with. A dilution of the above-mentioned strength of carbolic acid is taken because it is found empirically that it kills average strains of *B. typhosus* in 5 to 7½ minutes.

A 24 hours' growth of *B. typhosus* at 37°C. from a strain subcultured three times is taken as the standard organism. The subcultures are made in Lemco broth with a reaction of + 15 Eyre's scale.

Dilutions of the disinfectant to be tested should be made of a strength that may be expected to kill *B. typhosus* in 15 minutes and fail to kill it in 2½ minutes.

It is convenient to compare *four* dilutions of the disinfectant to be tested with the dilution of carbolic acid at one time and for this purpose a special test-tube rack known as *Rideal-Walker rack* is used. A special rack as made by Messrs. Baird & Tatlock is given in fig. 60.

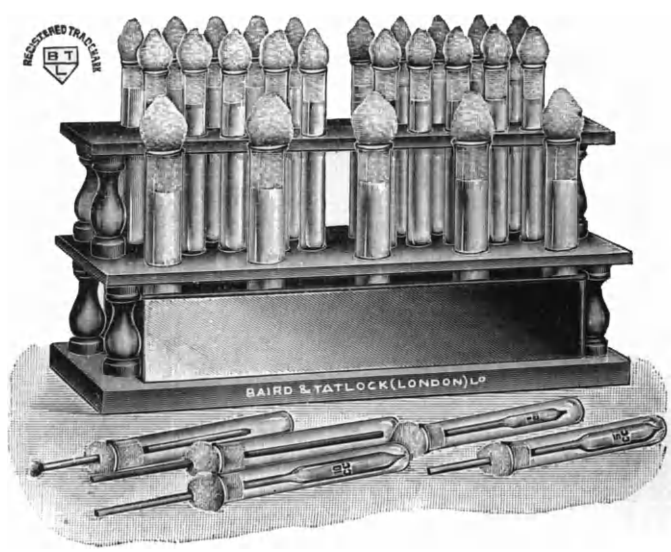

Fig. 60.—Rideal-Walker's Stand.
(Baird & Tatlock).

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It contains 35 apertures for test-tubes in groups of five. 6 of these groups are arranged in two parallel rows, while on a lower level in front of this is a group of 5 apertures.

In each of the upper six groups of 5 tubes 10 c.c. of Lemco broth is placed. In the lower group are placed 5 c.c. of the dilution of carbolic and four different dilutions of the disinfectant to be tested.

The broth culture is then taken and 5 drops removed from it in a measured pipette are added to the five tubes of the disinfectant and shaken. This should be done with a watch on the table beside the observer. At the end of 2½, 5, 7½, 10, 12½, and 15 minutes subcultures should be made from each tube of disinfectant into the six groups of broth tubes. If the observer works methodically he will find that it takes half a minute to add 5 drops of the culture to each of the 5 tubes of disinfectant or 2½ minutes in all. He then immediately takes in a standard platinum loop (3 m. m. in diameter) a loopful from the first tube he has seeded from the culture of *B. typhosus* and subcultures it into the first tube of the first series of 5 broth tubes; he then flames the loop and takes a loopful from the second tube of disinfectant and subcultures it into the second tube of the first series and so on at half minute intervals till all the thirty tubes have been seeded from the five tubes of disinfectant.

The removing of the cotton wool plug from each tube, seeding, flaming the neck of the tube and the cotton wool, re-plugging the tube and flaming the platinum loop should occupy half a mintue so that the observer can go straight on to the next tube. It requires a little practice to go through the whole series methodically in the time and beginners are therefore recommended not to try more than two dilutions of the test disinfectant at first.

The results are tabulated as follows :—

Sample	Dilution	Time of exposure to disinfectant in minutes.					
		2½	5	7½	10	12½	15
Carbolic Acid ...	1 – 100	+	+	–	–	–	–
Disinfectant A ...	1 – 120	+	+	+	–	–	–
" ...	1 – 110	+	+	–	–	–	–
" ...	1 – 100	+	–	–	–	–	–
" ...	1 – 90	–	–	–	–	–	–

The subcultures are incubated at 37°C. for 48 hours and if a growth occurs a + is entered in the proper place in the above table. The above hypothetical disinfectant by this test is shown to be slightly more powerful than carbolic acid, as a 1–110 dilution has the same bactericidal power as a 1–100 dilution of carbolic acid. Its strength is expressed as $\frac{110}{100}$ or 1·1. This is called the *Rideal-Walker coefficient* of this disinfectant for *B. typhosus.* Unfortunately, however, all strains of *B. typhosus* are not equally resistant so that it is not a scientifically accurate comparison.

This method does not take into account the presence of organic matter in the material to be disinfected, such as is always met with in nature; for instance, such a dilution of disinfectant would not disinfect a typhoid stool.

Martin-Chick Method.—To more nearly approach the condition met with in nature in testing a disinfectant Martin and Chick of the Lister Institute have modified the above process as follows :—

Fæces are dried over a water-bath at 105°C. and then ground into a fine powder and ·15 gramme added to 2·5 c. c.

of sterile distilled water in test-tubes, sterilized and stored. When required for tests varying amounts of dilutions of the disinfectant to be tested and a dilution of carbolic acid are added with enough sterile distilled water to make the total amount up to 5 c.c. The tubes then contain 3 per cent. of fæces. They are then placed in a water-bath at 20°C. and inoculated at 1 minute intervals with 5 drops of a 24 hours' growth of *B. typhosus* in broth at 37°C. When 30 minutes have elapsed since the first tube was inoculated, two samples are taken from it with a standard platinum loop and seeded into 10 c.c. of litmus glucose broth. One minute later samples are taken from the second tube and so on. These subcultures are incubated for 4 days at 37°C. and the presence or absence of growth as compared with the phenol dilution is noted.

At first a large number of dilutions are tested which can be gradually narrowed down. The results obtained by this show that the germicidal values of such disinfectants as the coal-tar derivatives as compared with carbolic acid are much lowered, while the germicidal value of the latter is itself considerably less under these conditions. The efficiency of phenol is reduced about 10 per cent. while that of the emulsions is reduced in some cases by 33 per cent. The reduction was found to be higher in the finer emulsions.

Before the publication of these results makers of commercial cresols were trying to make their products in such a way that, when mixed with water, they would produce as fine an emulsion as possible because, in attacking organisms in clear solutions, the finer the emulsion the greater the efficiency. Since then, these products are being now sold so as to produce much coarser emulsions when added to water.

From the above results it must be concluded that the disinfecting value of a germicide varies greatly with the nature of the medium in which the germ has to be attacked, and if enough particulate organic matter is present, the bacteria may escape altogether.

It is evident, therefore, that any attempt to disinfect a typhoid or cholera stool with a cresol in any dilution is bound to fail. For this reason it has been stated in the preceding chapter that such matters should be *cremated.*

Disinfectants which do not depend on the same factors as the cresols for their germicidal power, such as perchloride of mercury and carbolic acid, are able to sterilize such stools when penetration to all parts of the stool is attained, so if disinfection by means of these solutions is attempted the fæces must be thoroughly mixed with the disinfectant and left in contact with it for a prolonged period, but with such a simple and efficient method as cremation at hand it is unnecessary to resort to such methods.

The bactericidal power of the various disinfectants on the market varies greatly for different organisms, so that standards for each organism are necessary and have been worked out for many, such as *B. pestis, V. cholera,* etc., but for some organisms the action of disinfectants cannot be ascertained by the above methods. Tubercle bacilli, for example, are known to be much more easily killed in a moist state than when in a dried state. In the case of spore-forming organisms the culture and the subculture must be put under the best conditions for the production of spores and many spores should be present in the cultures used.

In spore-bearing organisms, metallic salts are the best disinfectants, such as perchloride of mercury or sulphate of copper.

The practical lessons to be derived from the above are fairly obvious and may be summarised as follows :—

All disinfectants made from the destructive distillation of coal, such as the cresols, lysol, cyllin, etc., are excellent for use in surgery and in bacteriological laboratories. Practical sanitarians must, however, be careful to note that in using such substances as these to disinfect latrines, drains, water-closets and infected material, considerably stronger solutions than those advertised as sufficient by the proprietors of these germicides must be used. They must also not be misled by the term "carbolic acid coefficient." This is a term without any comparative meaning until the method by which this coefficient has been arrived at is known. It *does not* mean a *Rideal-Walker* coefficient or a *Martin-Chick* coefficient. They must use their own judgment in advising what dilution of the disinfectant is necessary to disinfect the material it is intended to bring it in contact with and the organism the material is infected with.

Acid solutions of perchloride of mercury in strengths of 1 – 500 to 1 – 1,000 are best for latrines of stone or earthenware but these cannot be used for iron latrines. For the latter solutions of cyllin in strengths of 1 – 100 to 1 – 200 are found effective in India and are commonly used. Tricresol is chiefly used in the military department.

Solid Disinfectants.—These are only of use as deodorants in the form of powder.

Carbolic Powders.—A good carbolic powder should contain at least 15 per cent. of penols and the vehicle should be silicious matter and not lime.

Such powders slowly lose their strength in keeping by volatilization, so that only fairly fresh powder should be used. If the powder is made up with *lime*, carbolate of lime is formed and it contains little or no active carbolic acid so that such a powder is *practically useless as a disinfectant.*

Slaked Lime is a good deodorant as it absorbs most organic vapours and also sulphuretted hydrogen. It is very little used as a disinfectant.

Bleaching Powder acts by oxidization. It contains a large quantity of lime and so should not be used in drains.

Soap is a good disinfectant and an excellent wash for latrine seats can be made with soft soap and perchloride solution.

Gaseous Disinfectants.—*Formic Aldehyde* is a very powerful and efficient disinfectant in its gaseous state. It is, however, strongly irritant even in great dilution. It is most efficient at a moderately high temperature and in a moist atmosphere; 70°F. and 70 per cent. of humidity are stated to be the most suitable.

The gas can be produced by allowing a mixture cf air and the vapour of methyl alcohol to pass over red hot platinum, the alcohol being converted into formic aldehyde and water.

Trillat has perfected an apparatus for generating the gas from commercial formalin which contains 40 per cent. of formic aldehyde, by heating it with a little calcium chloride in an autoclave. The trade name of "formo-chlorol" has been given to this solution. The calcium chloride raises the temperature at which the solution boils and as the aldehyde comes off at a lower temperature, it is obtained practically dry. The vapours are allowed to enter through a long copper tube into the room, being carried through the keyhole, when the pressure inside the autoclave reaches 40 lbs. This process should be kept going for a half to one hour, a half to one litre of the solution being required for every 1,000 cubic feet of space. This apparatus is exceedingly convenient owing to the ease with which rooms can be disinfected and the large amount of gas which can be produced by it.

When aqueous solutions of the aldehyde are concentrated further than 40 per cent. polymerization takes place; the isomeric substance formed is known as "*paraformaldehyde.*" This substance can be made into tablets and is sold in that form as "*paraform tablets,*" each tablet weighing one gramme. If these tablets are heated over a flame, by means of a special lamp, aldehyde is given off. 25 tablets should be vaporized for each 1,000 cubic feet of space to be disinfected. This method of obtaining formic aldehyde is very convenient as the tablets with the lamp are very much more easily conveyed to the houses to be disinfected.

The *Autan method* of producing the gas is in general use, is very effective and is carried out as follows ;—

Take 5 ounces of potassium permanganate and 10 ounces of formalin, mix them in a suitable receptacle and place the mixture in the room to be disinfected. Formic aldehyde is given off with the heat produced. This quantity is sufficient for 1,000 cubic feet of space.

Paraform tablets can also be used in this method: 100 paraform tablets 1 gramme each crushed up and dissolved in boiling water mixed with 10 ounces of permanganate crystals are sufficient for 1,000 cubic feet. This is, however, more expensive than the former. In both cases the room should remain sealed for 6 hours. This is the official method in use in America.

Ammonia neutralizes formaldehyde so that the last traces of the gas can be removed from a room by placing open dishes of ammonia in the room.

Formaldehyde is a light and easily diffused gas, so that its penetrative power and disinfecting action is much more rapid than that of sulphurous acid, which is a gas with a density double that of the air.

Sulphurous Acid.—In solution it is a powerful disinfectant but in its gaseous form it is very much less powerful. It is usually produced by burning roll sulphur in air: two pounds for every thousand cubic feet gives about a 2 per cent. dilution in the atmosphere. The room requires to remain sealed for six to 24 hours according to the size of the room. It is also sold in a liquid state in cylinders under pressure. Two cylinders are required for every 1,000 cubic feet. As the gas is heavy it should be liberated as high in the room as possible.

This method of disinfecting rooms is now largely replaced by the formalin methods which are cheaper, more rapid and more convenient to carry out.

As an insecticide sulphurous acid is very much more efficacious than formaldehyde and should always be used in preference to the latter where the chief object is to destroy vermin and not bacteria. In unsealing the room, the operator should wear a cloth soaked in sodium carbonate solution over his mouth.

Chlorine.—This gas has a high disinfecting power, being much stronger than SO_2. It is generated by the action of hydrochloric acid on bleaching powder. The objections to the use of this gas are its high density and therefore bad diffusing qualities, its bleaching action, which is much greater than SO_2 and formalin, and its action on metals. Weak ammonia neutralizes this gas as well as formalin and a cloth dipped in it should be placed over the mouth when unsealing the room.

The gaseous disinfectants mentioned before give better results in the presence of moisture and hence a bucketful of water should be kept in the room to be disinfected to render the air moist.

Hydrocyanic Acid Gas.—Recently Glen Liston introduced in India the use of this gas as a disinfectant. It is formed by the action of a 33 per cent. solution of potassium cyanide on a 33 per cent. solution of sulphuric acid. The gas is evolved in a closed chamber and kills all bugs, lice, fleas, etc. and their eggs in a strength in the air of the room of 50 parts per 1,000. It also kills rats and other small animals.

A well-equipped chamber of this kind was put up in the Alexandra Dock, Bombay, in 1917, to de-verminize the clothes of troops returning from active service. The reagents flowed through tubes into the chamber and mixed by flowing down a channel provided with a series of baffles. An electric fan forced the gas all over the chamber. At the end of 15 minutes the gas was allowed to escape and the clothes and accoutrements removed. No danger to attendants working the plant was incurred.

Other gases, such as nitrous acid, hydrochloric acid, bromine, iodine, etc., have disinfecting properties but, owing to the many objection to their use, are seldom resorted to.

Rooms may also be disinfected by liquid being sprayed on the walls, ceiling and floor by sprayers or atomizers. In France the spray method is the official one in use, the disinfectants usually used being formalin, perchloride or chinosol solution. The "Invicta" sprayer is very useful for this purpose. The disinfectant is introduced and brought under a pressure of 45 lbs. to the square inch, which produces the spray through the nozzle. Other forms are on the market which require pumping, but they are neither so cheap nor so efficient as the "Invicta."

The spraying must be done very carefully and *one to two hours* should be spent in disinfecting an ordinary small room.

The German official method is to rub the walls down with bread and then wash them with carbolic solution.

Any heavy furniture should be disinfected in the same way as the walls, roof, etc. All bedding, fabrics, etc., should be disinfected by steam. Books and articles which cannot be disinfected by steam can be disinfected in formalin vapour.

Rooms to be disinfected by fumigation must be *very carefully sealed* and the best material to use for this purpose is putty. All apertures and crevices, such as those round doors and windows, should be stopped up in this manner or the fumigation process will be useless.

CHAPTER XII

HOUSING AND TOWN-PLANNING

Both in Europe and in the tropics the proper housing of the general population is a matter which, until recent years, received very little attention. Towns grew up in a haphazard way, without any definite system to facilitate sewerage, drainage and conservancy, which was either absent or of a primitive nature. In old towns in many parts the streets are narrow and tortuous, the houses are crowded together, and blind alleys and confined courts are common.

In Chinese and Indian cities the conditions that are met with in such localities are almost inconceivable and incapable of improvement except by demolition. In many of these towns there are hundreds of lanes between the houses choked up to two or three feet deep with decaying debris and excrement, often not removed for months. The houses are often two, three, and four stories high, and light and air are shut out at all times of the year. Such places are beyond improvement, and the only remedy is demolition and the laying out of the area in wide streets and properly constructed houses.

During this and last century in Europe much more attention has been paid to the proper laying out of areas for building, and the demolition of large insanitary areas.

In Paris, Baron Hausmann, during the second empire, demolished large numbers of insanitary and ill-constructed houses, and laid out large wide boulevards and streets. In England, nearly all the local authorities have realised the urgency of action in such matters, and, aided by the additional powers given to them in the various Housing and Town-Planning Acts, are gradually abolishing overcrowded and unhealthy areas. In the large towns of South America and the southern States of North America many improvements have been made and towns like Buenos Aires, Rio de Janeiro and New Orleans are now in many parts object lessons in the proper laying out of towns in the tropics.

In India, in many towns, city improvement trusts have been formed, and, under variousd owers granted by the provincial Governments, are demolishing insanitary areas and replacing them with wide streets and open spaces, in order that the teeming population of these cities may have the benefit of light and fresh air. Only properly planned towns can be endowed with efficient sewerage and drainage systems, and the surface cleanliness of towns can only be properly attended to in towns that are well laid out. In villages, the houses, although in themselves mostly insanitary, are more scattered, and light and air gain a ready access to them, but many Governments have taken up the question of the provision of model houses for agriculturists, and in many places model villages have been laid out.

The task in the thickly populated cities is a herculean one, especially in large cities like Bombay and Calcutta, but a beginning has been made and the end to hope for is the eventual total extinction of the overcrowded slums, and the consequent improvement in the health of their inhabitants.

In most of the cities of upper India also this matter has been taken in hand, and a beginning has been made to eradicate these foul and unhealthy areas.

During an investigation into the causes of a death rate of 79 per mille in Cawnpore city, it was found that the population of one of the quarters of the city reached the enormous figure of 531 per acre, a figure which is probably not surpassed by any other city in the world; the existence of such conditions under British rule is anything but creditable, and steps to remedy these conditions are now in progress. In this quarter all possible defects of construction were to be found. Tall houses were intersected with tortuous lanes and "gullies" and the main streets were only about 10 feet wide with no open spaces ; most of the houses were built back to back, with no through ventilation, and little access of light ; and as many as seven or eight people were occupying rooms about 8 or 10 feet square. Surface drainage was either absent or so faulty in level that its presence was worse than complete absence. Privies and cesspools overflowed into "gullies" 2 and 3 feet wide at the back of the houses, but often into the above mentioned main streets. The health authority of the city have done their best to keep this area clean ; but, owing to the difficulty of access, and the inadequacy of the powers with which they are invested, little can be done. The only remedy is demolition, and a complete new lay out of the area.

Powers to Local Authorities.—The powers necessary in order that local authorities may cope with existing insanitary areas must be far-reaching; and, although they may vary in detail in various places, they all must embody the following principles :—

1. Power to demolish and reconstruct any area declared insanitary, and incapable of being rendered healthy by other means. This may be done by purchasing the area outright, and selling the sites in the area when properly laid out for building purposes or by carrying out the improvement and debiting the various owners with the cost of the improvement, by which the value of the land has been enhanced, and compensating those wbo have suffered loss. If, owing to the irregularity of the plots owned by different owners, it is found impossible for the owners to build on their plots houses which in the aggregate meet with modern sanitary requirements, the local authority should have power to rearrange

the boundaries of the various plots equitably, recover the cost from those who have gained by the rearrangement, and compensate those who have lost by it.

2. Power to require owners of unhealthy houses, in cases where it is not considered necessary to demolish the whole area, to demolish them, or, if feasible, put them in a sanitary condition within a reasonable space of time.
3. Power to carry out the improvement at the expense of the owner, in default of his compliance with the order.
4. Power to compel owners of houses to supply such sanitary conveniences in houses as meet with the approval of the Public Health department. Each local authority should have bye-laws laying down its requirements for each class of house, and should be prepared to supply owners with standard plans approved by the Public Health department.
5. Power to prevent the erection of any new building, the plans of which have not been passed by it.

With regard to town-planning schemes, the following main principles should be observed :—

1. The requirements of the town being dealt with should be kept in view, taking into consideration the chief trades and industries carried on in it.
2. The class of residents who will inhabit the quarter being constructed must also be considered.
3. The requirements of the present and future traffic to be expected must be arranged for.
4. The means for the disposal of sewage and refuse must be borne in mind.

5. Streets should, as a rule, be as straight as possible and should intersect each other at right angles ; the principal streets should be in the direction of the prevailing winds.

6. Main streets in business areas should be 80 to 100 feet wide and in residential areas 50 to 60 feet wide. Cross streets should never be less than 20 feet wide.

7. Between each pair of main streets back streets should be constructed, so that house refuse may be removed with ease. These should be 15 to 20 feet wide. If the town is sewered, the sewers should run under these back lanes, and not under the main streets, as water-closets are usually placed at the back and not at the front of houses.

8. The corners of all larger streets should be rounded in the form of an arc of a circle, the radius of which is not less than 15 feet. The necessity for this provision has arisen owing to the great increase in fast-moving traffic. In most cities in which there is a large motor traffic, streets with right-angled corners are little better than death traps, unless the traffic is most carefully regulated. With rounded corners at busy crossings the liability to accidents is greatly reduced.

9. Pavements for pedestrians should be provided in all newly laid out areas. In most cities in the tropics they are conspicuous by their absence.

10. Open spaces for air and recreation are necessary in all large towns.

11. Trees should be planted at suitable intervals along the sides of streets, in order to provide shade for the inhabitants of the locality.

12. Regulations should be made controlling the height of the houses which may be built on streets of various widths. In the tropics a good general rule is that in main streets no house should be higher than the width of the street it is situated on, and in side streets not more than one and a half times as high.

13. Every house should have a space at the back, between it and the back lane, which should vary with the height of the house. A good general principle is that if a line be drawn from the bottom of the back boundary wall to the top of the house, and a horizontal line be drawn from the same spot to a spot vertically under it at the bottom of the wall of the house, the angle between the two should not be more than $63{\cdot}5^\circ$.

14. In the business portion of the town, at least one-third of the total site area should remain unbuilt on. It can be used as a yard or garden. In residential areas, at least one-half of the site should be left uncovered.

15. Verandahs should be provided to all houses in the tropics and there is no objection to these verandahs extending to the edge of the pavements in main streets, provided that at least 12 feet be fixed as the minimum height for the ground floor verandah above the pavement. This arrangement will provide shade for pedestrians in the heat of the day.

16. Factories, work places, and warehouses, should be differently legislated for, and are better to be apart from the residential quarters altogether.

CONSTRUCTION OF DWELLING HOUSES.—All local bodies should have, and should stringently enforce, byelaws to secure sufficient light and air in the area under their control and to ensure the proper drainage of such houses. All houses should have through ventilation, and should contain no inside rooms which are used for sleeping in. The depth of a house from back to front must, therefore, be limited.

The window area provided for each room should be at least one-tenth the floor area and windows should be capable of being opened wide when required.

A building site should be dry, elevated and well away from insanitary surroundings. The soil should be free from surface contamination and not retentive of moisture. Soils best suited for building purposes are sand and gravel while clay and made soils are unhealthy, and should therefore be avoided. The subsoil water should be low, at least 15 feet below the surface, and at a constant level. There should be no trees in the immediate vicinity of the site of the building.

Proper drainage of the site should be ensured and the foundations should be built on concrete.

In the tropics all houses should be raised on a plinth at least one foot above the ground. The floor should be made of some impermeable material to prevent the entrance of ground air and to render it free from dampness due to improperly drained soil. It would seem desirable to provide all the walls with damp-proof courses.

No modern houses are built with "tykhanas" (cellars), as a great many of the old houses were in India, as these could be kept cool in hot weather.

The yards should be properly paved with impervious material, so that storm water may be carried away by the surface drains and not soak into the ground near the building.

The floors and walls should be of some impervious material to prevent the entrance of rats, or the harbouring of insects, which aid in spreading infectious disease.

The roofs should be, if possible, double, and the intervening space between the roofs well ventilated. Thatched roofs, though they tend to keep the house cool and dry, harbour rats, snakes and insects, and should, therefore, be avoided as far as possible.

Jack-arched roofs are greatly used in India, and these, if covered with a thick layer of clay, are fairly cool. All rooms should be ventilated as described in Chapter III and a sufficient amount of cubic space per occupant provided.

In calculating cubic space, no height above 12 feet is taken into account, but rooms of a height of at least 20 feet are desirable, as they remain much cooler than rooms with low roofs.

Private wells in houses or their yards should not be permitted at all, unless they are under the complete control of the local authorities, who should ensure their proper protection from contamination by the methods detailed in the chapter on water supply.

No special remarks are called for with regard to the construction of houses in villages, if the general principles enunciated above are attended to.

Animals, however, should not be kept in dwelling houses, nor should rooms be built over cowsheds, stables, etc., and used as dwelling rooms. These places should also have impermeable materials on the floors, should be well ventilated and drained, and kept clean. The best cowsheds in the tropics are open sheds, simply consisting of a roof supported by pillars. These matters are referred to in detail in the chapter on sanitary law.

The recently passed Town Planning Act in the United Provinces provides for the formation of City Improvement

Trusts to which the municipality can hand over areas to be reconstructed in accordance with modern practice.

CONSTRUCTION OF HOSPITALS.

GENERAL CONSIDERATIONS.—All that is applicable to site, surroundings and construction of houses applies equally well or more so to hospitals. The importance of fresh air and light in sick wards cannot be over-estimated as they are occupied day and night. The site should be dry and open, well drained, preferably on a porous subsoil and should not be surrounded by overcrowded areas or thick vegetation. For infectious disease hospitals a site should be selected in a sparsely populated neighbourhood or outside the town, easy of access.

WARDS.—Long wards should face east and west so as to admit sun on each side alternately, and if any deviation is necessary on account of extreme heat in this country, it should preferably be such as to give a south-east and north-west aspect. Single storey hospitals are to be preferred as they permit of free circulation of air, but from motives of economy and convenience of construction two or more storeys may be built. Each ward should, if possible, be completely detached from the rest.

Small wards are suitable in a hospital, since provision has to be made for the isolation of severe or infectious cases and the separation of patients according to sex and sometimes according to certain diseases. Such wards are nowadays provided in most of the fever hospitals. As a general proposition, however, large wards are more readily ventilated and are more economical in construction and management and more convenient as regards nursing. The size of wards mainly depends on the number of patients for whom accommodation is required.

For long wards the width should be 24 to 30 feet, the height at least 14 feet, and the length such as to allow a cubic space per patient of at least 1,200 feet. Not less than 2,000 feet is considered necessary in an infectious diseases or lying-in hospital, or for severe surgical cases. Increase in the amount of space by increasing the height is not to be recommended, as extreme height is of little value with regard to ventilation. In hospitals it is essential to have plenty of floor space around each bed. For nursing purposes at least 90 to 100 square feet per bed is necessary. Wherever there is any possibility of septic or other infection, as for example in surgical wards, lying-in wards and wards for infectious diseases, the beds should be fairly well apart. In such cases 12 feet of wall and 150 feet of floor space should be allowed. For convenience in nursing the number of beds in one ward should not exceed 32 and should ordinarily be 24 or 28.

The beds are arranged with their heads to the wall, facing into the ward. The wall space for each bed should be 8 feet and each bed should be placed between two adjoining windows, the space between the windows being not less than 1 foot wider than the bed. At the most two beds may be allowed in one space, the space between them being at least 3 feet. The interval between the windows of a ward should be such as to allow of this arrangement.

All crevices and stagnant corners in which dust may lodge must be avoided. The floors should be of some impermeable material, the walls lined to a height of 4 feet with glazed tiles or cement, or in the absence of such materials, simply painted.

The circular ward system advocated by many has several advantages, such as the absence of corners for the accumulation of dust, the all round aspect by which the ward obtains sunlight at all seasons of the year and at every hour of the day, and the facility offered to nurses and attendants in going about from one bed to another. On the other hand, if a circular ward is to accommodate the same number of patients as an oblong ward, with an equal floor measurement, the beds of the patients which are placed around the wall must be very closely packed together, and the necessary amount of wall space cannot by any possibility be attained. In India circular wards are not favoured.

Ventilation must be provided for to the extent of at least 3,000 cubic feet per head per hour, and it may be taken as a safe rule that the whole air of the ward ought to be changed at least 3 times in an hour so that the hourly supply of fresh air should be three times the cubic capacity of the wards Ventilation may be by windows on opposite sides of the ward especially in India. One square foot of window to every 70 cubic feet of ward space is a suitable proportion. In European countries extraction is provided for by fireplaces, stoves, windows opening at the top, Sheringham's valves near the ceiling, chimney shafts and in other ways. In those countries the hospitals for infectious diseases, especially for small-pox, have an extraction shaft upon a large scale, the foul germ-laden air being made to pass through a gas furnace; in many hospitals the heating and ventilation systems are combined.

HOSPITALS FOR FAIRS.—The following is a description of temporary hospitals for fairs, based on the instructions laid down in the Manual of Government Orders, U. P :

At every fair of importance, especially where there is no permanent dispensary, at least two hospitals should be provided : one a general hospital and dispensary and the other a hospital for contagious diseases.

General Hospitals.—The general hospital should be erected at an appropriate and convenient place near the centre of the fair. It should be situated on a side road rather than on the main road so as to escape the dust. If a second hospital is required it should be put near the chief approach road to the fair. A site plan is shown in figure 61.

There should be an out-patients department and two wards, one for males and the other for females. It should be

50 feet long and 20 feet broad and should consist of a pent roof of thatch raised 7 to 8 feet off the ground by means of poles well set into the ground and so bound together and strengthened by cross-poles as to be able to stand up safely against a strong wind. Walls of matting should be furnished on all four sides. The floor of the hospital should have a pathway, six feet wide, along the centre, and be slightly raised for beds on each side.

In the compound quarters must be provided for all the staff employed at the hospital—Assistant Surgeons, Sub-assistant Surgeons, compounders, "kahars," and at large fairs for a female Sub-assistant Surgeon and a *dhai* as well. There must also be a godown for stores, separate cook houses for Muhammadans and Hindus, and male and female latrines. The latrines should consist of a small detached structure of thatch provided with earthen pans. Beds for the accommodation of the sick must be provided and in addition a few roughly made *charpais* for conversion into doolies.

The dispensary should be a rectangular building, 36 feet long by 12 feet broad, with a plinth raised one foot above the ground level. The building should have a pent roof with walls on three sides only. The fourth side should consist of matting or grass screens hinged to the under surface of the pent roof. When necessary these screens can be swung up and supported on bamboo poles so that the whole of one side of the dispensary can be opened up. The dispensary should be divided into two halves by a central screen ; in each half a room 6 feet wide should be partitioned off for the examination of patients. The arrangement of the building is shown in fig. 62.

Infectious Diseases Hospitals.—The infectious diseases hospital should be placed well out in the open, near to but outside the fair at a retired place, where the hospital with its inmates may be readily cut off from communication with the people visiting the fair. It should consist of a hut 30 feet long and 20 feet broad for the patients and a smaller hut for the Sub-assistant Surgeon on duty. Two other huts, one 10 feet

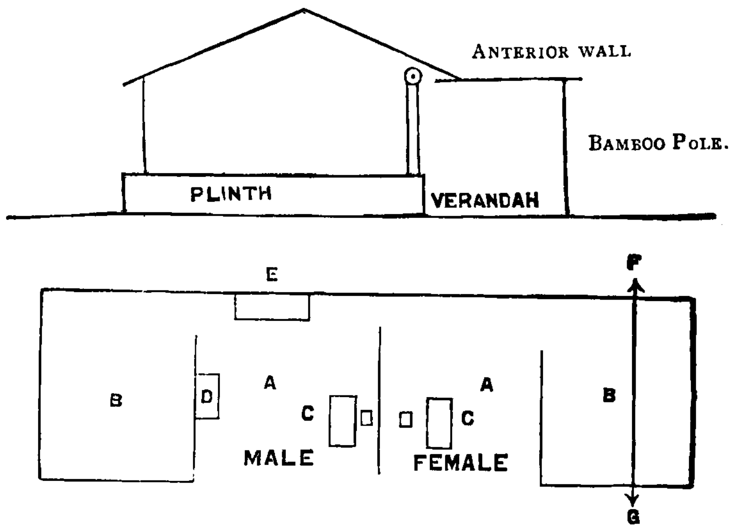

Fig. 62.—Plan and Section of Dispensary as used for in the United Provinces.
A.—Out-patients Hall.
B.—Examination Rooms.
C.—Tables and chairs for the attending physician.
D.—Compounding table.
E.—Compounder's almirah.

by 10 feet for a godown and one 10 feet by 15 feet for the *dooly* bearers, should also be erected. Shelters should also be put up for a sweeper and a *bhishti* (water-carrier). Two thatch latrines with wooden seats and iron pans or earthen receptacles should also be constructed in one enclosure surrounded by a light fence or bamboo railing 1 yard high. The equipment required is four beds, a *dooly*, a drum of cyllin or hycol, a vessel for boiling clothes and an empty kerosine oil can. There should be stored a sufficient quantity of material to permit of its immediate extension and should an epidemic occur in the fair the first case should be removed to this hospital and extra huts put up as required.

CHAPTER XIII

PERSONAL HYGIENE

HABITS.—Good habits formed early in life are a great aid in maintaining health. Bad habits, when formed, are very difficult to eradicate. Regular habits in eating, sleeping, work, exercise etc. should be cultivated. All habits with regard to work, mental or physical, to be made permanent, need strict adherence to the fixed time at which the work is to be carried out.

THE CLEANLINESS OF THE BODY.—Washing :—Baths :—A cold bath is one below 75° F ; a tepid bath between 80° and 90° F ; a warm bath between 90° and 100° F and a hot bath between 105° and 110° F.

Bathing should be continued all the year round. The body should be washed with warm water and soap once a day in winter, and once or twice a day with cold water in summer but face and hands should be washed more frequently. In case of people who take baths at long intervals, the dried up sweat and fat matters of the skin collect and retard the action of the skin, producing a disagreeable smell. Such people do not keep good health, and are more liable to infectious diseases than people who bathe regularly.

If cleanliness of the skin is observed there is little to fear from the body parasites, especially lice.

There are three kinds of Lice which are common parasites of man :

1. *Pediculus Capitis* —head louse,
2. *Pediculus Vestimenti* —body louse,
3. *Phthirius inguinalis* —lice of the pubic region.

A detailed description of the methods of getting rid of the parasite is given under "Relapsing Fever" (Chapter X).

Cheap soaps with free alkalies in them should not be used for washing the skin. If the soap makes the skin dry and rough its use should be discontinued.

The body should be rubbed first with a sponge and then with a rough towel until it is dry. Wet clothes produce chill and should not be worn after a bath. Cold baths are unsuited for the sick and delicate people, but rapid sponging with water and then rubbing the skin dry with a rough towel will remove all dirt from the surface of the body. Warm bath causes dilatation of the blood vessels of the skin, resulting in a loss of heat and lowering of temperature. Baths should not be taken during fever but the body may be washed with warm water without unduly exposing the skin. A bath should not be taken soon after a meal as it is likely to interfere with digestion.

There are two special kinds of bath—steam and hot air baths. The former is known as "Russian" bath and the latter as "Turkish." These baths are followed by rubbing the body and dashing cold water on it. They are contra-indicated in heart disease.

HAIR.—Hair of the head should be cared for as follows :

It should be kept clean by brushing or combing once or twice a day. The roots of the hair dry up for want of the natural secretion, so oil may be rubbed into the roots to replace the oily material secreted by the scalp, and to prevent the premature falling off of the hair. This should be done after washing the head with some cleansing substance. Yolk of egg, which forms the main ingredient of many of the shampoo powders on the market, is most suitable for this purpose ; bicarbonate of soda may also be used. Some cheap soaps contain a large amount of free alkali which makes the hair brittle, and should therefore not be used.

TEETH.—The care of the teeth is essential for the maintenance of good health. They should be brushed with a tooth-brush and some dentifrice at least once a day—preferably at night before retiring to bed.

NAILS should be cut short to prevent accumulation of dirt and germs under them and a nail-brush may be used to keep them clean.

THE CARE OF THE BOWELS.—People of sedentary habits are usually prone to suffer from constipation, loss of appetite, head-ache, etc. They resort to the use of laxatives habitually to secure a movement of the bowels instead of establishing regular habits to promote the healthy action of the bowels by making the necessary changes in their diet and in their mode of living. Tendency to constipation may be corrected by forming a daily habit of evacuating the bowels at a certain fixed time, preferably in the morning, and by including a certain amount of coarse food in the diet. At the same time an effort should be made not to overtax the central nervous system by insufficient hours of rest and over-activity. A moderate degree of muscular exercise, such as that involved in walking, running, riding, rowing, etc., is conducive to improving the muscular tone of the intestines. Abdominal massage is attended with good results in overcoming constipation.

EATING.—Good habits should be formed as to eating.

The food should be wholesome, properly cooked and appetisingly served. It should be taken at regular hours and should be well chewed.

While eating one should not give way to feelings of worry, distress, etc. which are likely to impair digestion.

The food should not be eaten in excess or in too small an amount. A good rule to follow would be to eat slightly less than what one is inclined to take. Nothing heavy should be taken in between meals as it would interfere with the appetite.

In India two meals a day are usually taken, i.e., at mid-day and at night. In the case of grown up people the meals should ordinarily be taken three times a day, i.e., morning, noon and night. Children and sick people should be given food at regular and more frequent intervals.

SLEEP.—A certain amount of sleep is required to maintain the different organs of the body in a healthy condition and to enable them to function normally. During sleep some of the organs are at complete rest, while others are at work less actively.

The amount of sleep varies with age, temperament and amount of work. As a rule 8 hours' sleep for an adult and 10 to 12 hours' for a child is necessary. For old men 6 to 7 hours of sleep with extra rest for a couple of hours is needed. The best time for sleep is of course during the night, but in India people generally take an hour or two of nap in the afternoon during summer, as the days are long and excessive heat predisposes to drowsiness and sleep.

"Early to bed and early to rise" is a good rule to follow, both in the tropics as well as in the temperate regions. A heavy meal within 3 hours of retiring is not conducive to a sound and refreshing sleep.

It is a bad habit to sleep with one's head covered, as one inhales the same air over and over again. People who sleep thus look pale and anæmic and are liable to diseases of the lungs.

BED-ROOM.—It should be thoroughly ventilated and should contain only a few articles of furniture that are essential for daily use; otherwise, excess of furniture will diminish the air space, retard free circulation of air and light, and harbour rats and insects, such as mosquitoes, fleas, etc. Dogs, cats and other such animals should not be kept in the bed-room.

A bed-room on the first floor is preferable to one on the ground floor. In India a single room is used for cooking and sleeping purposes by the poorer classes. This is very objectionable as it not only vitiates the air but renders the floor damp, and gives the place a gloomy appearance. It is very common among the poor in this country to sleep on the floor. This practice is injurious to health as ground air is inhaled, and in addition, the damp floor may cause rheumatism and predispose to chills and attacks of fever, dysentery, diarrhœa, etc. At the same time there is a great danger of being bitten by snakes, scorpions, centipedes etc. It is therefore necessary for a person to sleep on a bed. Iron or brass beds, preferably with a spring framework, are the best. "Newar" and "canvas" beds are also suitable as bedsteads, but the tape and the canvas must be washed periodically.

String beds are not so good, as they cannot be kept clean and generally harbour parasites, especially bugs. Some sort of cover on a bed in the shape of a quilt or a mattress, which should neither be too soft nor too hard, is necessary. Straw, coir, cotton, hair, or feathers are used as stuffing material. In case straw is used for this purpose, it should be changed every few months.

Pillows are made of a similar material.

Bed sheets and pillow covers should be kept clean and frequently washed. The bed covering should not be too heavy but should be sufficient to keep the person warm. Pillows, blankets, and bed sheets should be exposed to the sun daily for a couple of hours at noon time and the mattress at least once a week. The latter should be turned over every week before it is put on the bedstead after exposure to the sun. Heavy curtains should not be used, but the bedsteads in the tropics should be provided with mosquito curtains during certain seasons of the year to keep off mosquitoes and flies.

There should be no light or open fire in the bed-room, The windows, on retiring to bed, should be left open at night to give free access to fresh air. Doors and windows of sleeping apartments should be kept open for a few hours daily to promote free circulation of fresh air and access of sunlight.

In this country people sleep at night in the open during the hot weather and they use roofs or streets for this purpose. There can be no objection to the former so long as they protect themselves from dew and dampness by means of a sheet hung over the bed, supported by poles. The practice of sleeping in streets and bye-lanes is objectionable, as foul air from drains, etc., is inhaled. Verandahs offer a good place for sleeping out-doors.

Some people take drugs to induce sleep. Under no circumstances should one resort to the use of drugs to bring on sleep, except under medical advice.

EXERCISE.—The object of exercise is to promote and develop the healthy activity of the different organs of the body. It is essential to take a moderate amount of exercise for the healthy functioning of the different organs of the body. The effects of exercise on the body from a physiological standpoint are as follows :

During exercise groups of voluntary muscles come into play. The circulation is accelerated, bringing more food material to the tissues and rapidly removing waste products from the body. The frequency and force of the heart beat is increased and the pulse becomes fuller and stronger. The respiration is quickened and the amount of air inspired and expired is greater in quantity together with an increased elimination of CO_2 and moisture from the lungs. At the same time there is more oxygen supply to the different tissues of the body to carry on their functions.

The action of the skin is promoted, leading to the dilation of cutaneous blood vessels with an increased production of sweat, which, on evaporating, serves to regulate the temperature of the body. Owing to the excessive action of the sweat glands the kindneys are relieved of their function to a great extent and hence the output of water, salts in the urine is diminished.

Exercise should be taken regularly and systematically, and in the open air whenever possible. The commoner forms of exercises are walking, running, riding on horse back, rowing, boxing, wrestling, swimming, etc.

Walking is the cheapest and best form of exercise and is within the reach of rich and poor alike.

Rowing is good for the lungs and muscles of the chest and abdòmen. Riding on horse back is too violent for people with a weak heart, but is very useful for healthy persons and those suffering from impaired digestion.

Any form of exercise should not be such as to overtax the heart and produce pain and palpitation. Again, exercises, which call for the least amount of interference with the rhythm of respiration and cause the least amount of strain or tension, are the most suitable.

The Swedish forms of exercises are well adapted to prevent disorders of heart arising through exercise. They also interfere least with respiration and are being introduced in many institutions.

It is advisable to put on some warm outer garment after exercise to avoid the body getting chilled by a rapid loss of heat, especially in the cold season.

The amount of physical work for a healthy individual is estimated to be 300 foot-tons per day. It is calculated by the following formula :

$$\frac{(W+W^1)XD}{2,240} \times C = \text{foot-tons.}$$

W = weight of the man in lbs.

W^1 = weight he carries.

D = distance walked in feet.

C = coefficient of traction.

"Coefficient of traction" is work equivalent to the raising of the weight of the body, plus any additional weight carried, to a height equivalent to a fraction of the distance walked. It varies with the rate of speed of walking and is one-twentieth the distance walked when the rate is 3 miles per hour.

Any standard of work will also depend on certain factors such as age, sex, race, occupation, diet, etc., if it is not to produce any injurious effects on the body.

CLOTHING.—Clothing is worn with the object of affording comfort to the body, for protection from cold, heat, rain, wind and injury and for personal adornment.

The materials usually used for clothing are cotton, wool, fur, silk, flax, jute, hemp, coir, leather, feathers. Some of these are derived from the vegetable kingdom and others from the animal kingdom.

Cotton has a smooth fine texture. It is largely used in the tropics for making garments. It is a durable material, does not shrink in washing, is a good conductor of heat and is non-absorbent of moisture.

Strictly speaking, it is not suitable for garments worn next the skin, as it absorbs sweat and becomes moist and wet. The moisture during re-evaporation may cause a chill, but this effect can be overcome by using loosely woven garments. They are light and comfortable when wool or silk are added to he material, as unmixed cotton carries away readily the heat from the body surface. As cotton can readily be washed and as it is lighter and cheaper as compared with other clothing materials it is largely used in hospitals for overalls, aprons, etc., of the staff. It is also greatly used in this country for both outer and inner garments for wear almost all the year round. When examined under the microscope, the fibres appear flat and twisted and are seen to possess no joints (fig. 63).

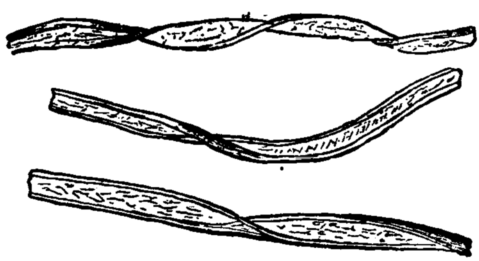

Fig. 63.—COTTON FIBRES. (× about 200.)
(Parkes and Kenwood's Hygiene and Public Health.)

Linen materials are of a fine and close texture. They allow heat to escape readily from the surface of the body. Like cotton, linen is not suitable for under garments. Microscopically, the fibres appear round and jointed with imbricated scales running in one direction (fig. 64).

WOOL is one of the important clothing materials used extensively in cold countries. It absorbs and retains moisture and prevents the loss of heat from the surface of the body. For these reasons it is advisable to wear in the tropics a soft flannel garment next the skin to avoid sudden chilling of the body. It is also very necessary to wear a woollen outer garment after exercise when followed by profuse sweating. Wool has certain disadvantages such as (1) the irritating effects of coarse wool on the skin (2) the hardening and shrinking of the fibres on frequent washing resulting in the loss of its absorbent properties. Woollen garments should therefore be carefully washed so as not to impair its hygroscopic properties.

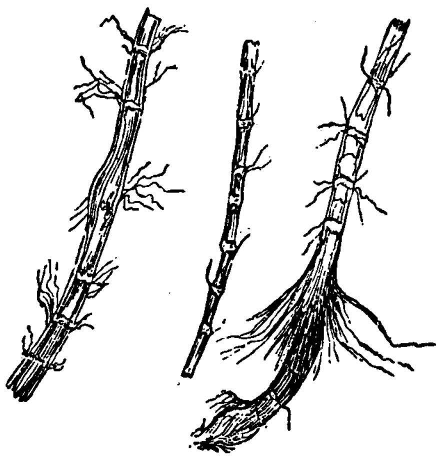

Fig. 64.—LINEN FIBRES. (× about 200.)
(Parkes and Kenwood's Hygiene and Public Health.)

Microscopically, the fibres of wool appear rounded with fine cross markings and marginal indentations (fig. 65).

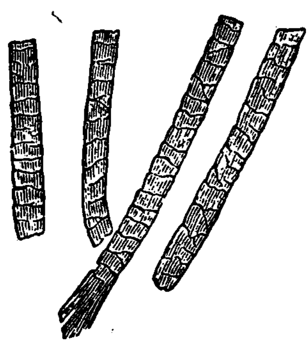

Fig. 65.—WOOL FIBRES. (× about 200.)
(Parkes and Kenwood's Hygiene and Public Health.)

SILK is a bad conductor of heat, shrinks slightly in washing, is practically non-porous and is more absorbent than cotton or linen. It is less irritating to the skin and hence forms an excellent material for under garments. It may be worn throughout the greater part of the year in place of cotton. Garments made of silk are light but less durable and costly. Microscopically, the fibres are structureless without markings or scales (fig. 66).

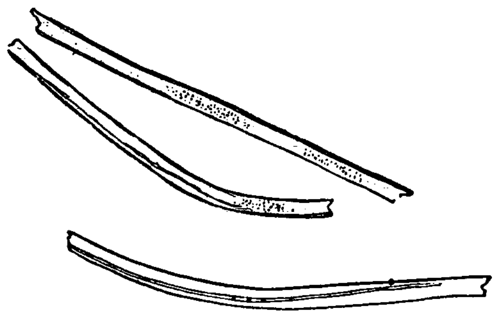

Fig. 66.—SILK FIBRES. (× about 200)
(Parkes and Kenwood's Hygiene and Public Health.)

WATER-PROOF material is used for the protection of the body from rain. It is a bad conductor of heat and hence it is a source of discomfort when worn during the sultry wet months of the year.

LEATHER as a material for clothing is rarely used in the tropical countries, but forms the chief clothing material for people inhabiting the coldest parts of the globe. Clothing must be adapted to the age, climate and personal comfort. Children and old people need to be protected by warm clothing against sudden changes and extremes of temperature. Clothing should not be worn too tight, as it would interfere with the normal functioning of the internal organs of the body and the circulation of blood. Regard to this point must be had in the designing of dress of women and children in particular Sleeping garments should be quite loose.

The best colours of clothing materials for use in the tropics are white, grey, or khaki. The darker shades may be worn in the evening or night. Aniline dyes used for the purpose of dyeing dress materials are of vegetable origin and are harmless. Mineral dyes containing arsenic are injurious as they may irritate the skin and cause eczema. During hot weather the head, nape of the neck, and the spine need protection from the direct rays of the sun in the tropics. Flannel abdominal belts may also be used to avoid Colic, Diarrhœa, Dysentery, etc.

Boots should fit the feet and should be neither too tight nor too loose. There should be just sufficient space within boots or shoes to allow of the free movement of the joints and toes of the feet in walking. High-heeled boots so commonly worn by European women, are a source of discomfort and produce fatigue.

CHAPTR XIV

SCHOOL HYGIENE.

The importance of hygienic conditions cannot be too strongly emphasised in connection with school premises. Not only are they necessary to protect the health of the scholars, but also as an object lesson of what adequate and up to date sanitation is. Impressions gained at the school age are likely to have a lasting effect and will induce children to expect, and when they in turn become parents, demand proper sanitary conditions in their own homes. This is all the more important in tropical countries where the hygienic knowledge of the indigenous inhabitants is of the most primitive description.

School premises should therefore be designed on sanitary principles, maintained in a sanitary condition and equipped with up to date sanitary conveniences.

In addition, the elements of sanitary science should be taught in all schools as part of the curriculum in a degree suitable to the age of the scholars.

School premises.—The *site* of all school premises should be on elevated well-drained soil with adequate surface drainage to rapidly remove the storm water.

The building should not be situated in insanitary surroundings or near buildings in which insanitary trades are carried on.

There should be no other buildings within 40 feet (as a minimum) of the school building in order that there may be free access of light and air.

The *type of building* will depend on whether the school is a primary, middle, or high school. In the tropics, protection is necessary from the dazzling light of the sun ;

verandahs are therefore necessary especially on the south front of the building in tropical regions like India. These should be at least 10 feet high.

One-storey buildings are better for the tropics and the building should stand on a plinth at least one foot in height. The ceilings should be at least 20 feet in height and the roofs should be of such material as will afford efficient protection from the sun. Jack-arched roofs of brick covered with one foot of clay are very suitable in the tropics. These roofs can easily be kept clean and do not harbour rats, snakes or insects.

Owing to the difficulty of ventilating school class rooms, they should have windows on both sides, which can be opened to admit of the free perflation of the wind.

No scholar should be far from the light, so that broad class rooms only lighted on one side are not desirable.

Class rooms should not be too large nor is the teaching of large numbers in one room favoured by the educational authorities. Class rooms 40 feet long and 30 feet broad, with verandahs on each side, are the most suitable.

Lighting.—Proper lighting is essential for class rooms. Children who have to read in a defective light hold their books too near the eyes, muscular strain is induced, which leads to an alteration in the curvature of the eye-ball which is particularly plastic in children. The result of this is permanent short-sight.

The class rooms should be lit by windows in the two side walls only, the end walls should have no windows in them. The window area should be about $\frac{1}{5}$th the floor area of the room. In a class room 40 feet long and 30 feet broad, four windows on each side, 7 foot high by $4\frac{1}{2}$ feet wide, would be very suitable and would give adequate light to every part of the room. The lower sill of the windows should be at least 4 feet from the floor so that the attention of the scholars may not be distracted by outside objects. These windows will be adequately protected from the glare of the sun by the verandahs.

In addition to these windows there should be openings or windows high in the room for ventilation, these will be dealt with under that heading.

Windows opening outwards in two halves are the best in this type of building. This arrangement permits of the whole of the window area being opened to the perflation of the wind when desired. The doors for the entrance of scholars may be constructed in the end wall while at the other end a door may communicate with a private room for the master at that end of the class room.

Orientation.—In the tropics such a class room should be built so that one side faces the direction of the prevailing winds. In India, where in most places the prevailing winds are more or less east and west, such a building should be constructed with its length lying north and south.

Ventilation.—The natural ventilation of school class rooms in all countries is unsatisfactory. It is not possible to supply 3,000 cubic feet of fresh air per head to the scholars without the creation of a disagreeable draught in cold weather. Louvred openings are probably the best type of ventilators for schools in the tropics. They should be placed near the ceiling sloping from within outwards and upwards and in such climates it is better to supply 4859 square inches of exit openings per occupant of the room. Louvred inlets may also be provided near the floor but they are not essential. These openings should be protected by wire gauze on the outside to prevent the ingress of birds and insects.

Clerestory Windows may be substituted for louvred openings; they should be protected by wire gauze and be shaded by sloping wooden canopies outside. The area of these might conveniently be 2 square feet; 8 of them would be sufficient outlets for foul air for a room with 40 occupants.

In large schools with an electric light plant, exhaust fans should always be placed in the upper corners of the rooms in order to rapidly exhaust the foul air. In the tropics, owing to the high temperature for the greater part of the year, the personal emanations from the scholars are much greater than in Europe, so that the air becomes foul and unpleasant much more rapidly; the necessity for rapid removal of this foul air is thus emphasised.

In high temperatures the air of a room can be changed very frequently as the objections to a draught being caused do not exist, in fact a steady draught is necessary to assist the body to maintain thermal equilibrium. It also reduces the amount of perspiration.

Furniture.—In India it is not usual in primary schools to supply any desks and benches; the scholars sit on mats on the floor and write with one knee raised to rest the slate on. There is very little objection to this posture, if teachers take care to see that it is always adopted for writing. They should not allow children to place their slates on the floor for writing as their posture then would lead to spinal curvature if persisted in and also cause undue compression of the abdominal and thoracic organs.

In middle and high schools desks and benches should always be provided. The type of benches and desk recommended in England are quite suitable for the tropics. They should be arranged parallel to each other and at right angles to the windows. If the room is only lit from one side, this light should fall on the left of the scholars. Desks should be 15 to 18 inches broad; they should be moveable so that they may be adjusted at an angle 15° to the horizontal for writing and 45° for reading.

The front of the seat should be one inch behind a perpendicular dropped from the edge of the desk when placed for writing. The desk and seat should be joined in one piece so that the seat cannot be moved about. The seat should be made to fit the scholar so that there should be several sizes in each school for the different classes. The height of the seat should be equal to the length of the child's leg from the sole of the foot to the knee; the breadth should be two-thirds of the upper leg and the perpendicular distance from the seat to the edge of the desk placed for writing should be one-sixth of the height of the scholar. The seat should have a straight back with a curved pad to support the chid's back from between the angles of the scapulae to the top of the sacrum.

Two feet should be allowed for each pupil on a common seat.

There should be room for the teacher to be able to pass along between each row of seats and there should be alleyways down each side at the walls and in the middle of the room. The teacher should have raised platform in order that he can overlook the scholars.

Blackboard and maps should never have glazed surfaces as the light reflected from such surfaces causes eye-strain to the scholars looking at them.

School books should be printed on good paper, not in any way transparent and the type should be suitable to the age of the scholar. "DOUBLE PICA" is a suitable size of print in lower primary schools and "PICA" for older children.

The walls should be of some smooth material so as not to harbour dust. Concrete floors are very suitable in the tropics as they are cool and can be easily cleaned. No warming arrangements are necessary in tropical climates as the day temperature even in the coldest time of the year is always agreeable.

Floor Area and Cubic space—The English Education Department lays down a minimum of 10 square feet and 100 cubic feet per scholar as the minimum requirements. In the tropics a minimum of 15 square feet and 150 cubic feet would be much more preferable, and in middle and high schools 15 square feet and 200 to 300 cubic feet would be required. It is impracticable in most cases to allow sufficient cubic space per scholar in order to get an ideal state of ventilation; this should be made up for by opening all windows and doors and allowing the room to be thoroughly flushed with fresh air at least once an hour.

In the tropics it would be better to keep the windows open all the time, and if they are, they should be protected by immovable wire gauze of a mesh sufficiently fine to keep out flies and other large insects.

In **boarding schools** 500 cubic feet should be the minimum allowed per head in sleeping apartments; these rooms are better if located in a separate block altogether from the school buildings.

Such a room as described above would be a good pattern of class room; in large schools there should be several class rooms like this. Such rooms built on the pavilion plan on each side of a long corridor would, with slight modifications, be very suitable for the tropics.

Sanitary Conveniences.—In all schools the modern types of sanitary conveniences should always be installed. In the tropics they should be in the form of latrines and urinals in one corner of the playground and should not form part of the school buildings.

In small primary village schools a good pattern latrine such as the Donaldson might be erected. There should be provided 5 seats to a 100 scholars as a minimum. These latrines should be kept in thorough order and repair as an object lesson to the scholars.

In schools in towns with pipe-water supply the latrine should be a water-flush latrine of the trough pattern, properly constructed of good material and well supervised.

Water Supply.—In all small boarding schools, open mouthed wells should be abolished and hand pumps substituted for the raising of water as described in Chapter I ; if there is a pipe water supply, this should always be laid on to the school for the use of the scholars. Bathing platforms, properly sloped and drained, should be constructed round the pumps. In large schools without access to a public water supply, the school authorities might instal a small engine to pump up the water required for flushing, bathing, cooking and drinking. The upkeep of a small oil engine is not great and the benefits of a constant pure water supply are inestimable.

Play Grounds.—All schools in towns should have playgrounds, part of which should be covered for the use of the children in wet weather. In primary schools in villages the provision of a playground is, however, hardly necessary.

School premises should be inspected frequently by the health officer of the area in which they are situated and any defects pointed out by inspecting officers should be removed at the earliest possible moment by the educational authorities.

In places where wholetime school medical officers have been appointed annual inspection of each school should be required.

School Hours.—The length of school hours at the various school ages is most important from the health point of view.

Children in the lowest classes at the ages from 6 to 8 should not be taught for longer than 3 hours daily and no lesson should last longer than fifty minutes. The child should be allowed an interval of 10 minutes between each lesson for recreation in the playground, attending to the calls of nature, etc.

From the age of 8 to 10, four hours' teaching would not be too much and such children might be given about half-an-hour's home work in addition.

From the ages of 10 to 13 the child might have 5 hours' in school and one hour's home lessons. This 5 hours' period should be broken by an hour's interval for food, recreation, etc. This home work at this age might be increased to one hour.

At ages over 13, the school hours should be six and the home work limited to two hours.

School hours in the tropics should vary with the time of the year. In the hot season the schools should open in the early morning which is the coolest time of the day, while in the winter similar hours to those observed in European schools are quite suitable. These, however, are matters which are best settled in each locality according to its needs. In village schools where children sometimes walk long distances to school it will be necessary to meet their conveniences in every way by holding school at hours to suit them.

Physical Training should be included in all schools curricula. Graduated exercises, such as Lingh's Swedish exercises, are very beneficial to scholars both from the health and disciplinary point of view. The exercises should, of course, be suitable to the ages of the children and should be carried out daily from a period of a quarter to half an hour. Organized games in the higher schools are also desirable and competitions between schools in such games as cricket, football, hockey, etc., engenders a spirit of emulation and esprit de corps in a school which has a widely recognized moral and educative value.

The Teaching of Hygiene in Schools.—Hygiene is taught in an elementary form in the schools of most countries and there is no doubt that it should be taught also in the schools in the tropics to the children of the native inhabitants of these regions as well as of Europeans. In India, elementary hygiene is taught to some degree in the High schools, and in normal schools for teachers it is also taught in order that school teachers may acquire hygienic knowledge to impart in turn to their scholars. It is necessary, however, to consider in this connection the religious and other susceptibilities of the scholars and their parents. The implating of western ideals in the minds of oriental peoples without arousing their active antagonism is always difficult and must be undertaken with great circumspection. Teachers of all schools should therefore be taught the salient principles of personal and general hygiene in such a manner as will ensure their cordial sympathy and agreement with these principles in order that they may be able to hand over their knowledge efficiently and convincingly to the children placed in their charge for instruction.

Hygiene should therefore be taught to the necessary extent in all the schools and training classes for teachers, and they should be required to exhibit a sound knowledge and understanding of the elements of personal hygiene, the precautions to be taken to avoid infectious diseases, especially in the presence of epidemics, and the supervision of the sanitation of school premises, dormitories and their accessory sanitary equipments such as water supply, disposal of refuse, excreta, etc.

It is not necessary that hygiene should be made a separate subject of examination, but lessons on subjects dealing with hygiene in the vernacular and in English should be introduced into all school readers in lower and middle class schools and a knowledge of the meaning of the subject matter of such lessons should be required in such of them as are included in examinations.

Teachers should also explain the elements of hygiene by personal precept and by suitable object lessons.

In high schools books on hygienic principles written in narrative form might be included in the text books required to be read for examinations. In India tales illustrating the advantages of a pure water supply, the methods of minimising the danger of becoming infected with plague, cholera, dysentery, eye diseases and tuberculosis are especially suitable.

Teachers should also be required to insist on bodily cleanliness among scholars, and the observance of cleanly and orderly habits. Scholars habitually dirty in their habits and clothes should be excluded from the schools.

Hygiene lessons should begin about the age of eight and should be continued throughout the school curriculum. They should commence with the very simplest principles of personal hygiene which are well within the mental capacity of the scholars and should be gradually enlarged and added to in the higher classes. Impressions well ground into the minds of children between the ages of 8 and 16 are likely to have lasting effect and will lead in time to a demand for better sanitation in the homes of the people and a cessation of the objections to the introduction of up to date methods of sanitation which are so frequently met with at present.

Medical Inspection of School Children.—It is generally recognised now-a-days that school children should be medically inspected at intervals, in order that incipient maladies may be recognised early in their course and suitable advice as to their treatment given. In the tropics eye diseases are common and a large proportion of the blindness among adults in India is the result of carelessness in dealing with minor affections of the eye among children.

Medical inspection of scholars is carried out 3 times during a child's school career in England, while in Japan all scholars are medically inspected annually. Each scholar should have a school medical history sheet which should be kept up to date by inspecting officers.

Local authorities have the question of the medical inspection of children under consideration in most provinces of India and the formation of an efficient agency to carry out frequent inspection of scholars and schools is likely to result in the near future.

CHAPTER XV

CLIMATE AND METEOROLOGY

The Causes of High Temperatures.—The portion of the earth's surface which may be said to possess a warm climate, roughly lies between latitudes 38° north and south of the Equator.

The higher temperature of these regions is chiefly due to the fact that they are longer exposed to the vertical, or nearly vertical, rays of the sun than any other part of the earth's surface. Similarly, the polar regions are cold, because they never receive the sun's rays, except at an extremely acute angle.

The amount of heat we receive from the sun is not so much due to its proximity as to its height above the horizon and the length of time it remains there. The difference of temperature in summer and winter is due to the fact that the apparent part of the sun is south of the Equator for six months and north of it for the other six months. It crosses the Equator at the spring and autumn equinoxes in March and September, and travels about 23 degrees north in summer and 22 degrees south in winter.

The climate of equal latitudes, therefore, if other things were equal, should be the same. Other things, however, are not equal and consequently the climate of places in the tropics on the same parallels of latitude varies greatly, owing to their physical characters.

CIRCUMSTANCES WHICH MODIFY HIGH TEMPERATURES.

Land.—The presence of land, as islands or continents, and the physical features of such land, have a great effect on the temperature. Land is much more easily heated than water and also radiates its heat much more rapidly. Sand absorbs heat very quickly ; clay less quickly and mould about half as much heat as sand in the same time.

Vegetation and *forests* also affect the temperature and stretches of land covered with vegetation are cooler than those that are bare, as vegetation prevents the rapid absorption of heat.

The *elevation of the land* above the sea level has also a great influence on the temperature, which decreases about 1° F. for every 300 feet of ascent. Continents, or portions of continents, not much raised above sea level, within the tropical or sub-tropical zones, have a high day temperature. Those parts which are devoid of vegetation, and not in close proximity to the sea, have the highest day temperature. At night, or in the early morning, the temperature is very much lower than in the day time, owing to the rapidity with which land, especially bare land, loses heat. The diurnal range of temperature in such places may be as much as 50° F. In India examples of such places are the Rajputana and Sind deserts, and in other parts of the world the deserts of Arabia and North Africa in the northern hemisphere, and North Australia in the southern hemisphere.

In similar latitudes in Africa, in the southern hemisphere, most of the parts of the continent far removed from the sea, such as the Transvaal and Rhodesia, are on high plateaux, so they do not experience such high temperatures. In South America also the temperature of the interior of the continent is modified by the presence of forests and luxuriant vegetation.

Islands and Sea coasts.—Water takes up heat slowly and loses it slowly. The humidity of the air has a great influence on temperature, which is much lower in the presence of large volumes of water. The temperature of islands and the coasts of continents in these regions is largely modified by proximity to the sea. The temperature of bare land may rise as high as 200° F., while the temperature of the sea rarely rises above 90° F., so that air in contact with the sea is at a much lower temperature than air over the land.

The heated air over the land rises in the evening, and an inrush of cooler air from the sea causes the evening breezes well known in such regions and as the land loses its heat rapidly during the night, there is a current of air set up in the opposite direction in the morning.

Examples of such places are Ceylon, the Malacca coast, the Malay Peninsula, the West India Islands, etc. The variations in the summer and winter, temperatures of such places are also very small.

Mountains.—The presence of high mountains which receive a high annual rainfall, and consequently are covered with vegetation, also modify the heat of the adjacent low-lying tracts and a downrush of cooler air from them to the heated plains takes place towards evening.

They also form the watersheds of rivers, which by irrigating the adjacent plains give rise to a high degree of vegetation, which tempers the heat.

Ranges of mountains which receive little or no rainfall have, however, little effect on the temperature of the sub-adjacent plains, such as the mountains in parts of Arabia, which are bare of all vegetation.

Thermometers.—The temperature is measured by means of instruments known as Thermometers.

The materials used contract or expand when exposed to varying degrees of heat and cold. Mercury is commonly employed, because of its very low freezing point and its high boiling point but alcohol is preferred when very low temperatures may have to be recorded, because it does not freeze at the greatest known degree of cold.

The instruments are graduated from the fixed points of freezing and boiling water by plunging them into melting ice and boiling water, respectively, at the standard pressure. On the Centigrade scale the freezing and boiling points are 0 and 100 respectively, while on the Fahrenheit scale the freezing point is 32 and boiling point 212.

Maximum thermometer (fig. 67) has a mercurial column

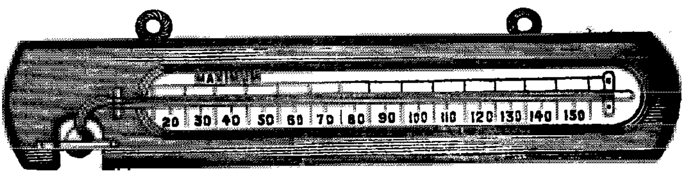

Fig. 67.—The Maximum Thermometer.

and is designed to register the highest temperature reached during the period of exposure of the instrument. The registration is effected by either breaking the column of mercury by an air bubble or by a slight narrowing of the tube near the bulb. In either case the natural cohesion of the metal, when contracting, is overcome and the mercury always remains at the highest point reached. Another method is to insert a small piece of solid glass enamel in the bend near the bulb ; this, acting as a valve, allows the mercury to pass on one side of it as it expands, but does not allow it to return on cooling. In hanging a maximum thermometer, it is necessary to see that the end of the tube furthest from the bulb is slightly inclined downwards, so that when temperature falls the column of mercury may be prevented from returning back to the bulb. Before reading the instrument the end furthest from the bulb should be gently elevated to an angle of about 45°.

Minimum thermometer (fig. 68) indicates the lowest temperature reached, alcohol being used instead of mercury. In Rutherford's thermometer the index moves with the spirit on contraction by cold owing to capillary attraction, but not on expansion, thus showing the lowest temperature. The end

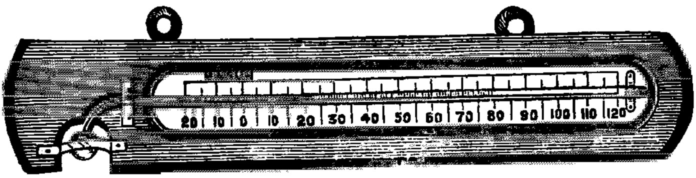

Fig. 68.—The Minimum Thermometer.

of the index furthest from the bulb indicates the minimum temperature. These instruments should be hung so that the bulb end is 1 inch lower than the other end, because then the index is less likely to be affected by a rise in temperature.

In *Six's thermometer* (fig. 69) there is a U-tube the middle part of which is occupied by mercury. The bulb (*a*) and both the tubes above the mercury contain alcohol, in which are two steel indices, which are brought by means of a magnet to rest upon either columns of mercury, and (*b*) is a small chamber containing air. On a rise of temperature, the alcohol, expanding in the bulb (*a*), depresses the mercury level in one arm, and therefore raises it in the other, the maximum temperature being indicated by the position reached by the lower end of the index. Conversely, as the temperature falls the alcohol in the bulb contracts, and the pressure of the air in the chamber (*b*) depresses the mercury level in the arm immediately beneath, and therefore raises the mercury level in the other arm, the index then registers the lowest temperature

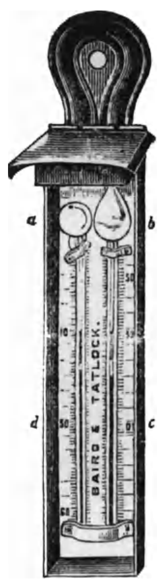

Fig. 69.—Six's Thermometer.

experienced. Thus in the arm (*c*) maximum temperatures are registered and in the arm (*d*) minimum temperatures.

Shade maximum and minimum thermometers should be placed horizontally in the shade, or in a Stevenson's louvred box, 4 feet above the ground and at least 20 feet away from buildings or other sources of radiation.

Atmospheric pressure.—Under the modern system, a number of barometric readings taken at the same time over an extended area are telegraphed to a central station, where they are laid down upon a map. On this map lines are drawn connecting the places showing equal barometric pressure ; these lines are termed "isobars." This weather map will show the cyclonic or anticyclonic systems, as the case may be, their position, and their extent. A cyclonic system is a system having at its centre the lowest barometrical pressure, and surrounded by isobars of gradually increasing pressure. The isobars will be near or far apart according to the amount of depression in the centre. If this depression is great, then the isobars are generally close together, and the "gradients" are said to be "steep". If, on the other hand, the depression in the centre is shallow, the isobars are further apart, and the gradients are "shallow".

An anticyclonic system is the reverse of this for its centre is the highest barometrical reading and it is surrounded by isobars of gradually decreasing pressure.

In order to restore atmospheric equilibrium the air tends to move from a region where the barometer is high and pressure greatest, towards one where it is low and the pressure is least. Consequently, currents of air set in from all sides towards the centre of a cyclonic system. These currents of air do not, however, as a matter of fact, flow straight to or from the centre but have a gyratory movement imparted to them, owing to the rotation of the earth on its own axis.

The forces mentioned above apply to the currents of air moving towards the centre of a cyclonic system, or away from the centre of an anticyclonic system. In the case of a cyclonic system (in the northern hemisphere), a current setting towards its centre from the north appears to come from north-east. A current setting towards the centre from the south of the system is deflected to the east, or comes from south-west. In this way a gyratory or spiral movement is imparted which causes the wind to travel round the centre of a cyclonic depression, in a direction against the hands of a watch ; or supposing a person to be travelling with his face towards the direction the wind is taking, he will always keep the centre of the system, i.e., the point of lowest pressure, on his left hand side.

The central space of the cyclone is occupied by a vast ascending current, which after rising to a considerable height flows away as upper current into surrounding regions.

The direction of the wind round an anticyclonic centre is exactly the reverse. The air flows away from the centre of greatest pressure in all directions. The current flowing southwards is deflected to the west, and appears to come from north-east. The current flowing northward is deflected to the east and comes from south-west. Consequently the currents revolve with the hands of a watch and the person travelling with the wind keeps the centre of the system—the point of highest pressure—always on the right hand.

Winds travelling from high latitudes to low ones meet an atmosphere which is rotating at a greater rate than they are, and consequently appear to come out of the north-east in the northern hemisphere. On this account the trade winds blowing towards the equator appear as north-east winds in the northern hemisphere. The direction of the trade winds is constant over all open seas to about 30° north and south of the equator, but land changes their course.

The position of the sun has an influence on the strength and direction of these trade winds ; when the sun is near the Tropic of Cancer the south-east wind is more southerly and strong, and the north-east wind is weaker and more easterly. The reverse happens when the sun approaches the Tropic of Capricorn.

In India the south-west monsoon is an inrush of moist air from the southern seas to replace the partial vacuum caused by the rising of the air over vast areas of land heated by the vertical rays of the sun in the tropical tracts of the northern hemisphere. In winter there is a movement of cool air from northern hemisphere to hot areas of the tropics and sub-tropical zones. From this it follows that having a weather (synoptic) chart before us, and knowing the distribution of pressure over the area included in the chart, we can generally tell the direction of the wind at any particular spot ; if we know what course the system is taking, i.e., the direction in which it is travelling, we can predict what changes will subsequently take place in that direction, so long as it remains included in the system.

Cyclonic systems are never stationary. They move over the earth's surface usually from west to east in European latitudes but in the case of British Isles coming from off the Atlantic, their approach is difficult to forecast. In these depressions the isobars lie close together and the winds are strong. The arrival of cyclonic systems off the coasts of England heralds the approach of cloudy skies, wind, rain and damp air. These conditions imply warmth in winter, and cold weather in summer.

Anticyclones, on the contrary, are generally more or less stationary, or move very slowly. The isobars lie far apart, and the winds are light. They are accompanied by fine weather, a dry atmosphere, a sky generally clear of clouds, though fogs are very likely to prevail at places. These conditions produce cold, frost or fog in winter, and heat in summer.

The synoptic charts (figs. 70 and 71) show that the wind

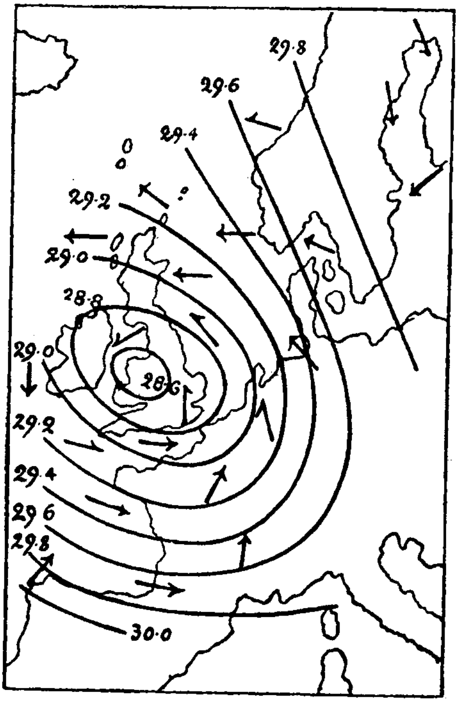

Fig. 70 —Synoptic Chart showing Cyclonic System.
The arrows show the direction of the wind. The figures show the barometric pressure of the isobars.
(*Parkes and Kenwood's Hygiene and Public Health*).

in both cyclonic and anticyclonic systems has a direction more or less parallel to the isobars, but still, on the whole, tending to cross the isobars very obliquely, so as to blow spirally toward the centre of the cyclone and spirally away from the centre of the anticyclone.

Secondary cyclones are formed by looped concentric isobars with incomplete circles, the pressure being lowest in the centre.

V. shaped depressions have the lowest pressure in the interior forming, for example, the angular intervals between adjoining anticyclones.

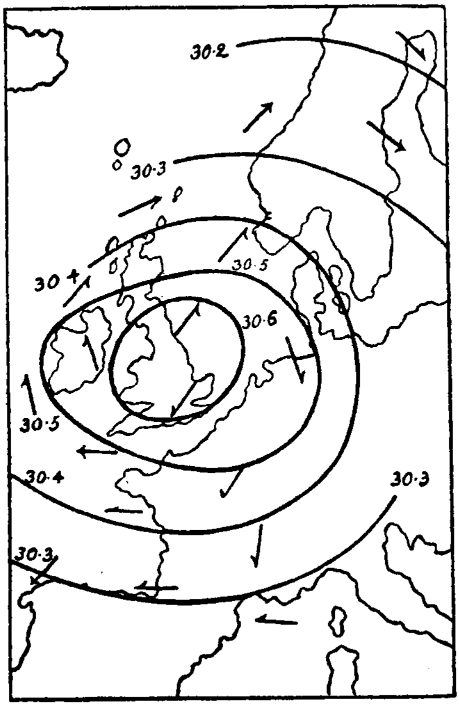

Fig. 71.—SYNOPTIC CHART SHOWING ANTICYCLONIC SYSTEM.
(*Parkes and Kenwood's Hygiene and Public Health*).

Wedges of high pressure are inserted between two adjacent cyclones, and usually point to the north, the highest pressure being in the interior.

Cols are necks of comparatively low pressure between two adjacent anticyclones.

Wind may be measured by Anemometers as regards either its pressure or velocity.

Robinson's Wind Anemometer (fig. 72) is an instrument which records the velocity of the wind. It is the only one in

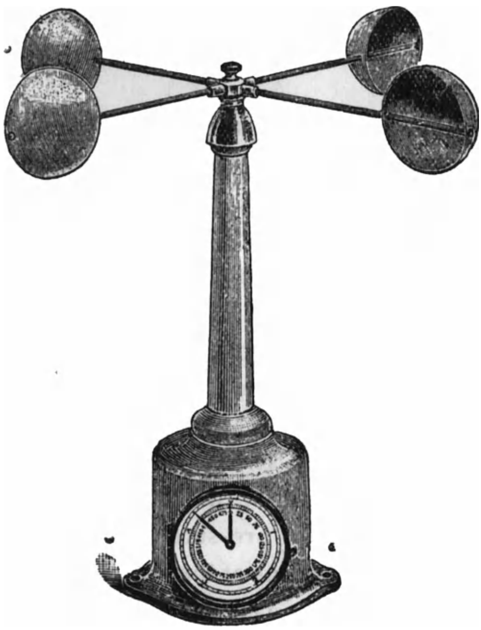

Fig. 72.— Robinson's Anemometer.
(Baird & Tatlock).

common use. It consists of four light arms rotating in a horizontal plane around an axis, through which their movements are transmitted to a series of recording dials. Each arm has at its extremity a hemispherical cup facing horizontally at right angles to the arm. In whatever direction the wind blows, the vanes move, the resultant pressure on the concave surface being greater than that upon the convex. The re-revolving cups set in motion a train of clockwork and the velocity of the wind is recorded on a series of dials.

It was formerly believed that the cups moved at a rate equal to only one-third that of the wind and the index dials were graduated accordingly. It appears, however, that the pressure is greater than one-third and has a direct relation to the size of the cups and the velocity of the wind. The square of the velocity in miles per hour multiplied by ·005 gives the wind pressure in pounds per square foot and on the other hand the square root of 200 times the wind's pressure gives the velocity.

The instrument must be kept clean and well oiled and should be fixed at least 20 feet from the ground, away from buildings. The average velocity of the wind is from six to eight miles per hour.

In Beaufort scale the force of the wind is stated by arbitrary numbers ranging from 0 (calm) to 12 (hurricane). On this scale in a light wind the air travels at a rate of 13 miles per hour, in a "moderate breeze", 23, in a "strong breeze" 34 and in a "gale" 65.

All wind direction observations by vanes, etc., should be recorded to the nearest point of the compass.

The Barometer.—The pressure of the atmosphere is exerted equally in all directions at the same level but on account of the compressibility of the gaseous bodies the lower levels of a high column are denser than the higher. Air pressure is measured by means of barometers which are of mercury, glycerine or water. The weight of the atmosphere at the sea level supports a column of mercury of 29·992 inches or 760 millimetres in height, a column of glycerine about 324 inches and one of water 34 feet in height. The water barometer is accordingly the most sensitive, but it is inconvenient in use.

The simplest form of mercurial barometer consists essentially of a graduated U-tube, with one end closed. The closed arm is about 32 inches in height and the open arm about 8 or 9 inches. The mercury placed in the U-tube is made to completely occupy the closed arm so that all the air is displaced from it ; then when the tube is brought to its proper upright position and the mercury falls, there is a complete vacuum left above it in the closed arm. The varying pressure of the atmosphere on the surface of the mercury exposed in the open (short) arm causes the level of the mercury to rise and fall in the long (closed) arm and the difference between the levels in the two arms represents the height of the column of mercury supported by the atmosphere.

In a standard mercurial barometer a vertical tube 33 inches long rises from a cistern of mercury, the tube above the level of the mercury being in a state of perfect vacuum. In Fortin's barometer (fig. 73), the small cistern has a leathern bottom which can be raised or lowered by means of a thumb screw (a). The scale for reading the height of the column of mercury is divided into inches, tenths, and half-tenths ($\frac{1}{20}$) of inches and to obtain more accurate readings than the scale alone allows, a sliding scale or vernier (b) is attached which serves to indicate the amount of space occupied by the mercury between the half-tenths lines. The vernier scale is divided into twentyfive equal parts, which correspond to twentyfour half-tenth divisions on the barometer scale. Consequently each division on the vernier is $\frac{1}{25}$ less than a half-tenth division on the barometer scale, and is therefore $\frac{1}{25}$ of $\frac{1}{20}$ inch ($=\frac{1}{500}$ or 0.002 inch).

In order to take an accurate observation the eye, the zero edge of the vernier, and the top of the mercury should all be in the same horizontal plane, hence the necessity of fixing the barometer at a height convenient to the observer. The temperature of the attached thermometer (c) is first noted, then the level of the mercury in the cistern is so adjusted that the ivory point (d) projecting downward from the roof of the cistern just touches the surface of the mercury. This little ivory point indicates the zero of the scale, and since the level of the mercurial surface in the cistern varies with every change of atmospheric presssure the level of the mercury must be adjusted prior to each observation, to the

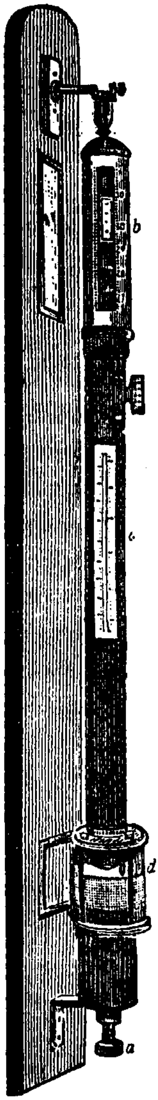

Fig. 73.—Fortin's Standard Barometer.

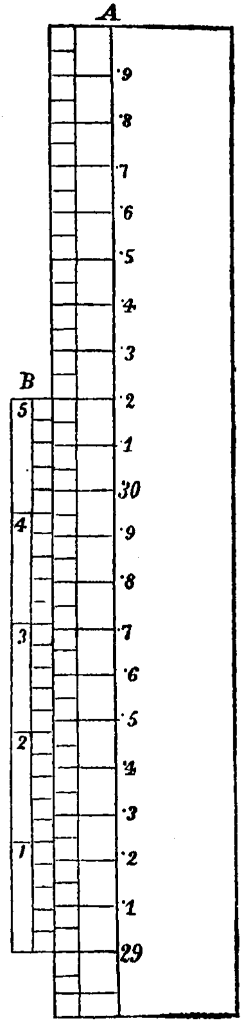

Diagram of Barometer Scale and Vernier.
A, Scale, *B*, Vernier.

(*Parkes and Kenwood's Hygiene and Public Health*).

zero of the scale. Next read off on the barometer scale the division immediately below the top of the column of mercury. Then adjust the vernier so that its lowest line is level with the top of the column of mercury and the light is just excluded between the lower end of the vernier and the top of the mercury, and count the number of divisions on the vernier from below upwards, until a line on the vernier is exactly continuous with one on the barometer scale. Multiply the number of the division on the vernier so obtained by 0.002 and add the result to the already observed height on the barometer scale. Corrections by Glaisher's tables must then be made for temperature above 32°F.—for mercury, like all other metals, expands with a rise of temperature. The mercury falls about $\frac{1}{1,000}$ inch for every foot ascent above sea level, and allowance must be made for this if the observation is made at an altitude.

The barometer must always be carefully and truly fixed by means of a plumb line in a good light and protected from sunshine, rain and winds. Before fixing, it should always be ascertained if the vacuum above the mercury is true. To do this, unscrew the bottom of the cistern until the mercury is 2 or 3 inches from the top and then rather suddenly decline the instrument. If the vacuum is true the mercury strikes against the top of the tube with a sharp click, but a dull sound results if air is present. In the latter case, screw up the bottom tightly, turn the instrument upside down, and tap the side forcibly until a bubble of air is seen to pass through the mercury column into the cistern. Barometric observations are always expressed to the third place of decimals ; and isobarometric lines indicate areas over which the barometric pressure is identical. If the isobars, which are drawn for each $\frac{1}{10}$ inch, are close together, the "barometric gradient" is said to be steep, and the wind velocity will be high.

Aneroid barometers dispense entirely with liquids and measure the barometric pressure by means of the elasticity of the metal. The instrument consists of a small air-tight metallic box from which the air has been exhausted but the two flat surfaces of the box are kept apart by a powerful sensitive spring. The atmospheric pressure acts upon the spring and is recorded on a dial. This instrument is chiefly used for taking altitudes. The practice is to read the aneroid to the nearest $\frac{1}{100}$ inch both at the commencement and at the termination of an ascent and then to subtract one reading from the other (ignoring decimal points) and multiply the difference by 9, this giving the height of the ascent in feet.

The weight of a cubic foot of dry air at 32°F. and 30 inches of mercury is 566.85 grains. As air expands $\frac{1}{491}$ of its volume for every degree rise Farenheit, the volume at 60° F., for instance, is $1+\frac{1}{491}\times(60\text{-}32)=1.057$ cubic feet. The weight is inversely as volume ; consequently the weight of a cubic foot of dry air at 60° F. $=\frac{566.85}{1.057}=536.28$ grains.

The weight of a cubic foot of water vapour at 60° F. is 5.77 grains. Therefore, the added weight of a cubic foot of dry air at 60° and of a cubic foot of vapour at 60° are $536.28+5.77=542.05$ grains. But dry air expands on taking up moisture, and the actual weight of a cubic foot of saturated air at 60° is 532.84 grains or 3.44 grains less than the weight of an equal volume of dry air at that temperature because the cubic foot of originally dry air is now more than a cubic foot. This fact explains the fall of the barometer when the moisture in the air is increasing and a fall of rain is imminent.

Atmospheric humidity.—The instruments which register the moisture in the atmosphere are known as *hygrometers*. Of these there are two distinct classes, i.e., those which indicate the dew point directly and those from which the dew point is indirectly determined. In the former class the air is cooled until the moisture is deposited on a bright surface to which the thermometer is attached, the latter indicating the temperature of the point.

In Daniell's Hygrometer (fig. 74) now rarely used, ether is placed in the lower bulb, and the other bulb (which contains nothing but ether vapour) is covered with muslin moistened with ether. This ether on the muslin evaporates into the air, and the loss of heat so occasioned condenses the ether vapour inside the bulb, causing evaporation from the ether inside the other (lower bulb). The lower bulb thus becomes gradually colder, and chills the air surrounding it, until a temperature is reached at which the air is compelled to part with some of its moisture, which condenses upon the bright metal band surrounding the bulb. Directly this takes place the temperature of the dew point is read off from the attached thermometer. The temperature at which the due disappears is next observed, and the mean between these two temperatures is taken as the dew point.

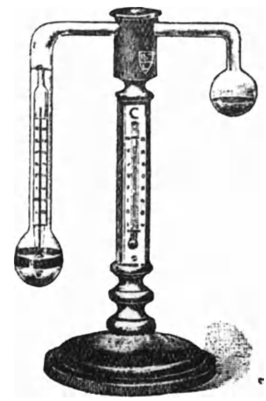

Fig. 74.—Daniell's Hygrometer. (Baird & Tatlock)

There are some other instruments such as Regnault's, Dines' and Saussure's hygrometers for recording the amount of moisture in the atmosphere, based on similar principles.

Wet and dry bulb Hygrometer.—This instrument (fig. 75) is usually employed to estimate the humidity in air. It consists of two absolutely identical thermometers mounted on a stand and fixed side by side. In the wet bulb thermometer the bulb is kept moist by being covered with muslin, one end of which dips into a small vessel of distilled water so that moisture ascends by capillary attraction. The evaporation of moisture from the wet bulb, which takes place so long as the surrounding air is not saturated, causes loss of heat and the wet bulb reads lower than the dry bulb. Both the vessel containing water and the wet bulb must be sufficiently far from the dry bulb to ensure that the readings of the latter are not affected by the evaporation. The instrument must be exposed in the shade and protected from air currents and direct sunshine both of which, by increasing evaporation, would cause the wet bulb thermometer to indicate a temperature not strictly due to the hygrometric state of the atmosphere. If the muslin becomes frozen in the winter, the two thermometers will read the same ; then the wet bulb should be brushed over with cold water, and the evaporation which will go on from the frozen surface will enable a proper reading to be taken.

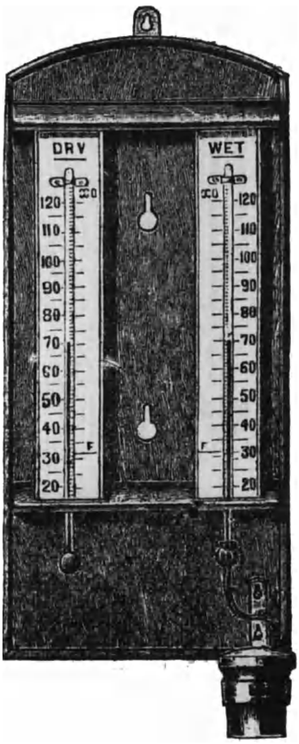

Fig. 75.—Wet and Dry Bulb Hygrometer. (Baird & Tatlock).

From the readings of the dry and wet bulbs can be ascertained the relative humidity of the air, i.e., the amount of moisture present in the air, expressed as percentage of the amount just necessary to cause saturation ; the *dew point*, i.e., the temperature at which the amount of moisture actually present in the air causes saturation ; and the *weight of vapour* *in a cubic foot of air*, from which can be deducted the additional weight of vapour necessary to cause saturation or the *drying power of the air.*

The relative humidity is found from tables. The greater the difference between the dry and wet bulbs the lower is the relative humidity. If the dry and wet bulbs record the same temperature the air is completely saturated with moisture.

The dew point can be determined by the equation : Dew point $= T^d - F(T_d - T_w)$; where T_d is the dry bulb temperature, T_w is the wet bulb temperature and F the factor opposite the dry bulb temperature found in Glaisher's tables.

The "elastic force of vapour" or "the tension of aqueous vapour" is the amount of the barometric pressure which is due to the aqueous vapour in the atmosphere. If the temperature of the air is lowered and with it the tension of aqueous vapour, a temperature will sooner or later be reached at which the air is saturated with moisture, and then the slightest further reduction in temperature will cause a deposition of dew ("dew point"). The tension of aqueous vapour is ascertained from tables or by formula. The relative humidity can be calculated by dividing dew point by the elastic force of the aqueous vapour at the temperature of the air, and then multiplying by 100.

The weight of moisture which a cubic foot of dry air can take up, before it is saturated, varies with temperature. The higher the temperature the larger is the amount of vapour which can be held and when warm air, laden with moisture, is chilled, the moisture representing the difference between what it originally held and what it is capable of holding at the reduced temperature is deposited in the form of dew or rain.

Rainfall.—To the winds is chiefly due the rainfall of a country. Moist winds from the sea, on striking the cooler air on mountains, such as in the Western Ghauts and the Himalayas in India, deposit their moisture as rain.

Areas with much vegetation also cause the deposit of rain, as the air over them is cooler than the moisture-laden winds which encounter it. Areas in the interior of a continent, even on the coast with no adjacent high land, receive very little rain.

In India the greatest rainfall from the monsoon is received as a rule in the region of the Western Ghauts and in the Himalayas, the greatest rainfall being in those portions of the country where the hills are in close proximity to the sea. For this reason the rainfall of the Bombay Presidency is high during the south-west monsoon, while that of the Madras littoral is low, as most of the moisture has been removed from the air before it crosses the Western and Eastern Ghauts. Similarly, the rainfall of Bihar, Assam, Bengal and the Eastern parts of the United Provinces is high, while that of the Western districts of the United Provinces, Rajputana and Sind is low, as the moisture has been largely removed by the time the monsoon winds have reached them. The Punjab, the Himalayas and Kashmir have, however, a good rainfall, as owing to their height they are much colder than the advancing moist currents, and are, therefore, able to cause the deposition of rain in spite of the fact that most of the moisture has already been removed.

It is seldom, however, that sufficient moisture remains to cause deposition of rain in the Trans-Himalayan countries. In seasons when the temperature in May and June has been very high in North-Western India, the partial vacuum created is so great that the moist currents are strongly attracted and arrive in these latitudes containing a large percentage of moisture and a greater deposition of rain is produced. A cool hot weather, therefore, may be expected to result in a deficient monsoon.

In places like the Sahara and the Arabian deserts, the moisture has all been removed from the south-west winds before reaching them and these places are practically rainless. Aden may be without any rainfall for several years.

Estimation of rainfall.—This is determined by an instrument known as Rain Gauge (fig. 76). It consists of a

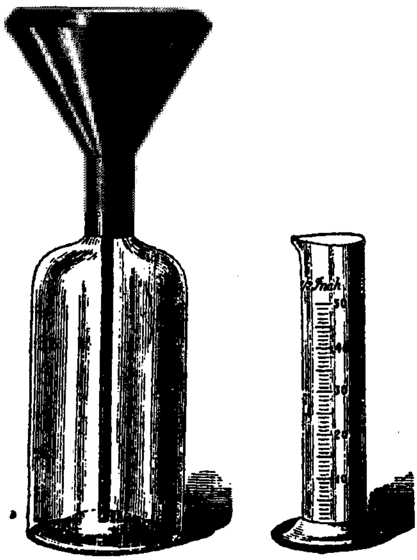

Fig. 76.—Rain Gauge.
(Baird & Tatlock).

vessel supporting at its top a circular funnel which collects the rainfall. The vessel must be sunk in level ground, away from shrubs and buildings, to such a depth that the collecting surface is one foot from the ground. A measuring glass graduated according to the area of the funnel so as to indicate the fall of rain as decimals of an inch, is required. The area of the top of the circular funnel (the receiving surface for the rain) is usually 50 square inches. To graduate the measuring glass for a funnel of this area, 50 cubic inches of water are poured into it, and a mark placed at the level the fluid stands at. Then if the rainfall collected on 50 square inches should measure the 50 cubic inches, each square inch of surface has collected one cubic inch of water, and the rainfall is "one inch." But the glass below the mark is divided into 100 equal parts, so that each division indicates a fall of $\frac{1}{100}$ or 0.01 inch of rain. The readings are ordinarily taken daily at a fixed hour in the morning generally at 9 a.m.

In Crosley's self-registering rain gauge every $\frac{1}{100}$ inch of rainfall is recorded on a dial. The rainfall collected gradually fills one compartment of a small bucket divided into two compartments and balanced on a pivot. When one compartment is full the bucket tips and causes an index to record and the second compartment then commences to fill.

Fogs.—Aqueous vapour requires free surfaces for its condensation. When air is filtered, no cloud of condensed vapour can be formed. "Wet fogs" result when the particles of suspended matter are relatively few and the condensed moisture excessive, whereas "dry fogs" occur when the smoke and dust are relatively abundant. When the films of moisture are discoloured by the products of coal combustion, a yellow fog will result.

The death rate of towns in England is generally increased on account of fogs and is chiefly due to the irritating effects of the impurities present in the atmosphere upon the lungs and to the sudden fall of temperature on such occasions. In London and other towns in England there is a considerable loss of sunshine on account of fogs.

Clouds consist of collections of condensed aqueous vapour, the principal forms being (1) the cirrus, consisting of separate fine feathery formations, generally white in colour, (2) the stratus, consisting of a smooth horizontal stratum of cloud, (3) the nimbus, constituting the raining clouds of dark coloured irregular forms, and (4) the cumulus or heavy, thick, well defined clouds, generally rounded off in shape. Two or more of these four principal forms may be mixed together, giving rise to appearances which are defined as "cirro-stratus", "cirro-cumulus" "strato-cumulus", "cumulo-nimbus", etc.

Climate and Public Health.—In areas which have a large rainfall, and the air is moist and hot, luxuriant vegetation results, and the temperature in such areas is most equable, and there are no extremes of heat and cold such as are experienced in dry, bare areas. In these areas all the lower forms of vegetable life proliferate with great rapidity, and fermentation and putrefaction is accelerated, so that tropical conditions favour the existence and growth of many organisms, such as moulds and bacteria whose effects on man are injurious. These conditions also favour the reproduction of insect life, and as many insects are known to be carriers of pathogenic germs, the inhabitants of tropical countries are more exposed to the invasion of disease than those who live in more temperate regions, where the meteorological conditions are such as to inhibit the lower forms of vegetable and animal life. Insanitary conditions are, therefore, a greater danger to the public health in the tropics than in temperate zones. Before the introduction of sanitary measures in tropical countries in which Europeans lived, the death rate among them was very high. In the West Indies in the early part of the nineteenth century the death rate among Europeans was usually over 100 per mille the causes of death being chiefly dysentery, diarrhœa and typhoid fever, due to no attempt being made to obtain pure water supplies ; malaria and yellow fever, due to the vehicle by which these diseases gain entrance to the body, *i.e.*, the mosquito, not being known, and phthisis, due to overcrowding and insufficient ventilation.

In India, 50 years ago, the death rate among European troops was as high as 69 per mille, typhoid fever and cholera being the chief causes of death, and malaria of inefficiency. This death rate has now been brought down among troops, who are, of course, selected men who have been passed as physically fit before coming to the country, to a point much lower than the general death rate of Great Britain.

This improvement is, however, not altogether due to general sanitary measures, such as the improvement of water supplies, better housing and ventilation, and anti-malarial measures, but also to the fact that diet and clothing suitable for tropical countries and personal hygiene is now better understood.

In India there has not been any great change in the death rate since such rates have been recorded. It varies between 30 and 50 per mille in various parts of the country, but there is hope that this high death rate will be appreciably reduced by the introduction of measures for the benefit of the general public health. It is, however, necessary that the principles of hygiene should be grasped and acted on by the people. It is not, however, to be expected that the introduction of pure water supplies, proper systems for the removal of refuse and excreta, and the control of epidemic outbreaks of disease, will produce any great immediate effect on the death rate ; but the education of the people and the dissemination of the principles of the prevention of disease in schools, will eventually crown the efforts of sanitarians with success.

In India already a certain measure of success has been attained by enormously reducing the death rate from small-pox by vaccination, and from cholera by the control of epidemics, and in Panama the drastic measures taken by the Americans have practically abolished water-borne diseases, malaria and yellow fever.

In addition to infectious diseases, the inhabitants of the tropics are also liable to suffer from the effects of high temperature on the system, and also from the direct effects of the rays of the sun.

The native inhabitants of the tropics have a very different dietary from the natives of temperate and cold climates, and Europeans who do not endeavour to conform to the dietary and habits necessary in tropical regions soon begin to suffer from ill-health.

Even with every precaution, prolonged residence in the tropics is undoubtedly injurious to the health of Europeans.

The description of the meteorological phenomena and instruments is substantially the same as the one given in Parkes and Kenwood's Hygiene and Public Health.

CHAPTER XVI

VITAL STATISTICS

The science of statistics consists in the collection of individual facts with a view to grouping them into different classes according to certain definite characters which they possess. It does not follow that because in any series of cases two groups bear a certain numerical proportion, they will always bear the same proportion in a subsequent series of cases.

For example :—If 100 cases of enteric fever are taken and it is noticed that 25 died and 75 recovered, it does not follow that in the next hundred cases examined the proportion of deaths will also be 25. The relative values of two or more series of observations are as the square roots of the number of observations ; thus if a larger number are examined the accuracy increases as the square root of the number. Ex. :—The relative values or accuracy of a group of 10 observations is to a group of 100 as $\sqrt{10}$ is to $\sqrt{100}$. The smaller the number of observations, the greater is the possible deviation from the proportions which may be observed in another similar series. By *Poisson's formula*, the limits of error may be ascertained.

Let M = number of cases recorded.
, m = number of cases in one group.
,, n = number of cases in the other group.

Then $m + n = M$; and $\frac{m}{M}$ and $\frac{n}{M}$ are the proportions of each group to the whole, but on subsequent occasions the proportions may be $\frac{m}{M} + 2\sqrt{\frac{2\,m.n}{M^3}}$; or $\frac{m}{M} - 2\sqrt{\frac{2.m.n}{M^3}}$.

The same holds good for the n group.

Example :—M = 100 cases of fever,
m = 25 cases which die.
n = 75 cases which recover.

Then the proportion of $\frac{m}{M}$ or $\frac{1}{4}$ of fatal cases may, in a subsequent series, be $\frac{1}{4}+2\sqrt{\frac{2\times 25\times 75}{100^3}}={}^{\cdot}25+{}^{\cdot}1225={}^{\cdot}3725$

$$\text{or } \frac{1}{4}-2\sqrt{\frac{2\times 25\times 75}{100^3}}=.25-.1225=.1275$$

i.e., in another series the values of m and n may be 37 or 13.

If 1,000 cases are taken and of these 250 die and 750 recover, then the limit of error in a subsequent series will be much less, and so on.

The Arithmetical Mean is found by adding together the numerical values of the figures in a series and dividing by the number of units in the series.

It may be shown as $\frac{a+b+c+d}{4}$

The relative values of 2 or more similar series are as $\frac{1}{(pe)^2}$ where *pe* is the probable error.

pe is approximately $\frac{2}{3}$ of the mean error.

To find the Mean error.

(1) Find the mean of the series of observations ;
,, ,, ,, ,, all the observations above the mean and subtract the mean from it ;

this gives the mean error in excess.

(2) Find the mean of all the observations below the mean and subtract the latter from the mean ;

This gives the mean error in deficiency.

Add the results together and divide by 2 ; the result would be the *mean error*.

Example :—

Suppose the lengths of 11 pieces of paper are 3, 6, 8, 5, 4, 1, 10, 11, 12, 2, 4 inches. Then the mean is 6.

The mean error in excess is 4.

The mean error in deficiency is 3.

∴ the mean error is 3.5.

The *probable error* of a mean result may be calculated as follows :—

1. Draw the mean of all the observations.
2. Find the error of each result from the mean.
3. Square each of these apparent errors.
4. Add together the squares of the errors.
5. Take the square root of the sums.
6. Divide the square root by the number of observations.
7. Multiply the result by .67449 or $\frac{2}{3}$.

Example :—Take six pieces of paper 21, 32, 27, 25, 18 and 33 inches in length.

1. Take the mean = 26
2. Apparent errors = 5, 6, 1, 1, 8, 7.
3. Their squares = 25, 36, 1, 1, 64, 49.
4. Their sum = 176.
5. Square root = 13 (round numbers)
6. Divide by 6 = 2.16
7. Multiply by ·67449 = 1·45 = the *probable error* of the mean result.

In addition to the *arithmetical mean* there are :—

The *geometrical mean* $= \sqrt[4]{abcd}$

The *harmonic mean* $= \dfrac{4}{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}}$

The *quadratic mean* $= \sqrt{\dfrac{a^2+b^2+c^2+d^2}{4}}$

If the terms of the series are equal the means are all identical, if the terms are unequal the quadratic mean is the highest, the arithmetical mean next, then the geometrical and harmonic means.

The reliability of an average or arithmetical mean is dependent on the degree of approximation between the various factors and the mean.

Ex. :—Street A has 20 houses
,, B ,, 20 ,,

In	,, A	10 houses	have	8	inhabitants.
		6 ,,	,,	4	,,
		4 ,,	,,	2	,,
In	,, B	1 ,,	,,	7	,,
		10 ,,	,,	6	,,
		9 ,,	,,	5	,,

The average in each case is 5.6

But the value of the average is in inverse ratio to the *standard deviation*, which is

$$\sigma = \sqrt{\frac{n_1 a_1^2 + n_2 a_2^2 + n_3 a_3^2 \ldots\ldots\ldots\ldots}{N}}$$

where n_1 n_2, etc., are the number of factors having the same measurements and a_1 a_2 are the number of group units separating each group value from the mean value of the whole N. The standard deviation in street A will be found to be 2.5 while in street B it is .58

$$\text{Ex. :—(A) } \sigma = \sqrt{\frac{10 \times 2.4^2 + 6 \times 1.6^2 + 4 \times 3.6^2}{20}} = 2.5$$

$$\text{(B) } \sigma = \sqrt{\frac{1 \times 1.4^2 + 10 \times 0.4^2 + 9 \times .6^2}{20}} = .58$$

The two standard deviations above are comparable because the averages are the same.

If the averages do not coincide then comparable figures can be obtained by dividing each standard deviation by its corresponding mean and multiplying by 100. The result is called the *coefficient of variation.*

Thus, if there be a third street C with 20 houses, of which 10 houses have 7 inhabitants,

6 have 6 inhabitants

and 4 have 5 inhabitants,

then, compared with A and B,

the average = 6.3 and the standard deviation is .78, then the coefficients of variation of A, B, and C are 44.6, 10.36 and 12.38.

Series of phenomena are said to be correlated when certain values of one phenomenon occur more commonly with given values of the other.

Ex. :—If with more rainfall there is more malaria then there is correlation between the two, i.e., positive correlation. If with less rainfall there is more diarrhœa then there is negative correlation and the more frequently the same thing is observed the nearer the correlation.

The *coefficient of correlation,* when positive, is any figure between 0 and + 1, and when negative, any figure between 0 and − 1. If there is complete correlation then the coefficient of correlation is 1. If there is no correlation then it is 0.

Coefficient of correlation of two series of figures

$$= \frac{\text{sum of the products of the deviation}}{\text{standard deviation series 1} \times \text{standard deviation series 2} \times \text{the number of observations.}}$$

To apply the coefficient of correlation proceed as follows:

Suppose it is desired to find the probable malaria death rate in any year from the rainfall.

Let a = the rainfall for the year in which the deaths are to be estimated.

and a' = the mean rainfall of a series of years.

and $\sigma\, a'$ = the Stand. Dev. from the mean in those years.

and $\sigma\, b'$ = the Stand. Dev. from the mean in the malaria death rate in those years.

and b = the death rate to be estimated.

and b' = the mean malaria death rate in those years.

and C = the coefficient of correlation between the two series

then $a\text{-}a' = \frac{\sigma\ a'}{\sigma\ b'} \times C \times (b - b')$

Theory of Probability.—The object of the theory is to obtain an accurate measure of the likelihood of the occurrence of events under conditions some of which are known and some unknown. Algebraically the probability of an event is expressed by a fraction, the numerator of which represents the number of ways in which the event can happen and the denominator the sum of the number of ways in which it can happen and in which it can fail.

If the sum of the two probabilities is unity, the measure of probability may vary from 1 to 0, 1 = the certainty of its occurrence, and 0 = the absolute certainty of its non-occurrence.
Ex :—In men between 20 and 35 years of age suppose on the average 20 per cent. recover and 20 per cent. die and 60 per cent. are invalided, the probabilities of death and recovery are equal i.e., $\frac{1}{5}$ and the probability of being invalided is $\frac{3}{5}$.

The statistical methods enumerated are of great use to Public Health Officers and are applied in working out death, birth, marriage and disease rates and in estimating probabilities from a known set of conditions.

To obtain reliable public health statistics it is necessary to have a reliable and as nearly correct as possible estimate of the population.

The only correct method is a census but as a census at present takes place only once in 10 years, it is necessary to estimate the population for the intermediate years. In India in most places, births, deaths etc., are calculated on the population at the last census. This method is very fallacious as it assumes that the population remains the same during the whole of the 10 years. In England it is estimated in accordance with the *Law of Population*, by which a population increases in regular geometrical progression when the births exceed the deaths and the ratio of births and deaths to the population remains constant.

Of course this method ignores migration which takes place between town and town and country and country, but as there is no effective method of checking migration it has to be ignored.

Ex. :—If the birth rate of a population numbering 5,000 is 30 per 1,000 and the death rate is 20 per 1,000 and these rates remain constant for 10 years, the annual rate of increase is 10 per 1,000 or ·01 per unit, so that 1,000 persons at the end of a year become 1,010 and one person becomes 1.01.

$\therefore$ the population at the end of 10 years $= 5{,}000 \times 1.01^{10}$ $= 5{,}523$ persons.

$\because$ the population at the end of 1 year is $5{,}000 \times 1.01$; at the end of 2nd year it is $(5{,}000 \times 1.01) \times 1.01 = 5000 \times 1.01^2$, etc. The formula for obtaining the rate of increase from the figures of two censuses may be expressed as $Pb = Pa(1+r)^{10}$ where Pa is the population of the first census and Pb is the population of the second census, r being the net annual rate of increase *per unit*; $\therefore$ log. Pb = log. Pa + 10 log. $(1+r)$;

$$\therefore \log.\ (1+r) = \frac{\log.\ Pb - \log.\ Pa}{10}.$$

The "*increment of life*" is the excess of births over deaths.

The "*decrement of life*" is the deficiency of births from deaths.

The "*effective population* is that between 20 and 70 years.

The "*specific population*" is the population per acre which is the same thing as the "*density of population*."

In calculating birth or death rates for any year, the estimated population for the *middle* of that year is taken as a basis as it represents the average number of persons alive during that year.

The following is the method used in England by the Registrar-General to estimate the population of a town or district for the middle of any year.

Suppose the population in 1901 was Pa and in 1911 it was Pb and we want to find the population for the year 1912 expressed as P.

Then log. Pb − log. Pa = log. of the rate of increase for 10 years or $(1+r)^{10}$.

This divided by 10 will give the log. of the increase for one year. From April 1911 to July 1912, i.e., from the time the census was taken until the middle of 1912, it is $1\frac{1}{4}$ years. log. P = log. Pb + $\frac{5}{4}$ log. of rate of increase for 1 year.

The number corresponding to the logarithm will give the calculated population.

This method of course assumes an increase at the same ratio.

This may be checked by the number of inhabited houses as shown by the rate book and the average number of inhabitants in each house but this is not as a rule applicable in India.

It can also be checked by the births.

Take the average birth rate for the previous 10 years and divide by this the number of births registered during the year in which the population is required × 1000. This is fairly approximate.

The *marriage rate* is usually expressed as

$$\frac{\text{number of marriages} \times 1{,}000}{\text{population}}$$

but it should more properly be expressed as the number of persons married annually per 1,000 marriageable persons, *i.e.*, those over fifteen years who are unmarried.

The marriage rate is highest in large towns in European countries to which many young adults emigrate from country districts, and where more constant labour at a higher rate of remuneration than in the country can be secured. In England and Wales the average annual fecundity of married women of reproductive ages is about 260 live births to 1,000 women.

Birth rate is the proportion of children born in one year per 1,000 of the population. It is calculated by multiplying the number of births in a year by 1,000 and dividing by the population. For greater accuracy it may be calculated as below :—

$$\frac{\text{number of births in the year}}{\text{mid-year population}} \times 1,000.$$

For shorter periods, such as quarters, months or weeks, it is calculated in the same way. Ordinarily 365 days in a year are taken as the basis of calculation but if greater accuracy is desired the astronomical year of 365.24 days or 52.177 weeks may be adopted.

Newsholme is, however, of opinion that a more correct way is to take the number of women at child-bearing age instead of the total population.

There has been a steady decline in the birth rate in England and in nearly all European countries. In France the fall in the birth rate is a matter of great concern to the State. The figures for England and Wales are 35.4 in 1871-80, 32·4 in 1881-90, 29·9 in 1891-1900, 27·2 in 1901-1910, 20·9 in 1916 and 19·7 in 1923. The chief causes of the decline are :

1. postponement of marriage to a later age ;
2. increase in the number of unmarried people ;
3. facility in getting a divorce ; and
4. general unwillingness on the part of the people to have a large family and the application of means to limit the number of offspring.

It is higher in large towns especially when economic conditions are normal ; lower in agricultural areas and in times of depression of trade.

In India too the birth rate is declining ; in 1922 it was 31·85 against 31.97 in 1921 and 32.98 in 1920. Soon after an epidemic a marked decline in the birth rate is noticed in the returns from affected areas.

Death rate.—Annual death rates are calculated by multiplying the number of deaths in a year by 1,000 and dividing by the population. They may also be calculated from weekly, monthly and quarterly returns, as follows :

A weekly death rate

$$= \frac{\text{No. of deaths in the week} \times 52.17747 \times 1{,}000}{\text{population.}}$$

A monthly death rate

$$= \frac{\text{No. of deaths in four weeks} \times 13 \times 1{,}000}{\text{population.}}$$

A quarterly death rate, i.e., of 13 weeks

$$= \frac{\text{No. of deaths in a quarter} \times 4 \times 1{,}000}{\text{population.}}$$

In estimating the death rate of several districts or towns, the method of taking the average of the death-rates will produce a fallacy. The total number of deaths in all the areas must be taken and multiplied by 1,000 and divided by the population.

There has been a steady decline in the death rate in England, from 22.4 in 1841—50 to 15.4 in 1901-10 and 14.3 in 1911-15. In 1923 it was 11·6.

In India it was 30.84 in 1920, 30.59 in 1921 and 24·02 in 1922. The rate of mortality in urban areas is higher as compared with that in rural districts.

Death rates for short periods are not reliable indications of public health. In small populations even one year is too short a period to give a reliable rate.

Influence of birth rate upon the death rate.—Other things being equal, a high birth rate in a given year would theoretically increase the death rate, since the mortality among the newly born is generally greater than that of the population as a whole. But a high birth rate implies (a) a large proportion of the persons at the reproductive ages, and in a few years (b) a new population of children and young adults, since under the most adverse conditions a large majority of the infants survive. The mortality among both classes (a) and (b) is low, and more than balances the higher mortality in the first year or two of life. (Farr).

In comparing the death rate of two towns there are also serious sources of errors possible, as *the age distributions* may vary widely owing to local conditions. Now the death-rates at different ages are not the same.

Example :—In England and Wales during the year 1919 the death rates, as given in the Eighty Second Annual report of the Registrar-General, were :

	Males	Females
All ages	14.8	11.9
Under 5	32.4	26.1
5—10	3.4	3.4
10—15	2.2	2.3
15—20	6.6	3.4
20—25	6.6	4.2
25—35	6.6	5.1
35—45	6.6	6.2
45—55	14.5	10.7
55—65	27.8	22.0
65—75	63.4	51.2
75—85	153.8	128.4
85 and over	292.5	292.4

If therefore in one town there was a large young adult population such as in a town where employment attracted such people and in another there were chiefly children and old people it would not be right to compare the total death rates. The death rates at different ages would have to be compared to get a true estimate of the conditions of public health.

To correct this, *the standard death rate* must be obtained. This is a hypothetical death rate which presumes that the death rate at each age is in each town or district the same as that for the whole country. If then the number of people living in each group of age is known, the hypothetical death rate can be assigned to each. The total deaths thus calculated $\times$ 1000 divided by the population = the *standard death rate*. If the town in question has the same proportions of people living of the different ages and sexes as the whole country has, then the stanadard death rate for the town will be the same as that for the whole country. If, however, as usually happens, the age and sex distribution is different, the standard death rate is different. Divide then the death rate of the whole country by the standard death rate of the town and we get a factor. Multiply the recorded death rate by this factor and we get the *corrected death rate*.

Example :—If the population of a town is returned as 10,000 and the recorded death rate = 20 per mille, *i.e.*, a total of 200 and the hypothetical number of deaths = 150, then the standard death rate $= \frac{150 \times 1000}{10,000} = 15.$

If the annual death rate of the whole country = 16.5, then the factor for this town = 1.1

Then the *corrected death rate* = $20 \times 1.1 = 22$.

This shows that the death-rate has been under-estimated.

The *comparative mortality figure* is deduced from the above :

$$\text{it is } \frac{\text{corrected death rate} \times 1{,}000}{\text{death rate for the whole country}}$$

Ex. :—In the town above taken

$$\frac{22 \times 1000}{16.5} = 1{,}333.$$

This means that the death rate of the whole country is to the death rate of the town as 1,000 : 1,333 so that the mortality is much higher than it should be.

Infantile mortality.—It is calculated upon the birth returns, the formula being

$$\frac{\text{deaths of children under 1 year}}{\text{births registered during the year}} \times 1{,}000.$$

Infant mortality gives an indication as to the state of the health of the people, a high infant death rate implying an increased death rate up to 5 years of age. In England it is about one-third higher in urban districts than in rural and about one-fifth of the total deaths of infants occur in the first week of life. There it has dropped from 149 in 1871-1880 to 128 in 1901-10, 110 in 1915 and 77 in 1922. In India the rate in different provinces varies between 200 and 300 and in some places it considerably exceeds the latter figure. The following figures from the Annual Report of the Public Health Commissioner with the Government of India for 1922, giving details by age periods, would be found interesting :

	Under one month	1 to 6 months	6 to 12 months	Total
Ratio per 1,000 births in India	85	50	40	175
" " " " in England and Wales	34	24	19	77

The chief diseases responsible for a high infant mortality are (a) premature birth, congenital defects and tetanus ; (b) atrophy, debility, and marasmus; (c) convulsions; (d) diarrhœal diseases; (e) measles and whooping cough; and (f) bronchitis and pneumonia. Among the conditions contributing to infant mortality are poverty and urban conditions, unhealthiness of mothers, the industrial employment of women in manufacturing towns which has largely come into existence of late in Bombay, Ahmedabad, Cawnpore, etc., maternal ignorance and mismanagement (including inappropriate artificial feeding). Breast feeding is a natural protection against infant mortality. The means of prevention obviously include good health of the mother, skilful aid at birth, maternal care, breast feeding and cleanliness in all respects. Towards these ends efficient midwifery, domestic and municipal sanitation and the education of elder girls and women in child welfare are the available means. In England, by the application of these measures, especially directed towards the care of expectant mothers, and welfare of children, the infantile death rate has been reduced to 77 per 1,000 in 1922, the average for the 5 years ending 1922 being 85.

Of late the apalling mortality among infants has attracted considerable attention in India, and with a view to reduce this high death rate among them several societies, of which the Lady Chelmsford League for Maternity and Child Welfare requires special mention, have been organised in many places and are doing good work. The "Baby Week" recently started bids fair to be an important factor in the reduction of infantile mortality.

The zymotic death rate is the number of deaths from the seven principal zymotic diseases $\times$ 1000 $\div$ population. In England they are small-pox, measles, scarlet fever, diphtheria, whooping cough, fever (*i.e.*, typhus, enteric and simple continued fever), and diarrhœa.

In England the rate was 1.08 in 1913. In India only small-pox and "fever" and diarrhœa are common. Here we require a different classification. Most Indian towns give returns showing the deaths from cholera, plague and small-pox separately, but the errors in diagnosis are so many that apart from these which are easily recognized, other disease returns cannot be taken as quite accurate. Experience teaches that small-pox, plague and cholera are usually correctly diagnosed and also that dysentery is usually recognized but most other diseases, such as tuberculosis, pneumonia, enteritis and any disease causing a febrile condition, are returned as fever, *i.e.*, malarial fever. Probably only 25 per cent. of the deaths imputed to malarial fever are really caused by that disease although the debility induced by malaria may often increase largely the deaths from other diseases.

When, however, the deaths from other epidemics are deducted from the total deaths the remainder is an excellent indication of the *relative* amount of malaria present in any year although the actuals are usually very much less.

Medical Officers of Health should devote serious attention to the question of accurate diagnosis of the causes of deaths and should check by personal investigation a certain proportion of the returns every year.

If general returns are compared with the returns in which the cause of death is certified by a qualified practitioner it is at once apparent that the general returns are in many instances very far from correct.

An application of the formula for estimating the population at any time is made with a view to find in how many years the population of a town, district or country will double itselt.

$$P' = PR^n$$
$$i.e.,\ 2P = PR^n$$
$$\therefore\ R^n = 2$$
$$n \log. R = \log. 2$$
$$n = \frac{\log. 2}{\log. R} = \frac{\log. 2}{\log. (1 + r)}$$

where the value of $R = (1+r)$
and the value of r is known
and n = the number of years,

The *Mean Age at Death* $= \frac{\text{sum of ages at death}}{\text{number of deaths}}$

The *Expectation of Life at Birth* is the same as the mean age at death when the population is stationary.

The *Probable Duration of Life* signifies the age at which any number of children born into the world become reduced to one half so that there are equal chances of their dying before and after that age.

De Moivre's hypothesis assumes that *decrements* of population are in arithmetical progression and that of 86 persons born one would die every year till all are extinct. This is a very rough approximate of the truth and was convenient in calculating annuities before accurate life tables were constructed.

The *Expectation of life*, *i.e.*, mean after-lifetime.—A life table shows how many of a given number, starting with a given age, live through each subsequent year of life and what is the sum of the number of years they live. The expectation of life is obtained by dividing the sum of these years by the number living at the year of age for which the expectation of life is desired.

Occupation and mortality.—In tracing, from mortality data, the influence of occupation upon health, it is necessary to take into account not only the numbers employed, but also their sex and age distribution, and the inevitable selection of the more robust for certain kinds of employment, and the weaker for others.

In the same standard population the mortality from any specified cause can be calculated for each of the age-decennia and for the whole adult age period ; multiply the annual deaths in standard population by $\frac{\text{deaths from the specified cause}}{\text{total deaths}}$: the deaths to be taken into account being, of course, those of the age period under consideration.

In like manner the smaller statistics of persons engaged in different occupations are dealt with, and in order to arrive at comparable result the standard age and sex distribution has to be observed. Thus, as regards a certain occupation it is ascertained from the census returns how many males in that occupation are living at each of the four age-decennia between 25 and 65; and from the death returns what is the annual number of deaths among them at each age-decennium. It is then easy to calculate the annual number of deaths among a standard population.

The resultant is compared with 1,000 for "all males." These are comparable figures; in the same way comparable data as to mortality from phthisis and other special causes can be obtained for each occupation.

Phthisis and respiratory diseases cause a high mortality among debilitated persons, especially those exposed to changing weather conditions, to hot or impure air, and to certain forms of dust. Hence the mortality from these causes in England is high among coster-mongers, cutlers, file makers, potters, printers and highest of all in Cornish tin miners.

Nervous diseases cause excessive mortality in occupations associated with alcohol or lead; the most fatal occupations in this respect are those of inn-keepers, glass-makers, file makers, and lead workers. The incidence of gout and of fatal kidney disease is very similar. Mortality from diseases of the liver is in the main associated with mortality from alcoholism, both being, for example, high among commercial travellers, butchers, brewers, and inn-keepers.

Diseases of the circulatory system are most fatal among coster-mongers, cabmen, brewers, publicans, potters, cutlers, file-makers and workers in glass.

The comparative mortality figures tend to establish a relation between intemperance and diseases of the heart, liver, kidneys, and nervous system, and also phthisis and gout. Lead poisoning, similarly, is seen to be associated with diseases of the kidney, heart, and nervous system, and also with gout (Whitelegge and Newman).

Comparative mortality accoiding to occupation among males 25-65 years of age (Whitelegge and Newman).

England and Wales 1900-1-2.	Alcoholism.	Gout.	Cancer.	Phthisis.	Bronchitis.	Pneumonia.	Liver diseases	Bright's disease.	Plumbism.	All causes.
All Males ...	23	2	68	186	57	90	27	35	1	1000
Agriculturists ...	7	1	50	85	22	49	13	18	...	602
Fishermen ...	12	...	65	100	27	62	16	20	...	967
Cotton manufacture	12	1	72	197	92	109	17	38	...	1114
Wool manufacture...	7	...	64	159	56	83	24	50	...	984
Coal miners ...	5	...	53	89	79	86	17	12	...	885
Coal heavers ...	29	1	57	213	91	157	18	42	...	1221
Tin miners ...	...	...	69	816	206	81	12	50	...	2131
Lead miners ...	6	...	66	324	53	84	19	19	...	1206
Glass manufacture..	7	4	71	283	132	104	23	53	8	1260
Earthenware ...	8	...	74	285	253	105	21	33	10	1493
Plumbers ...	13	8	73	213	57	85	21	74	23	1114
Cutlers ...	13	2	72	533	132	136	22	51	...	1566
File-makers ...	14	...	57	387	114	151	15	134	56	1700
Printers ...	8	3	65	300	47	64	24	42	2	994
Tailors ..	15	3	77	248	61	68	26	42	...	1027
Drapers ...	16	1	56	203	22	59	30	35	...	845
Grocers ...	11	1	54	125	30	43	32	37	...	729
Bakers ...	13	2	74	165	53	79	32	33	...	...
Butchers ...	34	5	74	182	58	96	60	46	...	1148
Brewers ...	47	5	119	248	96	96	73	43	...	1393
Inn-keepers ...	111	11	74	271	57	147	201	87	...	1781
Coster-mongers ...	59	1	93	554	165	177	40	55	...	2007
Dock labourers ...	50	2	76	308	137	187	22	41	...	1481
Chimney sweeps ...	48	4	152	284	100	136	32	23	...	1345

The following table shows the comparative mortality figure, calculated in the same way, for a number of other occupations.

All Males ...	1,000	Shoemakers ...	984
Clergy ...	524	Commercial travellers ...	988
Gardeners ...	563	Medical men ...	952
Teachers ...	665	Shopkeepers generally ...	973
Hosiery manufacturers ...	921	Law clerks ...	970
Lace workers ...	950	Hairdressers ...	1,196
Tanners ...	774	Hatters ...	1,137
Artists ...	823	Musicians ...	1,261
Lawyers ...	750	General labourers ...	2,235
Blacksmiths ...	937		

CHAPTER XVII

SANITARY LAW

The Acts which are in force at present in the United Provinces to regulate the application of sanitary principles in municipalites are :

1. The United Provinces Municipalities Act, Act II of 1916.
2. The Vaccination Act, Act XIII of 1880.
3. The United Provinces Prevention of Adulteration Act, Act VI of 1912, as amended by Act I of 1916.
4. The Epidemic Diseases Act, Act III of 1897.
5. The Indian Factories Act, Act XII of 1911.

In addition, there are certain Government orders which medical officers of health thould be acquainted with, viz.,

1. Government Notification No. 4000 XI-10-H, dated the 4th October, 1916. This deals with the annual administration report and sanitary report of a municipality and is contained in pages 241-251 of the Municipal Manual (edition of 1922).
2. Duties of medical officers of health. These are given on pages 294-295 of the Municipal Manual.
3. Government Notification dealing with conservancy and sanitation. This is contained in Part II, Chapter VIII of the Municipal Manual.
4. Government Notifications dealing with infectious diseases and their prevention. They are contained in Chapters VII and VIII, Part II of the Municipal Manual.
5. Registration and compilation of births and deaths. (Pages 312 and 313 of the Municipal Manual).
6. Municipal Vaccination. (Pages 481-488 of the Municipal Manual).
7. Relation of public officers to boards :
   (i) Director and Assistant Directors of Public Health ;
   (ii) Civil Surgeon ;
   (iii) Chemical Examiner ;
   (iv) Superintending Engineer, Public Health Department.

Part III of the Municipal Manual deals with model rules which board may by resolution apply to their towns. Some of these deal with questions of public health and medical officers of health should be acquainted with them, viz.,

1. Model building byelaws.

2. Model byelaws for the regulation of projections over public streets or drains.

3. Model byelaws for drains, privies and cesspools, etc.

4. Model byelaws for the registration and compilation of births and deaths in municipalities.

5. Model byelaws for the regulation of dairies.

6. Model byelaws for the regulation and inspection of slaughter-houses.

7. Model byelaws regulating the sale of meat.

8. Model byelaws for the regulation of burning and burial grounds.

9. Model byelaws regulating offensive trades.

10. Model byelaws requiring the licensing of dogs.

The Local Government can also make model rules from time to time under certain sections of the Act.

Of the above Acts it will be teen that the Municipalities Act is the most important and a medical officer of health should therefore be conversant with its provisions as a whole and especially with the sections affecting his duties.

The district medical officers of health should be acquainted with

1. sections of the District Boards Act, 1922, relating to public health ;

2. the United Provinces Town Areas Act, Act II of 1914 ;

3. the United Provinces Village Sanitation Act, 1892, as amended by Act V of 1912.

In addition, they should be thoroughly conversant with the rules made by the Local Government under certain sections of the District Boards Act dealing with public health matters and with the subject matter of paras. 2049-2077 of the Manual of Government Orders, U. P., applicable to fairs and para. 2035A which contains rules as to the prevention of cholera in rural areas.

THE MUNICIPALITIES ACT.

We will first deal with the provisions of the Municipalities Act and we will shortly direct attention to the sections which specially affect medical officers of health. In section 2 of the Act dealing with definitions, the terms "drains" and "streets" are defined.

"Drain" includes a sewer, pipe, ditch, channel or any other device for carrying off sullage, sewage and pollute water, or rain-water or subsoild water, together with pail depots, traps, sinks, cisterns, flush-tanks, and other fittings appertaining thereto.

"Street" means any bridge, footway, lane, square, court, alley or road or passage which the public or any portion of the public has a right to pass along and includes on either side the drains or gutters and the land up to the defined boundary of any abutting property, notwithstanding the projection over such land of any verandah or other superstructure.

Section 7 lays down the obligation of a board to make reasonable provision for all matters of public health, as follows :

(*a*) Watering public streets and places ;

(*b*) cleansing public streets, places, and drains, removing noxious vegetation, and abating all public nuisances ;

(*c*) regulating offensive, dangerous or obnoxious trades, callings or practices ;

(*d*) removing, on the ground of public safety, health or convenience, undesirable obstructions and projections in streets or public places ;

(*e*) acquiring, maintaining, changing, and regulating places for the disposal of the dead ;

(*f*) constructing, altering, and maintaining public streets, culverts, markets, slaughter-houses, latrines, privies, urinals, drains, drainage works, and sewerage works ;

(*g*) providing a sufficient supply of pure and wholesome water where the health of the inhabitants is endangered by the insufficiency or unwholesomeness of the existing supply, guarding from pollution water used for human consumption, and preventing polluted water from being so used ;

(*h*) registering births and deaths ;

(*i*) establishing and maintaining a system of public vaccination ;

(*j*) establishing, maintaining or supporting public hospitals and dispensaries, and providing public medical relief ;

(*k*) preparing such returns, statements, and reports as the Local Government requires the board to submit ; and

(*l*) fulfilling any obligation imposed by law upon it.

It should be noted that the above duties are obligatory.

Medical officers of health will find that in most municipalities the powers of the executive officer in dealing with matters detailed in many of the Sub clauses of this section are delegated to them, namely, (b), (c) (e), (f), (h) and (i).

Sections 8 lays down the optional duties, many of which refer to matters of public health. It is a pity that some of these, such as (c), reclaiming unhealthy localities, and (h), making arrangements for the confinement of stray dogs, are not obligatory.

It runs as follows :

(1) A board may make provision, within the limits of the municipality, and with the sanction of the Commissioner outside such limits for—

(*a*) laying out, in areas whether previously built upon or not, new public streets, and acquiring land for that purpose and for the construction of buildings, and their compounds, to abut on such streets ;

(*b*) constructing, establishing or maintaining public parks, gardens, libraries, museums, lunatic asylums, halls, offices, dharamsalas, rest-houses, encamping-grounds, poor houses, dairies, baths, bathing-ghats, washing places, drinking fountains, tanks, wells, dams, and other works of public utility ;

(*c*) reclaiming unhealthy localities ;

(*d*) furthering educational objects by measures other than the establishment and maintenance of primary schools ;

(*e*) taking a census, and granting rewards for information which may tend to secure the correct registration of vital statistics ;

(*f*) making a survey ;

(*g*) giving relief, on the occurrence of local calamities, by the establishment and maintenance of relief works or otherwise ;

(*h*) making arrangements for the confinement or destruction of stray dogs ;

(*i*) securing or assisting to secure suitable places for the carrying on of any trade or manufacture mentioned under sub-head (a) of heading G. of section 298 ;

(*j*) establishing and maintaining a farm or factory for the disposal of sewage ;

(*k*) constructing, subsidizing or guaranteeing tramways, railroads or other means of locomotion, and electric lighting or electric power works ;

(*l*) holding fairs and exhibitions ; and

(*m*) adopting any measure, other than a measure specified in section 7 or in the foregoing provisions of this section, likely to promote the public safety, health and convenience ;

(*n*) (1) the doing of anything whereon expenditure is declared by the Local Government or by the board with the sanction, in the case of cities of the Local Government, and in the case of other municipalities of the Commissioner, to be an appropriate charge on the municipal fund.

(2) A board may make provision for the extension beyond the limits of the municipality of the benefits of any municipal undertaking ;

Provided that no provision shall be made for the extension of the benefits of a municipal undertaking for the supply of water to any local area which comprises or contains the whole or a portion of a cantonment without the previous sanction of the Governor-General in Council.

Section 33 empowers Government officers to inspect municipal works and institutions.

Sections 60-65 define the functions of the executive officer of a municipality.

Section 62 confers on the executive officer, with the sanction of the Chairman, authority to delegate his powers. Many of such powers which are given in detail in Schedule II at the end of the Act, are delegated to the medical officer of health principally.

Sections 68 and 69 govern the appointment and dismissal of medical officers of health, etc., subject to the provisions of section 58 of the Act.

Section 93 gives the Director of Public Health, the Assistant Directors of Public Health and other officers the right to attend and speak at municipal meetings.

Section 112 details the powers of delegation of its functions by a board.

Section 116. Under this section municipal property is enumerated as follows :

Subject to any special reservation made by the Local Government, all property of the nature hereinafter in this section specified and situated within the municipality shall vest in and belong to the board, and shall, with all other property which may become vested in the board, be under its direction, management, and control, that is to say

(*a*) all public town walls, gates, markets, slaughter-houses, manure and night-soil dépôts, and public buildings of every description which have been constructed or are maintained out of the municipal fund ;

(*b*) all public streams, lakes, springs, tanks, wells, and works for the supply, storage, and distribution of water for public purposes, and all bridges, buildings, engines, materials, and things connected therewith or appertaining thereto, and also any adjacent land not being private property appertaining to any public tank or well ;

(*c*) all public sewers, drains, culverts and water-courses, and all works, materials, and things appertaining thereto ;

(*d*) all dust, dirt, dung, ashes, refuse, animal matter or filth or rubbish of any kind, or dead bodies of animals, collected by the board from the streets, houses, privies, sewers, cesspools or elsewhere or deposited in places appointed by the board under section 273 ;

(*e*) all public lamps, lamp-posts, and apparatus connected therewith or appertaining thereto ;

(*f*) all land or other property transferred to the board by His Majesty, or by gift, purchase or otherwise for local public purposes ; and

(*g*) all public streets and the pavements, stones and other materials thereof, and also all trees, erections, materials, implements, and things existing on or appertaining to such streets.

Section 128 permits the board to impose taxes.

Section 128, sub-section (1), clause (X), permits the board to impose a water-tax as prescribed in section 129.

Section 128, sub-section (1), clauses (XI) & (XII), permits the board to impose taxes on scavenging and cleansing privies and latrines in the manner prescribed in section 130.

Section 129 details the restrictions on the imposition of water-tax.

Section 150 lays down that a scavenging tax or a tax for the cleansing of latrines and privies shall be levied upon the occupier of a premises.

Sections 178 to 186 contain the building regulations which are of great importance.

Sections 187-188 contain the regulations for the extinguishing of fire.

Sections 189 to 194 contain the regulations referring to public drains.

Sections 195 to 202 contain the regulations for scavenging and cleansing.

Sections 203 to 223 contain street regulations.

Sections 224 to 235 contain regulations referring to water-supply, Section 236 contain regulations relating to powers for removal of structures interfering with public works.

With reference to sections 196 to 202 we have always advocated the abolition of the customary sweeper, wherever possible, and the taking over of the work of house-scavenging by the board, the cost being covered by a house-scavenging tax. The customary sweeper has certain hereditary rights however which cannot be abolished except with his own consent. He usually, however, has no objection to a fixed adequate monthly wage in place of his previous precarious earnings. House-scavenging under the system of customary sweepers is very imperfectly carried out and action by the board is so tedious and prolonged that very little good results. If the board themselves are responsible, the private owner is usually only too anxious to ventilate his grievances and the ultimate result is very much better.

The majority of these sections are optional and in most cases each individual case has to be brought to the notice of the board by the medical officer of health or sanitary inspectors and the boards pass such resolutions as they think fit.

From the point of view of the better sanitation of Indian towns, we think it is a pity that boards should have any option in this matter whatever.

The whole of chapter VII is given in full, owing to its importance. Medical officers of health should be intimately acquainted with its provisions.

POWERS AND PENALTIES IN RESPECT OF BUILDINGS, PUBLIC DRAINS, STREETS, EXTINCTION OF FIRES, SCAVENGING AND WATER-SUPPLY.

Building Regulations.

178. *Notice of intention to erect building or make well.*—(1) Before beginning, within the limits of the municipality—

(*a*) to erect a new building or new part of a building, or

(*b*) to re-erect, or make a material alteration in, a building, or

(*c*) to make or enlarge a well.

a person shall give notice of his intention to the board.

(2) The notice referred to in sub-section (1) as required in the case of a building shall only be necessary where the building abuts on, or is adjacent to a public street or place, or property vested in His

Majesty or in the board, unless, by a byelaw applicable to the area in which the building is situated , the necessity of giving notice is extended to all buildings.

(3) An alteration in a building shall, for the purposes of this chapter and of any byelaw, be deemed to be material, if—

(*a*) it affects or is likely to affect prejudicially the stability or safety of the building in respect of drainage, ventilation, sanitation, or hygiene, or

(*b*) it increases or diminishes the height of, area covered by or cubical capacity of, the building or reduces the cubical capacity of any room in the building below the minimum prescribed by any byelaw, or

(*c*) it converts into a place for human habitation a building or part of a building originally constructed for other purposes, or

(*d*) it is an alteration declared by a byelaw made in this behalf to be a material alteration.

179. *Plans and specifications required to validate notice.*—(1) Where a byelaw has been made prescribing and requiring any information and plans in addition to a notice, no notice under section 178 shall be considered to be valid until the information, if any, required by such byelaw has been furnished to the satisfaction of the board.

(2) In any other case, the board may, within one week of the receipt of the notice required by section 178, require a person who has given such notice to furnish a plan and specification of any existing or proposed building, or part of a building, or well, together with a site plan of the land, with such reasonable details as the board may prescribe in its requisition ; and, in such case, the notice shall not be considered to be valid until such plans and specification have been furnished to the satisfaction of the board.

180. *Sanction of work by board.*--(1) Subject to the provisions of any byelaw, the board may either refuse to sanction any work of which notice has been given under section 178 or may sanction it absolutely or subject to—

(*a*) any written directions that the board deems fit to issue in respect of all or any of the matters mentioned in sub-head (h) of heading A of section 298, or

(*b*) a written direction requiring the setback of the building or part of a building to the regular line of the street prescribed under section 222, or, in default of any regular line prescribed under that section, to the line of frontage of any neighbouring building or buildings.

(2) In the case of a refusal to sanction under sub-section (1), the board shall communicate in writing the reasons for such refusal to the person giving notice under section 178.

(3) Should the board neglect or omit for one month after the receipt of a valid notice under section 178 to make and deliver to the person who has given such notice an order of the nature specified in sub-section (1) in respect thereof, such person may by a written communication call the attention of the board to the omission or neglect, and, if such omission or neglect continues for a further period of fifteeen days, the board shall be deemed to have sanctioned the proposed work absolutely.

(4) Provided that nothing in sub-section (3) shall be construed to authorize any person to act in contravention of this Act or of any byelaw.

181. *Duration of sanction.*- (1) A sanction given or deemed to have been given by a board under the previous section shall be available for one year or for such lesser period as may be prescribed by byelaw.

(2) After the expiry of the said period the proposed work may not be commenced except in pursuance of a fresh sanction applied for and granted under the foregoing sections.

182. *Inspection of works requiring sanction.*—The Chairman, the executive officer and, if authorized in this behalf by resolution, any other member, officer or servant of the board may at any time and without warning inspect any work in respect of which notice is required under section 178—

(*a*) while under construction, or

(*b*) within one month of the receipt of a report that it has been completed or, in default of such report, at any time after completion.

183. *Compensation for damage sustained through order passed under section 180.*—Notwithstanding anything contained in section 125, a person giving notice under section 178 shall not be entitled to any compensation for damage or loss sustained by reason of an order passed by a board under section 180, unless—

(*a*) the order is passed on some ground other than that the proposed work would contravene a byelaw or be prejudicial to the health or safety of the public or any person, or (*b*) the order contains a direction of the nature specified in clause (*b*) of sub-section (1) of section 180, or

(*c*) the order is an order of refusal to sanction the re-erection of a building on the ground that it is unsuitable in plan or design to the locality, or is intended for a purpose unsuitable to the locality, or contravenes a byelaw under sub-head (*f*) of heading A of section 298.

184. ***Effect of sanction.***—(1) A sanction given or deemed to have been given under section 180 shall not, beyond exempting the person to whom the sanction is given or deemed to have been given from any penalty or consequence to which he would otherwise be liable under section 185, 186 or 222, confer or extinguish any right or disability, or operate as an estoppel or admission, or affect any title to property or have any other legal effect whatsoever.

(2) In particular such sanction shall not operate to relieve any person from the obligation imposed by section 209 to obtain separate sanction for any structure referred to therein.

185. ***Illegal erection or alteration of a building.***—Whoever begins, continues or completes the erection or re-erection of, or any material alteration in, a building or part of a building or the construction or enlargement of a well without giving the notice required by section 178, or in contravention of an order of the board refusing sanction or any written directions made by the board under section 180 or any byelaw, shall be liable upon conviction to a fine which may extend to five hundred rupees.

186. ***Power of board to stop erection, and to demolish building erected.***—The board may at any time by written notice direct the owner or occupier of any land to stop the erection, re-erection, or alteration of a building or the construction or enlargement of a well thereon in any case where the board considers that such erection, re-erection, alteration, construction or enlargement is an offence under section 185 and may, in like manner, direct the alteration or demolition as it deems necessary of the building, part of a building, or the well, as the case may be.

Extinction of fire.

187 ***Establishment and maintenance of fire brigade.***—The board may establish and maintain a fire brigade and may provide any implements, machinery or means of communicating intelligence which it thinks necessary for the prevention and extinction of fire.

188. ***Power of fire brigade and other persons for suppression of fires.***—(1) On the occasion of a fire in a municipality any magistrate, any member of the board, the executive officer, the engineer, or a secretary of the board, or any member of the fire brigade directing its operations and (if required so to do by a magistrate, a member of the board, the executive officer, the engineer or a secretary of the board) any police officer above the rank of constable, may—

(*a*) remove, or order the removal of, any person who by his presence interferes with or impedes the operations for extinguishing the fire or for saving life or property ;

(*b*) close any street or passage in or near which a fire is burning ;

(*c*) for the purpose of extinguishing the fire, break into or through or pull down, or cause to be broken into or through or pulled down or used for the passage of hoses or other appliances, any premises ;

(*d*) cause mains and pipes to be shut off so as to give greater pressure of water in or near the place where the fire has occurred ;

(*e*) call on the person in charge of a fire-engine to render such assistance as may be possible ; and

(*f*) generally take such measures as may appear necessary for the preservation of life or property.

(2) No person shall be liable to pay damages for an act done by him under sub-section (1) in good faith.

(3) Any damage done in the exercise of a power conferred or a duty imposed by this section shall be deemed to be damage by fire within the meaning of a policy of insurance against fire.

Public drains.

189. ***Construction of public drains.***—(1) The board may construct, within or, subject to the provisions of sub-section (2) of section 120, outside the municipality, such drains as it thinks necessary for keeping the municipality properly cleansed and drained and may carry such drains through, across, or under any street or place, and, after reasonable notice in writing to the owner or occupier, into, through, or under any building or land.

(2) Provided that no drain shall be constructed within the limits of a cantonment without the approval of the Local Government and

otherwise than with the concurrence of the General Officer Commanding the division in which such cantonment is situated or, in the event of such concurrence being withheld, the previous sanction of the Governor-General in Council.

190. *Alteration of public drains.*—(1) The board may, from time to time, enlarge, lessen, alter the course of, cover in or otherwise improve a public drain and may discontinue, close up, or remove any such drain.

(2) The exercise of the power conferred by sub-section (1) shall be subject to the condition that the board shall provide another and equally effective drain in place of any existing drain of the use of which any person is deprived by the exercise of the said power.

191. *Use of public drains by private owners.*—(1) The owner or occupier of a building or land within the municipality shall be entitled to cause his drains to empty into the drains of the board, provided that he first obtains the written permission of the board, and that he complies with such conditions consistent with any byelaw as the board prescribes as to the mode in which and the superintendence under which the communications are to be made between drains not vested in the board and drains which are so vested.

(2) Whoever, without the written permission of the board or in contravention of any byelaw or of any direction or condition made or imposed under sub-section (1), makes or causes to be made, or alters or causes to be altered, a connection of a drain belonging to himself or to some other person with a drain vested in the board, shall be liable upon conviction to a fine which may extend to fifty rupees, and the board may by written notice require such person to close, demolish, alter, re-make or otherwise deal with such connection as it deems fit.

192. *Power of board to enforce drainage connection with public drain.*—(1) When a building or land situated within one hundred feet of a public drain is at any time not drained to the satisfaction of the board by any or a sufficient drainage connection with such drain, the board may, by notice, require the owner or occupier of such building or land to make and maintain a drainage connection with the drain in such manner as the board, subject to the provisions of any byelaw, directs.

(2) The provisions of sections 306 to 312 (inclusive) shall apply to default in compliance with any such requisition notwithstanding that part of the land through which the said drainage connection is

required to pass may not belong to the person so making default, unless he shall prove that the default was caused by the act of the owner or occupier of such last mentioned land, and he has made application to the board under section 193.

193. *Power of private person to carry a drain through the land of another person.*—(1) Any person desiring that an existing or proposed drain on his land shall be carried through, or under the building or land, or connected with the drain, of another person owning a building or land abutting on, or a drain connected with, a municipal drain may apply to the board.

(2) The board on receiving an application under sub-section (1) may call upon the other person to show cause, within a specified period, why the applicant's drain should not be carried through or under his building or land or connected with his drain.

(3) The board shall hear any objection made by such person if submitted within the specified period and, thereafter, if it considers that the drain or drainage connection should be made, shall record an order to this effect.

(4) The order shall set out in writing—

(*a*) the period within which the parties shall come to an agreement as to the construction of the drain or drainage connection ;

(*b*) the period within which the drain or drainage connection shall be made ;

(*c*) the respective responsibilities of the parties concerned for the maintenance, repair, and cleansing of the drain or drainage connection when made ; and

(*d*) the sum (if any) payable, whether in the form of rent or otherwise, by the person making the application to the owner of the land, building or drain, as the case may be.

(5) If the sum awarded under clause (*d*) of sub-section (4) takes the form of a lump payment, the board may recover it in the manner provided by chapter VI and pay any sum recovered to the person to whom it is due. If a rent has been awarded, the person to whom it is due may recover it by suit in any civil court having jurisdiction.

(6) If the parties concerned fail to agree within the period specified in the order, or if the drain or drainage connection is not constructed within the period specified for its construction, the board may itself construct it and may recover the cost from the applicant in the manner provided by chapter VI.

194. *Right of owner to divert drain on his land.*—The owner of any land into, through, or under which a drain has been carried under the provisions of the preceding section may, at any time, with the written permission of the board and subject to such conditions as the board may impose, divert the drain at his own expense.

Scavenging and cleansing.

195. *Definition of house-scavenging.*—House-scavenging means the removal of filth, rubbish, ordure, or other offensive matter from the dustbin, privy, cesspool or other receptacle for such matter in or pertaining to a house or a building.

196. *Adoption and relinquishment by board of house-scavenging etc.*.—Subject to the provisions hereinafter contained with respect to the rights of customary sweepers and of agriculturists, the board may—

(*a*) by public notice, undertake the house-scavenging of any houses or buildings or the cleansing of any latrines or privies in the municipality from a date not less than two months after issue of the notice ;

(*b*) after giving by public notice or otherwise not less than two months' notice to the parties concerned, relinquish an undertaking under clause (*a*) ;

(*c*) on the application or with the consent of the occupier, at any time undertake the house-scavenging of a house or building or the removal of night-soil from any latrine or cesspool in any building or on any land or the removal of other offensive matter or rubbish from a building or land, on terms to be fixed by byelaw in this behalf ; and

(*d*) after giving not less than two months' notice to the occupier, relinquish an undertaking under clause (*c*)

197. *Objections to adoption.*—(1) The occupier of a house or building affected by a notice issued under clause (*a*) of section 196 may, at any time after the issue thereof, apply to the board to exclude that house or building from the notice.

(2) The board shall consider and pass orders upon such application within six weeks of the receipt thereof, and may by such order exclude such house or building from the notice.

(3) In deciding whether to exclude a house or building from the notice, the board shall consider, among other matters, the efficiency of the arrangements for house-scavenging made by the occupier.

198. *Continuance of house-scavenging once adopted by board.*—When the board has undertaken the house-scavenging of a house or building under section 196, it may continue to perform such house-scavenging, with or without the consent of the occupier for the time being of such house or building.

199. *Powers of municipal servants for house-scavenging.*—The servants of the board employed in house-scavenging may, at all reasonable times, do all things necessary for the proper performance of any house-scavenging undertaken by the board.

200. *Savings in favour of customary sweepers and of agriculturists.*—Notwithstanding anything in section 196 the board shall not, except in accordance with the provisions of sections 201 and 202,

(*a*) undertake the house-scavenging of a house or building in respect whereof a sweeper has a customary right to do such house-scavenging without the consent of the sweeper, or

(*b*) undertake the house-scavenging of a house or building occupied by an agriculturist who himself cultivates land within municipal limits or in a village conterminous therewith without the consent of the occupier.

201. *Punishment of customary sweepers for negligence.*—(1) Should a sweeper who has a customary right to do the house-scavenging of a house or building (hereinafter called the customary sweeper) fail to perform such house-scavenging in a proper way, the occupier of the house or building or the board may complain to a magistrate.

(2) The magistrate receiving such complaint shall hold an inquiry, and, should it appear to him that the customary sweeper has failed to perform the house-scavenging of the house or building in a proper way or at reasonable intervals, he may impose upon such sweeper a fine which may extend to ten rupees, and upon a second or any later conviction in regard to the same house or building, may also direct the right of the customary sweeper to do the house-scavenging of the house or building to be forfeited, and thereupon such right shall be forfeited.

202. *Procedure in case of default by agriculturists.*—(1) Should an agriculturist who himself cultivates land within municipal limits, or in a village conterminous therewith, fail to provide for the proper house-scavenging of a house or building occupied by him, the board may complain to a magistrate.

(2) The magistrate receiving the complaint shall hold an inquiry, and, should it appear to him that the agriculturist has not provided for

the proper house-scavenging of the house or building, he may pass an order empowering the board to undertake the same and thereupon the board shall be entitled to undertake such house-scavenging.

Street regulations.

203. *Notice of intention to lay out or make a street.*—(1) Before beginning to lay out or make a street, a person shall give notice in writing of his intention to the board.

(2) Where a byelaw has been made prescribing and requiring information and plans in addition to a notice, no notice under sub-section (1) shall be considered to be valid until the information (if any) required by such byelaw has been furnished to the satisfaction of the board.

204. *Postponement of work and demand for particulars.*—(1) Before passing an order on a notice submitted under section 203, the board may issue

(*a*) an order directing that for a period therein specified, which shall not be longer than one month from the date of such order, the intended work shall not be proceeded with, or

(*b*) an order requiring further particulars.

(2) No notice under section 203 shall be deemed valid until the further particulars (if any) required by an order under clause (*b*) of sub-section (1) have been furnished to the satisfaction of the board.

205. *Sanction of street by board.*—(1) The board may sanction the proposed street either absolutely or subject to such written directions as to level, means of drainage, direction and width as the board may deem fit to issue.

(2) Should the board neglect or omit for two months after the receipt of a valid notice under section 203 or, if an order has been issued under clause (*a*) of sub-section (1) of section 204, fail, within the period specified in such order, to make and deliver to the person who has given the notice an order of the nature specified in sub-section (1) in respect thereof, such person may by a written communication call the attention of the board to the omission, neglect, or failure, and, if such omission, neglect, or failure continues for a further period of one month, the board shall be deemed to have sanctioned the proposed street absolutely.

(3) Provided that nothing in sub-section (2) shall be construed to authorize any person to act in contravention of the provisions of this Act or of any byelaw.

206. ***Duration of sanction.***—(1) A sanction given or deemed to have been given by a board under section 205 shall be available for one year.

(2) After the expiry of the said period the proposed street may not be commenced except in pursuance of a further sanction applied for and granted under the foregoing sections.

207. ***Illegal making of a street.***—Whoever begins, continues, or completes the laying out or making of a street without giving the notice required by section 203 or in contravention of any written directions made by the board under section 205 or any byelaw or any provision of this Act shall be liable upon conviction to a fine which may extend to five hundred rupees.

208. ***Power of board to alter unsanctioned street and demolish buildings thereon.***—In any case where a board considers that any land is being or has been laid out as a street without the notice required by section 203, or in contravention of any written direction made by the board under section 205 or of any byelaw or provision of this Act, the board may, by a written notice, require the owner of the land to alter the street in such manner as it deems necessary and the owner or occupier of any building which is being or has been built on or along the street to alter or demolish such building.

209. ***Sanction of board to projections over streets and drains.***—(1) Subject to any rules made by the Local Government prescribing the conditions for the sanction by a board of projections over streets or drains, a board may give written permission, where provision is made by a byelaw for the giving of such permission—

(*a*) to the owners or occupiers of buildings in or on streets to erect or re-erect open verandahs, balconies, or rooms, to project over the street from any upper storey thereof, at such height from the surface of the street, and to such an extent beyond the line of the plinth or basement wall as are prescribed in such byelaws, and

(*b*) to the owner or occupier of any building or land to erect or re-erect any projection or structure so as to overhang, project into, or encroach on or over a drain in a street to such an extent, and in accordance with such conditions, as are in like manner prescribed.

(2) In giving permission, under clause (*a*) of sub-section (1), a board may prescribe the extent to which, and the conditions under which,

any roofs, caves, weather-boards, shop boards and the like may be allowed to project over such streets.

210. *Penalty for construction of projections over streets or drains without permission.*—Any person erecting or re-erecting any such projection, or structure as is referred to in section 209 without the permission thereby required or in contravention of any permission given thereunder shall be liable on conviction to a fine which may extend to two hundred and fifty rupees.

211. *Power to remove encroachments and projections over streets and drains.* - The board may, by notice, require the owner or occupier of a building to remove, or to alter a projection or structure overhanging, projecting into or encroaching on a street, or into, on or over any drain, sewer or aqueduct therein.

Provided that in the case of any such projection or structure lawfully in existence on or before the tenth day of March, 1900, the board shall make compensation for any damage caused by the removal or alteration, which shall not exceed ten times the cost of erection and demolition.

212. *Power to require levelling, paving, etc., of a street.*—(1) When the board considers that in a street not being a public street, or in a part of such street, within the municipality it is necessary for the public health, convenience or safety that any work should be done for the levelling, paving, metalling, flagging, channelling, draining, lighting or cleaning thereof the board may by written notice require the owners of the land or buildings fronting, adjoining or abutting upon such street or part thereof, to carry out such work in a manner and within a time to be specified in such notice.

(2) If such notice is not complied with during the time specified, the board may, if it thinks fit, execute the work, and may recover, in the manner provided by chapter VI, the expenses incurred in doing so from the owners in default according to the frontage of their respective ands or buildings and in such proportion as may be decided by the board.

(3) The owner or owners of a street or a part of a street wherein any such work as is mentioned in sub-section (1) has been carried out may require the board to declare the street a public street in accordance with the procedure prescribed by section 221.

Explanation.—A requisition by the owners of the greater portion of a street or a part of a street shall, for the purposes of this sub-section, be deemed to be a requisition of all such owners.

213. ***Power to require the protection of streets during erection of buildings, etc.***—(1) No person shall cut down any tree or cut off a branch of any tree, or erect or re-erect or demolish any building or part of a building or alter or repair the outside of any building, where such action is of a nature to cause obstruction, danger or annoyance, or risk of obstruction, danger or annoyance, to any person using a street, without the previous permission in writing of the board.

(2) The board may at any time by notice require that any person doing or proposing to do any of the acts referred to in sub-section (1), shall refrain from beginning or continuing the acts unless he puts up, maintains, and provides from sunset to sunrise with sufficient lighting such hoardings or screens as are specified or described in the notice, and may further at any time by notice require the removal, within a time to be specified in the notice, of any screen or hoarding erected in anticipation or in pursuance of any of the said acts.

(3) Whoever contravenes the provisions of sub-section (1) shall be liable on conviction to a fine which may extend to fifty rupees and to a further fine which may extend to five rupees for every day on which contravention continues after the date of the first conviction.

214. ***Power to require trimming of hedges and trees.***—The board may, by notice, require the owner or occupier of any land to cut or trim the hedges growing thereon and bordering on a street, or any branches of trees growing thereon which overhang a street and obstruct the same or cause danger.

215. ***Power to remove accidental obstructions.***—When a private house, wall or other erection or anything fixed thereto or a tree shall fall down and obstruct a public drain or encumber a street, the board may remove such obstruction or encumbrance at the expense of the owner of the same and may recover such expense in the manner provided by chapter VI, or may, by notice, require the owner to remove the same within a time to be specified in the notice.

216. ***Regulation of troughs and rain-water pipes affecting a street.***—The board may, by notice, require the owner or occupier of any building or land abutting on a street to put up and keep in good condition proper troughs and pipes for receiving and carrying off the water from the building or land, and for discharging the same in such manner as the board may think fit, so as not to inconvenience persons passing along the street.

217. *Naming of streets and numbering of buildings.*—(1) The board may—

(*a*) cause a name or a new name to be given to a street, and

(*b*) cause the name or the new name to be affixed to or marked on any building in such position as it thinks fit, or

(*c*) require by a written notice the owner or occupier of any building to affix thereto a number plate or a new number plate of a pattern approved by the board or itself cause a number or a new number to be affixed to or marked on any building.

(2) Any person destroying, pulling down, defacing or altering any name or number or number plate affixed to or marked on a building under sub-section (1) or affixing to or marking on a building a different name or number, from that affixed or marked by or under the order of the board shall be liable on conviction to a fine which may extend to twenty-five rupees.

218. *Power to attach brackets to buildings, etc.*—(1) The board may erect upon any premises, or attach to the outside of any building, or to any tree—

(*a*) posts, brackets or other supports for oil, gas, electric or other lamps.

(*b*) posts, brackets or other supports for telegraph wires, telephone-wires or wires conducting electricity for locomotive purposes, or

(*c*) shafts or pipes deemed necessary for the proper ventilation of drains and water-works.

(2) Provided that the erection or attachment of such supports, shafts and pipes shall not be effected in a manner to occasion injury or inconvenience and shall be subject, so far as may be, to any provisions of the Indian Telegraph Act, 1885, applying to the attachment, removal, or alteration of a telegraph line or posts.

Public Streets.

219. *Power to construct, improve, and provide sites on public streets.* A board may—

(*a*) lay out and make a new public street and construct tunnels and other works subsidiary to the same, and

(*b*) widen, lengthen, extend, enlarge or otherwise improve any existing public street if vested in the board, and (*c*) turn, divert, discontinue or close any public street so vested, and

(*d*) provide within its discretion building sites of such dimensions as it thinks fit to abut on or adjoin any public street made, widened, lengthened, extended, enlarged or improved by the board under clauses (*a*), (*b*) and (*c*) or by the Local Government, and

(*e*) subject to the provisions of any rule prescribing the conditions on which property may be acquired by the board, acquire any land, along with the buildings thereon, which it considers necessary for the purpose of any scheme or work undertaken or projected in exercise of the power conferred by the preceding clauses, and

(*f*) subject to the provisions of any rule prescribing the conditions on which property vested in the board may be transferred, lease, sell or otherwise dispose of any property acquired by the board under clause (*e*) or any land used by the board for a public street and no longer required therefor, and in doing so impose any condition as to the removal of any building existing thereon, as to the description of any new building to be erected thereon, as to the period within which such new building shall be completed, and as to any other matter that it deems fit.

220. *Use of public streets by vendors and other persons.* – Notwithstanding any right or privilege previously acquired, accrued or enjoyed, in a municipality for which byelaws under sub-head *b*) of heading **E** of section 298 have been made and are in force, no itinerant vendor, or any other person, shall be entitled to use or occupy any public street or place for the sale of articles or for the exercise of any calling or for the setting up of any booth or stall without the permission of the board given in accordance with such byelaws.

221. *Adoption of a street as a public street.*—(1) A board may, at any time, and shall when required by requisition under sub-section (3) of section 212, by public notice posted up in a street that is not a public street, or in a part of such street, give intimation of its intention to declare the same a public street, and, unless within two months next after such notice has been so posted up the owner or owners of such street or such part of a street, or of the greater portion thereof, lodges or lodge objections at the municipal office, the board may, by further public notice posted up in such street, or such part, declare the same to be a public street.

(2) Any public notice required under sub-section (1) shall in addition to being posted up in the street be published in a local paper (if any) or in such other manner as the board thinks fit.

222. *Power to regulate line of buildings on public streets.*—(1) Whenever the board considers it expedient to define the general line of buildings on each or either side of any existing or proposed public street it shall give public notice of its intention to do so.

(2) Every such notice shall specify a period within which objections will be received.

(3) The board shall consider all objections received within the specified period and may then pass a resolution defining the said line and the line so defined shall be called "the regular line of the street."

(4) Thereafter, it shall not be lawful for any person to erect, re-erect or alter a building or part of a building so as to project beyond the regular line of the street unless he is authorised to do so by sanction granted under section 180 or by a permission in writing (and the board is hereby empowered to grant such permission) under this section.

(5) Any owner of land who is prevented by the provisions of this section from erecting, re-erecting, or altering any building on any land may require the board to make compensation for any damage which he may sustain by reason of such prevention, and upon the payment of compensation in respect of any land situated within the regular line of the street such land shall vest in the board.

(6) The board may, by notice, require the alteration or demolition of any building or part of a building erected, re-erected or altered in contravention of sub-section (4).

223. *Duties of board when constructing public streets etc.*—(1) The board shall, during the construction or repair of a public street or of any water-works, drains or premises vested in it, or whenever any public street, water-works, drain or premises vested in it have, for want of repairs or otherwise, become unsafe for use by the public, take all necessary precautions against accident by—

(*a*) shoring up and protecting adjacent buildings, and

(*b*) fixing bars, chains or posts across or in any street for the purpose of preventing or diverting traffic during such construction or repair, and (*c*) guarding and providing with sufficient lighting from sunset to sunrise any work in progress.

(2) Whoever, without the authority or consent of the board, in any way interferes with any arrangement or construction made by the board under sub-section (1) for guarding against accident shall be liable on conviction to a fine which may extend to fifty rupees.

Water-supply.

224. *Power of board to construct and alter water-works*.—The board may—

(*a*) construct water-works within or, subject to the provision of sub-section (2) of section 120, outside the municipality, and may carry such works through, across, over, or under any street or place, and, after reasonable notice in writing to the owner or occupier, into, through, over, or under any buildings or land, and

(*b*) from time to time enlarge, lessen, alter the course of, cover in or otherwise improve any water-works and discontinue, close up, or remove the same.

225. *Power to require private watercourse, etc., to be cleansed or closed.*—(1) The board may, by notice, require the owner of, or the person having control over, a private water-course, spring, tank, well or other place, the water of which is used for drinking, to keep and maintain the same in good repair and to clean the same, from time to time, of silt, refuse or decaying vegetation, and may also require him to protect the same from pollution in such manner as the board may think fit.

(2) When the water of any such water-course, spring, tank, well or other place is proved to the satisfaction of the board to be unfit for drinking, the board may, by notice, require the owner or person having control thereof to desist from so using such water or permitting others to so use it, and if, after such notice, such water is used by any person for drinking, the board may, by notice, require the owner or person having control thereof to close such well, either temporarily or permanently, or to enclose or fence such water-course, spring, tank, well or other place in such manner as it may direct, so that the water thereof may not be so used.

226. *Emergent powers on outbreak of epidemic*.—In the event of a municipality, or any part thereof, being visited with an outbreak of cholera or other infectious disease notified in this behalf by the Local

Government, the Chairman of the board, or any person authorised by him in this behalf, may, during the continuance of the epidemic, without notice and at any time, inspect and disinfect any well, tank or other place from which water is, or is likely to be, taken for the purpose of drinking, and may, further, take such steps as he deems fit to prevent the removal of water therefrom.

227. *Removal of latrines, etc., near any source of water-supply.*—The board may, by notice, require an owner or occupier on whose land a drain, privy, latrine, urinal, cesspool, or other receptacle for filth or refuse exists within fifty feet of a spring, well, tank, reservoir or other source from which water is, or may be, derived for public use, to remove or close the same within one week from the service of such notice.

228. *Obligations of board imposing water tax.*—(1) The board of every municipality in which a water tax is imposed shall be bound—

(*a*) throughout a prescribed area or prescribed areas—

(i) to maintain a system of water-supply through pipes, and

(ii) to lay on water at a prescribed pressure and during prescribed hours, and

(iii) to supply, in all the chief streets in which mains have been laid, water to stand-pipes or pumps situated at such intervals as are prescribed, and

(*b*) to allow the owner or occupier of any building or land assessed to a prescribed minimum water tax to connect, for the purpose of obtaining water for domestic purposes, the building or land with a main by means of a communication pipe of the prescribed size and description, and

(*c*) to supply, within every twenty-four hours, to every owner or occupier entitled to a house connection under clause (*b*) whose land or building is provided therewith, such amount of water as is prescribed with reference to the water tax payable by him and his estimated requirements for domestic purposes into a storage cistern erected in or on the building or land, of a capacity not less than such amount and of a prescribed pattern and at an altitude not exceeding the maximum prescribed for the same.

(2) The word "prescribed" in sub-section (1) means prescribed by rule under section 235.

229. *Supply of water by agreement.*—Every board may by agreement supply any owner or occupier of land with any water that he may require for any purpose for such remuneration, consistent with any rate or rates prescribed by rule, and on such terms and conditions consistent with this Act and with any rule, as are agreed on between the board and such owner or occupier.

230. *Charges for water-supply.*—(1) When any building or land is connected with a main, the board may, so far as is consistent with any agreement made under section 229, charge the owner, lessor, or occupier, whichever is prescribed by rule, for all water consumed at the rate or rates so prescribed.

(2) Provided that the board shall deduct from the charge on account of water supplied in any month one-twelfth of the water tax assessed on the building or land.

231. *Exemption of board from liability owing to accident, etc.*—Notwithstanding any obligation imposed on a board by section 228 or by any agreement made under section 229, a board shall not be liable to any forfeiture, penalty or damages for failure to supply water, if the failure to supply arises from accident or from unusual drought or other unavoidable cause.

232. *Subordination to supply for domestic purposes of supply for other purposes.*—Notwithstanding any obligation to supply water imposed by an agreement under section 229, the board may, at any time, cease to supply water for other than domestic purposes, if it is of the opinion that such supply would interfere with the supply of water for domestic purposes, and in such case the board shall not be liable to any forfeiture, penalty or damages for so ceasing—

(*a*) unless the failure to supply such water arises from a cause other than one specified in section 231, and

(*b*) unless the board has undertaken to supply water for other than domestic purposes by an agreement made under section 229 making express provision for foreiture, penalty or damages upon failure to supply such water.

233. *Subordination of rights of supply to restrictive rules.*—Notwithstanding anything contained in section 228, or in any agreement under section 229, the supply of water to any building or land shall be, and shall be deemed to have been granted, subject to the provisions of any rule made under section 235, and in particular to any provision

as to the limit or stoppage of the supply, and as to the prevention of waste and misuse.

234. *Provision as to meters and connection pipes.*—All meters, connection pipes and other works incidental to the supply of water to any building or land shall, except as otherwise provided by rule, be supplied, repaired, extended and altered as may be necessary, at the expense of the person requiring the supply, but shall be under the control of the board.

235. *Water supply rules.*—(1) The following matters relating to the supply of water from municipal or public water-works shall be regulated and governed by rules, namely :—

(*a*) any matter in respect of which this Act declares that provision shall be made by rule ;

(*b*) the size and nature of the mains and pipes to be laid and the water-works to be constructed by a board for the supply of water ;

(*c*) the construction, control and maintenance of municipal water-works and of pipes and fittings in connection therewith ;

(*d*) the size and nature of the stand-pipes or pumps to be erected by a board ;

(*e*) the mains or pipes in which fire plugs are to be fixed and the places at which keys of the fire plugs are to be deposited ;

(*f*) the periodical analysis by a qualified analyst of the water supplied by a board ;

(*g*) the conservation and prevention of injury or contamination to sources and means of water-supply and appliances for the distribution of water, whether within or without the limits of the municipality ;

(*h*) the manner in which connection with water-works may be constructed or maintained and the agency which shall or may be employed for such construction or maintenance :

(*i*) the regulation of all matters and things connected with the supply and use of water and the turning on and turning off and preventing the waste of water ;

(*j*) the collection of water tax and of charges relating to the supply of water and the prevention of evasion of the same ; and (*k*) any other matter relating to the supply of water in respect of which this Act makes no provision or insufficient provision and furthur provision is, in the opinion of the Local Government, necessary.

(2) Provided that no rule shall be made under sub-section (1) affecting a cantonment or part of a cantonment without the previous sanction of the Governor General in Council.

POWER FOR REMOVAL OF STRUCTURES INTERFERING WITH PUBLIC WORKS.

236. *Unauthorized construction or tree over drain or water-work.* —(1) Where, on or after the 10th day of March, 1900, any street has been made or any building, wall or other structure has been erected or any tree has been planted without the permission in writing of the board over a public drain or culvert or a water-work vested in the board, the board may—

(*a*) by notice require the person who has made the street, erected the structure or planted the tree, or the owner or occupier of the land on which the street has been made, structure erected or tree planted to remove or deal in any other way the board thinks fit with the street, structure or tree ; or

(*b*) itself remove or deal in any other way it thinks fit with the street, structure or tree.

(2) Any expense incurred by a board by action taken under clause (b) of section (1) shall be recoverable in the manner prescribed by chapter VI from the person by whom the street was made, structure erected or tree planted.

CHAPTER VIII

Containing Sections 237 to 295 deals with Markets, Slaughter-houses, Sale of Food, Public Safety, Sanitation and Prevention of Desease, etc.

Sections 237 to 244 contain regulations as to markets, slaughter-houses, sale of food, etc.

Section 245 contains regulations as to nuisances from certain trades.

Sections 249 to 266 contain regulations as to public safety.

Sections 267 to 286 contain regulations as to sanitation and prevention of disease.

Sections 287 to 290 contain regulations as to inspection, entry, search, etc.

Sections 291 to 294 contain regulations as to rent and charges.

Section 295 contains regulations as to the obstruction of persons employed by the board.

Again, the majority of these sections are optional and medical officers of health find great difficulty occasionally in getting the boards to take action in accordance with the provisions of the Act.

Even when action is taken, in actual practice, months often elapse before the nuisance complained of is got rid of.

Sections 267 to 286 are most important and their provisions should be carefully studied by all medical officers of health.

The whole of the chapter is given below.

Other Powers and Penalties.

Markets, slaughter-houses, sale of food, etc.

237. *Places for slaughter of animals for sale.*—(1) The board may, with the approval of the District Magistrate, fix premises, either within or without the limits of the municipality, for the slaughter of animals, or animals of any specified description, for sale and may, with the like approval, grant and withdraw licences for the use of such premises.

(2) When such premises have been fixed by the board beyond municipal limits, it shall have the same power to make byelaws for the inspection and proper regulation of the same as if they were within those limits.

(3) When such premises have been fixed, no person shall slaughter any such animal for sale at any other place within the municipality.

(4) Should any one slaughter for sale any such animal at any other place within the municipality, he shall be liable on conviction to a fine which may extend to twenty rupees for every animal so slaughtered.

238. *Places for slaughter of animals not intended for sale or slaughtered for religious purpose.*—The board may, by public notice, and with the previous sanction of the District Magistrate, fix premises within the municipality in which the slaughter of animals of any particular kind not for sale shall be permitted, and prohibit, except in case of necessity, such slaughter elsewhere within the municipality :

Provided that the provisions of this section shall not apply to animals slaughtered for any religious purpose.

239. *Powers of District Magistrate in respect of animals not slaughtered for sale* – Whenever it appears to the District Magistrate to be necessary for the preservation of the public peace or order, he may, subject to the control of the Commissioner, prohibit or regulate, by public notice, the slaughter within the limits of a municipality of animals or animals of any specified description, for purposes other than sale, and prescribe the mode and route in and by which such animals shall be brought to, and meat shall be conveyed from, the place of slaughter.

240. *Disposal of flesh imported in contravention of a byelaw regulating importation.*—Should the flesh of any cattle, sheep, goat or swine be brought within municipal limits in contravention of a byelaw made under sub-head (*e*) of heading F of the section 298, it may be seized by an officer of the board authorized in that behalf, and may be destroyed or otherwise disposed of as the board may by general or special order direct.

241. *Licensing of markets and shops for sale of certain articles.*—(1) The right of any person to use any place, within the limits of a municipality, other than a municipal market, as a market or shop for the sale of animals, meat or fish intended for human food, or as a market for the sale of fruit or vegetables shall be subject to byelaws (if any) made under heading F of section 298.

(2) Provided that, where any byelaw is in force requiring a licence for the establishment or maintenance of a market or shop for the sale of any article mentioned in sub-section (1), the board shall not—

(*a*) refuse a licence for the maintenance of a market or shop lawfully established at the date of such byelaw coming into force, if application be made within six months from such date, except on the ground that the place where the market or shop is established fails to comply with any conditions prescribed by, or under, this Act, or

(*b*) cancel, suspend or refuse to renew any licence granted under such byelaw for any cause, other than the failure of the licensee to comply with the conditions of the licence or with any provision of, or made under, this Act.

242. *Improper feeding of animals kept for dairy purposes or used for food.*—Whoever feeds, or allows to be fed, an animal which is kept for dairy purposes, or may be used for food, on filthy or deleterious substances, shall be liable on conviction to a fine which may extend to fifty rupees.

243. *Inspection of places for sale of food, drink and drugs.*—The chairman, the executive officer and, if authorized in this behalf by resolution, any other member, officer or servant of the board may, without notice, at any period of the day or night, enter into and inspect a market, shop, stall or place used for the sale of food or drink for man, or, as a slaughter-house, or for the sale of drugs, and inspect and examine any article of food or drink, or any animal or drug which may be therein.

244. *Seizure of unwholesome articles and removal of deleterious and spent drugs.*—(1) If, in the course of the inspection of a place under the preceding section, an article of food or drink or an animal appears to be intended for the consumption of man and to be unfit therefor, the board may seize and remove the same, or may cause it to be destroyed, or to be so disposed of as to prevent its being exposed for sale or used for such consumption.

(2) If it is reasonably suspected that a drug has been improperly adulterated, or by reason of age or the effect of climate has become inert or unwholesome, or has otherwise become deteriorated in such a manner as to lessen its efficacy, or to change its operation, or to render it noxious, the board may remove the same, giving a receipt therefor, and may produce it before a magistrate.

(3) If it appear to a magistrate before whom a drug has been produced under sub-section (2) that the drug has been improperly adulterated or has become inert, unwholesome or deteriorated as aforesaid, he may order the same to be destroyed, or to be so disposed of as to him may seem fit, and if any offence appears to have been committed he may proceed to take cognizance thereof.

Nuisance from certain trades and professions.

245. *Regulation of offensive trades.*—(1) If it is shown to the satisfaction of a board that any building or place within the limits of the municipality which any person uses or intends to use as a factory or other place of business for the manufacture, storage, treatment or disposal of any article, by reason of such use, or by reason of such intended use, occasions or is likely to occasion a public nuisance, the board may at its option require by notice the owner or occupier of the building or place—

(*a*) to desist or refrain, as the case may be, from using, or allowing to be used, the building or place for such purpose, or

(*b*) only to use, or allow to be used, the building or place for such purpose under such conditions or after such structural alterations as the board imposes or prescribes in the notice with the object of rendering the use of the building or place for such purpose free from objection.

(2) Whoever, after receiving a notice given under sub-section (1), uses or allows to be used any building or place in contravention of the notice shall be liable on conviction to a fine which may extend to two hundred rupees and to a further fine which may extend to forty rupees for every day on which he so uses or allows to be used the place or building after the date of the first conviction.

(3) The Local Government may by notification make the provisions of this section, or of any byelaw made under heading G of section 298, applicable to any area beyond the municipality lying within a distance of a mile from the municipal boundary.

246. *Loitering and soliciting for immoral purpose.*—Whoever in a street or public place within the limits of the municipality, loiters for the purpose of prostitution, or importunes a person to the commission of sexual immorality, shall be liable on conviction to a fine which may extend to fifty rupees.

Provided that no Court shall take cognizance of an offence under this section except on the complaint of the person importuned, or on the complaint of a municipal officer or a police officer not below the rank of a sub-inspector respectively authorized in this behalf in writing by the board and the District Magistrate.

247. *Brothels, etc.*—(1) When a magistrate of the first class receives information—

(*a*) that a house in the vicinity of a place of worship or an educational institution or a boarding-house, hostel or mess used or occupied by students is used as a brothel or for the purpose of habitual prostitution or by disorderly persons of any description, or

(*b*) that any house is used as aforesaid to the annoyance of respectable inhabitants in the vicinity, or

(*c* that a house in the immediate neighbourhood of a cantonment is used as a brothel or for the purpose of habitual prostitution,

he may summon the owner, tenant, manager or occupier of the house to appear before him either in person or by agent; and if satisfied that the house is used as described in clause (*a*), clause (*b*) or clause (*c*) may by a written order direct such owner, tenant, manager or occupier, within a period to be stated in such order, not less than five days from the date thereof, to discontinue such use;

Provided that action under this sub-section shall be taken only –

(i) with the sanction or by the order of the District Magistrate, or

(ii) on the complaint of three or more persons residing in immediate vicinity of the house to which the complaint refers, or

(iii) in the cases referred to in the clauses (*a*) and (*c*) of this sub-section, on the complaint of the board.

(2) If a person against whom an order has been passed by a magistrate under sub-section (1) fails to comply with such order within the period stated therein, the magistrate may impose on him a fine which may extend to twenty-five rupees for every day after the expiration of the period during which the house is so used.

248. *Begging, etc.*—Whoever, in a street or public place within the municipality, begs importunately for alms, or exposes or exhibits, with the object of exciting charity, a deformity or disease or an offensive sore or wound, shall be liable on conviction to a fine which may extend to twenty rupees.

Public safety.

249. *Disposal of mad dogs, etc.*—The board may authorize any person to destroy or to cause to be destroyed, or to confine or to cause to be confined, for such period as the board may direct, any dog or other animal suffering, or reasonably suspected to be suffering, from rabies or, bitten by a dog or other animal suffering or suspected as aforesaid.

NOTE.—This section merely reproduces the provisions of section 123

(1) (i) of the Act of 1900, which empowered a board to destroy dogs suffer ing or reasonably suspected to be suffering from rabies, with an additional provision giving power to destroy animals other than dogs suffering from rabies. As regards ownerless dogs the other clauses of section 123 empowered a board to destroy such dogs only within a period to be fixed by public notice. These provisions proving inconvenient it is now provided that a board may under section 298H (*h*) provide by byelaw for the destruction of such dogs. The said section also debarred a board from destroying dogs wearing "collars or other marks distinguishing them as private property." As these vague phrases prevented effective action being taken, section 298H (*c*) to (*l*) now empowers boards to make byelaws requiring the registration of dogs, requiring that registered dogs shall wear a token to be issued by the board and providing that any dog not wearing such token may be destroyed, etc. No action for the destruction or confinement of *ownerless* dogs may however be taken *until byelaws are made for the purpose.*

250. *Muzzling order.*—(1) Where in any municipality the preva lence of rabies in the opinion of the board renders it necessary, the board may by public notice require the muzzling, for such period as it thinks fit or until such notice is cancelled, of all dogs within the municipality, or within any part of the municipality.

(2) During such period or time the board may exercise the power conferred by section 249 in respect of any dog which is found at large without a muzzle after a date to be specified in the notice.

251. *Bar to compensation for dogs lawfully destroyed.*—No damages shall be payable in respect of a dog or other animal destroyed or otherwise disposed of under the provisions of section 249 or 250 or of any byelaw made under sub-head (*h*) or (*l*) of heading H of section 298.

252. *Neglect of the rule of the road.*—Whoever, in driving, leading or propelling a vehicle along a street, fails, except in the case of actual necessity,—

(*a*) to keep to the left, and

(*b*) when he is passing a vehicle going in the same direction, to the right of that vehicle, shall be liable on conviction to a fine which may extend to ten rupees.

Exception.—This section shall not apply in the case of a municipality wholly or in part situated in a hilly tract.

253. *Driving vehicles without proper lights.*—Whoever drives, leads or propels a vehicle between nightfall and dawn in a street, unless the

vehicle is properly supplied with lights, shall be liable on conviction to a fine which may extend to twenty rupees.

Provided that a board may, by a special resolution confirmed by the Commissioner, direct that this section shall not apply in the case of vehicles proceeding at not more than a walking pace.

254. *Failure to remove elephant, etc., to safe distance.*—Whoever being in charge of an elephant, camel, or bear, omits, on being requested to do so, to remove so far as may be practicable his elephant, camel, or bear to a safe distance on the approach of a horse, whether ridden, driven or led, shall be liable on conviction to a fine which may extend to twenty rupees.

255. *Prohibition of tethering of cattle etc., on street.* -(1) The owner or keeper of any cattle or other animals found tethered or straying about without a keeper, in a street or public place shall be liable on conviction to a fine which may extend to twenty rupees.

(2) An animal found tethered as aforesaid may be removed by a municipal officer or servant or by a police officer to a pound as if the animal had been found straying.

256. *Halting vehicles or animals on public ground.*—Where any land vested in the board is, without the permission in writing of the board, used as a halting place for any vehicle or animal or as a place of encampment, the owner or the keeper of the vehicle or animal or the person encamping as the case may be, shall be liable on conviction to a fine which may extend to twenty rupees, and in the case of a continuing breach to a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the commission of the offence.

257. *Power as to inflammable structures.*—(1) The board may, by public notice, direct that, within certain limits to be fixed by it, the roofs and external walls of huts or other buildings shall not be made or renewed with grass, mats, leaves, or other highly inflammable materials without the consent of the board in writing.

(2) The board may, at any time by written notice, require the owner of a building which has an external roof or wall made of any such material as aforesaid to remove such roof or wall within such reasonable time as shall be specified in the notice notwithstanding that a public notice under sub-section (1) has not been issued or that such roof or wall was made with the consent of the board or before the issue of such public notice, it any :

Provided that in the case of any such roof or wall in existence before the issue of such public notice or made with the consent of the board, the board shall make compensation for any damage caused by the removal which shall not exceed the original cost of constructing the roof or wall.

(3) Whoever, without such consent as is required by sub-section (1), makes or renews, or causes to be made or renewed, or in disobedience to a notice given under sub-section (2) suffers to remain, a roof or wall of such material as aforesaid, shall be liable on conviction to a fine which may extend to twenty-five rupees and to a further fine which may extend to ten rupees for every day on which the offence is continued, after the date of the first conviction.

258. *Power to search for inflammable material in excess of authorized quantity.*—(1) The board may, without notice and at any period of the day or night, enter into and inspect a house or building which is suspected to contain petroleum, or other inflammable material, in excess of the quantity permitted to be kept in such house or building under the provisions of section 245 or of any byelaw.

(2) Should any such excess quantity of such material be discovered it may be seized and held subject to such order as a magistrate may pass with respect to it.

(3) If the magistrate decide that the material seized was stored in the house or building contrary to any direction made under section 245 or to the provisions of any byelaw, he may pass an order confiscating the same.

(4) Subject to any provision of or made under this or any other enactment, the material so confiscated may be sold by order of the magistrate, and the proceeds, after defraying the expenses of such sale, shall be credited to the municipal fund.

(5) No order of confiscation under this section shall operate to prevent any other criminal or civil proceedings to which the person storing the material in excessive quantity may be liable.

259. *Stacking, etc., of inflammable materials.*—The board may, where it appears to be necessary for the prevention of danger to life or property, by public notice prohibit all persons from stacking or collecting wood, dry grass, straw or other inflammable materials, or from placing mats or thatched huts or lighting fires in a place or within limits specified in the notice.

260. *Dangerous quarrying.*—(1) If, in the opinion of the board, the working of a quarry, or the removal of stone, earth or other material

from the soil in any place is dangerous to persons residing in, or entitled to visit, the neighbourhood thereof, or creates, or is likely to create, a public nuisance, the board may, by written notice, prohibit the owner of the said quarry or place, or the person responsible for such working or removal, from continuing or permitting the working of such quarry or the removing of such material, or may require him to take such order with such quarry or place as the board shall direct for the purpose of preventing danger or abating the nuisance arising or likely to arise therefrom.

(2) If, in any case referred to in sub-section (1), it appears to the board to be necessary in order to prevent imminent danger, it may cause a proper hoarding or fence to be put up for the protection of passengers near a quarry or place, and any expense incurred by the board in taking such action shall be paid by the owner or other person as aforesaid, and shall be recoverable in the manner provided by chapter VI.

261. *Displacing pavements etc.*—(1) Whoever displaces, takes up, or makes an alteration in, or otherwise interferes with, the pavement, gutter, flags, or other materials of a public street, or the fences, walls or posts thereof, or a municipal lamp, lamp-post, bracket, direction-post, stand-post, hydrant, or other such municipal property therein, without the written consent of the board, or other lawful authority, and whoever extinguishes a municipal light shall be liable on conviction to a fine which may extend to one hundred rupees.

(2) Any expense incurred by the board by reason of the doing of any such thing as is mentioned in sub-section (1) may be recovered from the offender in the manner provided by chapter VI.

262. *Discharging fire-arms, etc.*—Whoever discharges fire-arms or lets off fire-works or fire balloons, or engages in a game, in such a manner as to cause, or to be likely to cause, danger to persons passing by or dwelling or working in the neighbourhood, or risk of injury to property, shall be liable on conviction to a fine which may extend to twenty rupees.

263. *Powers for the prevention of danger from ruinous buildings, unprotected wells, etc.*—(1) A board may require by notice the owner or occupier of any land or building—

(*a*) to demolish or to repair in such manner as it deems necessary any building, wall, bank or other structure, or anything affixed thereto or to remove any tree, belonging to such owner or in the possession of such occupier, which appears to the board to be in a ruinous condition or dangerous to persons or property, or

(*b*) to repair, protect or enclose, in such manner as it deems necessary, any well, tank, reservoir, pool or excavation belonging to such owner or in the possession of such occupier, which appears to the board to be dangerous by reason of its situation, want of repair or other such circumstance.

(2) Where it appears to the board that immediate action is necessary for the purpose of preventing imminent danger to any person or property, it shall be the duty of the board itself to take such immediate action; and in such case, notwithstanding the provisions of section 287, it shall not be necessary for the board to give notice, if it appears to the board that the object of taking such immediate action would be defeated by the delay incurred in giving notice.

264. ***Power to prevent unoccupied buildings or lands becoming a nuisance.***—The board may, by notice, require the owner of a building or land which, by reason of abandonment or disputed ownership or other cause, is unoccupied and has become a resort of idle and disorderly persons or otherwise occasions, or is likely to occasion, a public nuisance to secure and enclose the same within a reasonable time fixed in the notice.

265. ***Obstruction of street.***—(1) Whoever without the written permission of the board—

(*a*) causes or allows any vehicle, with or without an animal harnessed thereto, to remain or stand so as to cause obstruction in any street longer than may be necessary for loading or unloading or for taking up or setting down passengers; or

(*b*) leaves or fastens any vehicle or animal so as to cause obstruction in any street; or

(*c*) exposes any article for sale, whether upon a stall or booth or in any other manner, so as to cause obstruction in any street; or

(*d*) deposits, or suffers to be deposited, any building materials, box, bale, package or merchandise in any street; or

(*e*) erects or sets up any fence, rail, post, stall or any scaffolding or any other such fixture in any street; or

(*f*) in any other manner wilfully obstructs or causes obstruction to the free passage of any street, shall be liable upon conviction to a fine which may extend to fifty rupees.

(2) The board shall have power to remove any obstruction referred to in sub-section (1), and the expense of such removal shall be recoverable from the offender in the manner provided by chapter VI.

(3) The power exerciseable by a board under sub-section (2) to remove obstruction from streets shall also be exerciseable for the removal by the board of obstructions from any open space, whether vested in the board or not, which is not private property.

(4) nothing contained in this section shall apply to any obstruction of a street permitted by the board under any section of this Act or any rule or byelaw made or licence granted thereunder.

266. *Digging up of public land.*—Whoever, without the written permission of the board, digs up or removes earth, sand or other material from any open space, whether vested in the board or not, which is not private property, shall be liable upon conviction to a fine not exceeding fifty rupees, and, if the offence is a continuing offence, to a further fine not exceeding ten rupees for every day during which the offence continues after the date of the first conviction for such offence.

Sanitation and Prevention of Disease.

267. *Private drains, cesspools, dustbins, latrines, etc.*—(1) A board may require by notice the owner or occupier of any land or building—

(*a*) to close, remove, alter, repair, cleanse, disinfect or put in good order any latrine, urinal, water-closet, drain, cess-pool, dustbin or any other receptacle for filth, sullage-water, rubbish or refuse pertaining to such land or building, or to remove or alter any door or trap door of any such latrine, urinal or water-closet which opens on to a street or drain ; or

(*b*) to provide such latrines, urinals, water-closets, drains, cess-pools, dustbins or other receptacles for filth, sullage-water, rubbish or refuse as should in its opinion be provided for the building or land whether in addition or not to any existing ones ; or

(*c*) to cause any latrine, urinal or water-closet provided for the building or land to be shut off by a sufficient roof and wall or fence from the view of persons passing by or dwelling in the neighbourhood.

(2) When requiring under sub-section (1) anything to be provided altered or done, the board may specify in the notice the description of the

thing to be provided, the pattern so as to conform with which the thing is to be altered, and the manner in which the thing is to be done.

268. *Latrines for factories, schools and places of public resort.*—The board may require by notice any person employing more than twenty work-men or labourers or owning managing or having control of a market, school or theatre or other place of public resort to provide such latrines and urinals as it may deem fit, and to cause the same to be kept in proper order and to be daily cleansed.

Provided that nothing in this section shall apply to a factory regulated by the Indian Factories Act, 1911.

269. *Power to require removal of nuisance arising from tanks, etc.*—(1) The board may, by notice, require the owner or occupier of any land or building to cleanse, repair, cover, fill up or drain off a private well, tank, reservoir, pool, depression or excavation therein which may appear to the board to be injurious to health or offensive to the neighbourhood.

(2) Provided that the owner or occupier may require the board to acquire at its expense, or otherwise provide any land or rights in land necessary for the purpose of effecting drainage ordered under sub-section (1).

270. *Inspection of drains, privies, etc.*—(1) Subject to the provisions of section 287, the board may inspect a drain, privy, water-closet, latrine, urinal, cess-pool or other receptacle for filth, and for that purpose may cause the ground to be opened where it thinks fit.

(2) The expense of such inspection and of causing the ground to be closed and made good as before shall be borne by the board, unless the drain, privy, water-closet, latrine, urinal, cess-pool or other receptacle for filth is found to be in bad order or condition, or was constructed in contravention of any provisions of, or made under, this or any other enactment, in which case such expenses shall be paid by the owner or occupier and shall be recoverable in the manner provided by chapter VI.

271. *Cleansing filthy buildings or land.*—Should any building or land be in a filthy or unwholesome state, the board may, by notice, require the owner or occupier thereof to cleanse, or otherwise put in a proper state, the building or land, and thereafter to keep the same in a clean and proper state.

272. *Failure to remove offensive matter.*—Whenever on any building or land—

(*a*) any dirt, dung, bones, ashes, night-soil or filth, or any noxious or offensive matter is kept for more than twenty-four hours, or otherwise than in some proper receptacle, or

(*b*) any receptacle for such things is suffered to be in a filthy or noxious state or is not subjected to any proper method of cleansing or purifying, the owner or occupier of the building or land shall be liable, on conviction, to a fine which may extend to fifty rupees and, in the case of a continuing breach, to a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender has been proved to have persisted in the commission of the offence.

273. *Regulation of the disposal of rubbish, night-soil, etc.*—(1) The board may—

(*a*) provide receptacles and places for the temporary deposit of offensive matter and rubbish ;

(*b*) appoint places for the disposal of night-soil, carcasses, and other offensive matters and rubbish ; and

(*c*) by public notice issue directions as to the time, manner and conditions at, in and subject to which any offensive matters or rubbish referred to in clauses (*a*) and (*b*) may be removed along a street, deposited or otherwise disposed of.

(2) It shall be sufficient notice of the appointment of a place under clause (*b*) of sub-section (1) that a notice board indicating such appointment is displayed on or near the place appointed.

(3) Before appointing a place outside the municipal limits under clause (*b*) of sub-section (1) the board shall obtain the previous sanction of the District Magistrate.

274. *Penalty for improper disposal of rubbish, night-soil, etc.*—The occupier of any building or land from which any offensive matter, rubbish, night-soil or carcass is thrown or deposited on any part of a public place or street, or into any public sewer or drain, or into any drain communicating with a public sewer or drain, otherwise than in a place appointed under clause (*b*) or in a receptacle provided under clause (*a*) of sub-section (1) of section 273, and any person contravening any direction of a board issued under clause (*c*) of the said sub-section shall be liable upon conviction to a fine not exceeding twenty rupees.

275. *Disposal of dead bodies of animals.*—(1) Whenever an animal in the charge of a person dies, otherwise than by being slaughtered

either for sale or consumption or for some religious purpose, the person in charge thereof shall, within twenty-four hours, either—

(*a*) convey the carcass to a place (if any) fixed by the board under section 273 for the disposal of the dead bodies of animals, or to a place beyond municipal limits not being within one mile of those limits, or

(*b*) give notice of the death to the board, whereupon the board shall cause the carcass to be disposed of.

(2) Every person bound to act in accordance with sub-section (1) shall, if he fail so to act, be liable upon conviction to a fine which may extend to ten rupees.

(3) For the disposal of the dead body of an animal under clause (*b*) of sub-section (1) the board may charge such fee as the board has prescribed, and may recover the same, if not paid in advance, from the owner or keeper of the animal in the manner provided by chapter VI.

276. ***Penalty for discharging sewage on public street, etc.***—Whenever the water of a sink, sewer or cesspool, or any other offensive matter is allowed to flow, drain or be put upon a public street or place, or into a sewer or drain not set apart for the purpose, without the permission in writing of the board or in contravention of any condition prescribed in such permission, the owner or occupier of the land or building from which such water or offensive matter so flows, drains or is put shall be liable upon conviction to a fine which may extend to twenty rupees.

277. ***Power to enter and disinfect buildings.***—Subject to the provisions of section 287, the board may enter and inspect a building, and may by notice direct all or any part thereof to be internally or externally limewashed, disinfected, or otherwise cleansed for sanitary reasons :

Provided that nothing in this section shall apply to a factory regulated by the Indian Factories Act, 1911.

278. ***Buildings unfit for human habitation.***—(1) Should a building, or a room in a building, be in the opinion of the board unfit for human habitation in consequence of the want of proper means of drainage or ventilation or otherwise, the board may, by notice, prohibit the owner or occupier thereof from using the building or room for human habitation or suffering it to be so used either absolutely or unless, within a time to be specified in the notice, he effects such alteration therein as is prescribed in the notice.

(2) Upon failure of a person to whom notice is issued under subsection (1) to comply therewith, it shall be lawful for the board to require by further notice the demolition of the building or room.

279. *Penalty for failure to give information of cholera, small pox, etc.*—Whoever,—

(*a*) being a medical practitioner and in the course of such practice becoming cognizant of the existence of cholera, plague, small-pox or any other infectious disease that may be notified in this behalf by the Local Government in any dwelling other than a public hospital in the municipality, or,

(*b*) in default of such medical practitioner, being the owner or occupier of such dwelling, and being cognizant of the existence of any such infectious disease therein, or,

(*c*) in default of such owner or occupier, being the person in charge of, or in attendance on a person suffering from any such infectious disease in such dwelling, and being cognizant of the existence of the disease therein,

fails to give, or gives false information to such officer as the board may appoint in this behalf respecting the existence of such disease, shall be liable upon conviction to a fine which may extend to fifty rupees :

Provided that a person not required to give information in the first instance, but only in default of some other person, shall not be punishable if it is shown that he had reasonable cause to suppose that the information had been, or would be, duly given.

280. *Removal to hospital of patients.*—When a person suffering, or certified by a duly qualified medical practitioner to be suffering, from cholera, plague, small-pox or any other infectious disease that may be notified in this behalf by the Local Government is—

(*a*) without proper lodging or accommodation, or

(*b*) living in a *sarai* or other public hostel,

(*c*) living in a room or house which he neither owns nor is otherwise entitled to occupy, or

(*d*) lodged in a room or set of apartments occupied by more than one family, and any of the occupiers objects to his continuing to lodge therein,

the board may, on the advice of a medical officer of rank not inferior to that of an assistant surgeon, remove the patient to a hospital or place at which persons suffering from such disease are received for medical treatment, and may do anything necessary for such removal.

281. *Penalty for acts done by persons suffering from disorders.*—Whoever, while suffering from an infectious, contagious, or loathsome disorder—

(*a*) makes or offers for sale an article of food or drink for human consumption or a medicine or drug, or

(*b*) wilfully touches any such article, medicine or drug, when exposed for sale by others, or

(*c*) takes any part in the business of washing or carrying soiled clothes,

shall be liable upon conviction to a fine which may extend to twenty rupees.

282. *Prohibition of cultivation, use of manure, or irrigation injurious to health.*—(1) If the Director of Public Health or the Civil Surgeon or Medical Officer of Health certifies that the cultivation of any description of crop or the use of any kind of manure or the irrigation of land in any specified manner—

(*a*) in a place within the limits of a municipality is injurious or facilitates practices which are injurious to the health of of persons dwelling in the neighbourhood, or

(*b*) in a place within or beyond the limits of a municipality is likely to contaminate the water-supply of such municipality or otherwise render it unfit for drinking purposes,

the board may by public notice prohibit the cultivation of such crop, the use of such manure or the use of the method of irrigation so reported to be injurious, or impose such conditions with respect thereto as may prevent the injury or contamination.

(2) Provided that when, on any land in respect of which such notice is issued, the act prohibited has been practised in the ordinary course of husbandry for the five successive years next preceding the date of prohibition, compensation shall be paid from the municipal fund to all persons interested therein for damage caused to them by such prohibition.

283. *Power to require owner to clear away noxious vegetation.*—The board may, by notice, require the owner or occupier of any land to clear away and remove any vegetation or undergrowth which may be injurious to health or offensive to the neighbourhood.

284. *Power to require excavations to be filled up or drained.*—(1) In a municipality for which byelaws have been made under sub-head (*g*) of heading I of section 298, the board may, by notice, require the owner or occupier of any land upon which an excavation, cess-pool, tank or pit has been made in contravention of such byelaws, or in breach of the conditions under which permission to dig any such excavation, cess-pool,

tank or pit has been granted, to fill up or drain the excavation, cess-pool, tank or pit within a period to be specified in such notice.

(2) The Local Government may by notification extend the provisions of this section and of byelaws made for the purpose of this section to an area beyond the municipality lying within a distance of a mile from the municipal boundary.

285. *Power in respect of burial and burning grounds.*—(1) The board may, by public notice, order a burial or burning-ground which is certified by the Civil Surgeon or health officer to be dangerous, or likely to be dangerous, to the health of persons living in the neighbourhood to be closed from a date to be specified in the notice, and shall, in such case, if no suitable place for burial or burning exists within a reasonable distance, provide a fitting place for the purpose.

(2) Private burial places in such burial-grounds may be excepted from the notice, subject to such conditions as the board may impose in this behalf:

Provided that the limits of such burial places are sufficiently defined, and that they shall only be used for the burial of members of the family of the owners thereof.

(3) No burial or burning-ground whether public or private, shall be made or formed without the permission in writing of the board.

(4) No person shall, except with the permission of the board in writing, bury or burn, or cause to be buried or burnt, a corpse in a place other than a recognized burial or burning-ground.

(5) Should a person bury or burn, or cause or permit to be buried or burnt, a corpse, contrary to the provisions of this section, he shall be liable upon conviction to a fine which may extend to fifty rupees.

286. *Bathing and washing places.*—The board may set apart suitable places for the purpose of bathing, and may specify the times at which and the sex of the persons by whom, such places may be used, and may also set apart suitable places for washing animals or clothes, or other things; and may, by public notice, prohibit bathing or the washing of animals or clothes or other things in a public place not so set apart, or at times or by persons other than those specified, and may in like manner prohibit any other act by which water in public places may be rendered foul or unfit for use or which causes or is likely to cause inconvenience or annoyance to persons lawfully using such places.

Inspection, Entry, Search, etc.

287. *Ordinary inspection.*—(1) The chairman, the executive officer and if authorized in this behalf by resolution, any other member, officer or servant of the board, may enter into or upon a building or land, with or without assistants or workmen, in order to make an inspection for survey or to execute a work which a board is authorized by this Act, or by rules or byelaws, to make or execute, or which it is necessary for a board, for any of the purposes or in pursuance of any of the provisions of this Act or of rules or byelaws, to make or execute.

(2) Provided that

(*a*) except when it is in this Act or in rules or byelaws otherwise expressly provided, no such entry shall be made between sunset and sunrise ; and

(*b*) except when it is in this Act or in rules or byelaws otherwise expressly provided, no building which is used as a human dwelling shall be so entered, except with the consent of the occupier thereof, without giving the said occupier not less than four hours' previous written notice of the intention to make such entry ; and

(*c*) sufficient notice shall in every instance be given even when any premises may otherwise be entered without notice, to enable the inmates of an apartment appropriated for females to remove to some part of the premises where their privacy need not be disturbed ; and

(*d*) due regard shall always be had to the social and religious usages of the occupants of the premises entered.

288. *Preventive inspection.*—Where there is reason to believe that, in any building or on any land, a work has been executed in connection with any municipal water-works, drainage-works or other municipal undertaking in contravention of the provisions of this Act or of rules or byelaws, the chairman or, if so directed by the chairman, the executive officer may at any time and without notice inspect such building or land.

289. *Powers for effecting entry.*—It shall be lawful for a person authorized under the provisions of section 287 or 288 to make an entry for the purpose of inspection or of search, to open or cause to be opened a door, gate, or other barrier—

(*a*) if he considers the opening thereof necessary for the perpose of such entry, inspection or search, and

(*b*) if the owner or occupier is absent, or, being present refuses to open such door, gate or barrier.

290. *Powers of board to require certain works to be executed by its own agency.*—(1) The board may by byelaw require any water-works, or work of the nature to which sections 192, 267, and 268 refer, to be executed by municipal or other agency under its own orders.

(2) The expenses of any work so executed shall be paid by the person by whom the work would otherwise have been executed, unless the board shall, by a general or special order or resolution, sanction, as it is hereby empowered to sanction, the execution of such work at the charge of the municipal fund.

(3) Any pipes, fittings, receptacles or other appliances for or connected with any water-works, or with the drainage of private buildings or lands shall, if supplied, constructed or erected at the expense of the board, be deemed to be municipal property, unless the board shall have transferred its interest therein to the owner of such buildings or lands.

Rent and charges.

291. *Recovery of rent on land.*—(1) Where any sum is due on account of rent from a person to a board in respect of land vested in, or entrusted to the management of, the board, the board may apply to the Collector to recover any arrear of such rent as if it were an arrear of land revenue.

(2) The Collector on being satisfied that the sum is due shall proceed to recover it as an arrear of land revenue.

292. *Recovery of rent of other immoveable property.*—Any arrears due on account of rent from a person to the board in respect of immoveable property, other than land vested in, or entrusted to the management of, the board, shall be recovered in the manner prescribed by chapter VI.

293. *Fees for use otherwise than under a lease, of municipal property.*—(1) The board may charge fees to be fixed by byelaws or by public auction or by agreement, for the use or occupation (otherwise than under a lease) of any immoveable property vested in, or entrusted to the management of, the board, including any public street or place of which it allows the use or occupation whether by allowing a projection thereon or otherwise.

(2) Such fees may either be levied along with the fee charged under section 294 for the sanction, licence or permission or may be recovered in the manner provided by chapter VI.

294. *Licence fees, etc.*—The board may charge a fee to be fixed by byelaw for any licence, sanction or permission which it is entitled or required to grant by or under this Act.

Obstruction to persons employed by board.

295. *Penalty for obstructing persons employed by board.*—Whoever obstructs or molests a person employed by, or under contract with, the board under this Act in the performance of his duty or in the fulfilment of his contract, or removes a mark set up for the purpose of indicating any levels or direction necessary to the execution of works authorized by this Act, shall be liable on conviction to a fine which may extend to fifty rupees.

CHAPTER IX.

Section 298. sub-section (1), authorises boards to make byelaws by resolution and the Local Government may also require them to make and enforce byelaws applicable to the whole or any part of the municipality consistent with the Act for the purpose of promoting or maintaining the health, etc., of the inhabitants of the municipality.

Sub-section (2) gives the lists of byelaws which boards are entitled to make in the plains and in the hills.

These lists are I any municipality, and II hill municipalities.

LIST I.

BYELAWS FOR ANY MUNICIPALITY.

A—Buildings.

(*a*) extending, with reference to sub-section 2 of section 178, the necessity of giving notice to all buildings ;

(*b*) declaring with reference to clause (*d*) of sub-section 3 of section 178, an alteration of any specific description to be a "material alteration ;"

(*c*) determining the information and plans to be furnished to the board under section 179 ;

(*d*) prescribing that, on payment of fees in accordance with such scale as is specified in this behalf, plans and specifications shall be obtainable from the board or from an agency prescribed by the board ;

(*e*) fixing, with reference to section 181, the period for which a sanction shall remain in force ;

(*f*) prescribing the type or description of buildings which may or may not, and the purposes for which a building may or may not, be erected in any prescribed area or areas ;

(*g*) prescribing the circumstances in which a mosque, temple, church or other sacred building may or may not be erected, re-erected or altered ;

(*h*) prescribing, with reference to the erection, re-erection or alteration of buildings, or of any class of buildings, all or any of the following matters :—

(i) the materials and method of construction to be used for external and party walls, roofs and floors ;

(ii) the position and the materials and method of construction of fireplaces, chimneys, drains, latrines, privies, urinals and cesspools ;

(iii) the height and slope of the roof above the uppermost floor upon which human beings are to live or cooking operations are to be carried on ;

(iv) the ventilation and the space to be left about the building to secure free circulation of air and to facilitate scavenging and for prevention of fire ;

(v) the level and width of foundation, level of lowest floor, and stability of structure ;

(vi) the number and height of the storeys of which the building may consist ;

(vii) the means to be provided for egress from the building in case of fire ;

(viii) any other matter affecting the ventilation or sanitation of the building ; and

(ix) the conditions subject to which sanction for the construction or alteration of a well may be refused or granted, with a view to prevent pollution of the water or danger to any person using the well ;

(x) regulating in any manner not specifically provided for in this Act, the erection of any enclosure, wall, fence, tent, awning or other structure, of whatsoever kind or nature on any land within the limits of the municipality ;

B. Drains, Privies, Cesspools, etc.

(*a*) regulating, in any manner not specifically provided for in this Act, the construction, alteration, maintenance, preservation, cleansing and repairs of drains, ventilation shafts and pipes, waterclosets, privies, latrines, urinals, cesspools and other drainage works ;

(*b*) regulating or prohibiting the discharge into drains, or deposit therein, of sewage, sullage, polluted water and other offensive or obstructive matter ;

(*c*) prescribing the size and nature of the works which owners or occupiers may be required to construct under sections 192, 267 and 268, and the agency which shall or may be employed for executing such works ;

C.—Extinction of Fire.

(*a*) prescribing the officer to whom and the place at which the outbreak of a fire shall be reported ; and

(*b*) generally making provision for the procedure and precautions to be adopted by the public on the occasion of a fire and for any other thing relating to fires in respect of which provision is necessary ;

D.—Scavenging.

(*a*) prescribing the times and places at which receptacles of filth, rubbish or other offensive matter shall be in readiness for the removal of the contents by the municipal scavenging agency ; and

(*b*) making provision for any other matter relating to house-scavenging ;

E.—Streets.

(*a*) determining the information and plans to be furnished to the board under section 203 ;

(*b*) permitting, prohibiting or regulating the use or occupation of any or all public streets or places by itinerant vendors, or by any person for the sale of articles, or for the exercise of any calling, or for the setting up of any booth or stall, and providing for the levy of fees for such use or occupation ;

(*c*) regulating the conditions on which permission may be given under section 209 for projections over streets and drains and under section 265 for the temporary occupation of streets ;

F.—Markets, Slaughter-houses, Sale of food, etc.

(*a*) prohibiting, subject to the provisions of section 241, the use of any place as a slaughter-house, or as a market or shop for the sale of animals intended for human food or of meat or of fish, or as a market for the sale of fruit or vegetables, in default of a licence granted by the board or otherwise than in accordance with the conditions of a licence so granted ;

(*b*) prescribing the conditions subject to which, and the circumstances in which and the areas or localities in respect of which, licences for such use may be granted, refused, suspended or withdrawn ; and

(*c*) providing for the inspection of, and regulation of the conduct of business in, a place used as aforesaid, so as to secure cleanliness therein or to minimize any injurious, offensive or dangerous effect arising or likely to arise therefrom ;

(*d*) providing for the establishment, and [except so far as provision may be made by byelaws under sub-head (*c*)] for the regulation and inspection of markets and slaughter-houses, of livery stables, of encamping grounds, of sarais, of flour-mills, of bakeries, places for the manufacture, preparation or sale of specified articles of food or drink, or for keeping or exhibiting animals for sale or hire or animals of which the produce is sold, and of places of public entertainment or resort, and for the proper and cleanly conduct of business therein ;

(*e*) in a municipality where a reasonable number of slaughter-houses has been provided or licensed by the board, controlling and regulating the admission within municipal limits, for purposes of sale, of the flesh (other than cured or preserved meat) of any cattle, sheep, goats or swine slaughtered at a slaughter-house or place not maintained or licensed under this Act ;

G.—Offensive Trades.

(*a*) except where and so far as is inconsistent with anything contained in the Indian Petroleum Act, 1899, or in rules made thereunder prohibiting the use of any place, in default of a licence granted by the board or otherwise than in accordance with the conditions of a licence so granted, as a factory or other place of business—

(*i*) for boiling or storing offal, blood, bones, guts, or rags,

(*ii*) for storing hides, horns or skins,

(*iii*) for tanning,
(*iv*) for the manufacture of leather or leather goods,
(*v*) for dyeing,
(*vi*) for melting tallow or sulphur,
(*vii*) for burning or baking bricks, tiles, pottery or lime,
(*viii*) for soap-making,
(*ix*) for oil-boiling,
(*x*) for storing hay, straw, thatching-grass, wood, coal or other dangerously inflammable material,
(*xi*) for storing petroleum or any inflammable oil or spirit,
(*xii*) for storing and pressing cotton and cotton refuse.
(*xiii*) for any other purpose if such use is likely to cause a public nuisance or involve risk of fire ;

(*b*) prescribing (but not so as to derogate from any power conferred on a board by section (245) the circumstances in which and the areas or localities in respect of which licences may be granted, refused, suspended or withdrawn ; and

(*c*) providing for the inspection and regulation of the conduct of business in a place used as aforesaid, so as to secure cleanliness therein or to minimize any injurious, offensive or dangerous effect arising or likely to arise therefrom ;

H.—Public Safety and Convenience.

(*a*) prescribing the standard weights and measures to be used within the municipality, and providing for the inspection of the same ;

(*b*) providing for the regulation or prohibition of any description of traffic in the streets, where such regulation or prohibition appears to the board to be necessary ;

(*c*) imposing the obligation of taking out licences on the proprietors or drivers of vehicles, boats or animals kept or plying for hire, or on persons hiring themselves out for the purpose of carrying loads, within the limits of the municipality, and fixing the fees payable for such licences and the conditions on which they are to be granted and may be revoked ;

(*d*) limiting the rates which may be demanded for the hire of a carriage, cart, boat or other conveyance, or of animals hired to carry loads, or for the services of persons hired to carry loads, and the loads to be carried by such conveyances, animals or persons when hired within the municiality for a period not exceeding twenty-four hours or for a service which would ordinarily be performed within twenty-four hours ;

(*e*) prohibiting, in any specified street or area, the residing of public prostitutes and the keeping of a brothel, or the letting or other disposal of a house or building to public prostitutes or for a brothel ;

(*f*) for the regulation of the posting of bills and advertisements ;

(*g*) fixing and regulating the use of places at which boats may be moored, loaded and unloaded, and prohibiting the mooring, loading and unloading of boats except at such places as may be prescribed by the board ;

(*a*) providing for the seizure and confiscation of ownerless animals straying within the limits of the municipality ;

(*i*) providing for the registration of dogs ;

(*j*) providing for the imposition of an annual fee for such registration ;

(*k*) requiring that every registered dog shall wear a collar to which shall be attached a token to be issued by the board ;

(*l*) providing that a dog, unless registered and wearing such token, may, if found in any public place, be destroyed or otherwije disposed of ;

(*m*) prohibiting or regulating with a view to promoting the public safety or convenience, any act which occasions or is likely to occasion a public nuisance and for the prohibition or regulation of which no provision is made under this heading ;

I.—Sanitation and Prevention of Disease.

(*a*) regulating or prohibiting, for the purpose of preventing danger to the public health, the stalling or herding of horses, camels, cattle, swine, donkeys, sheep, or goats ;

(*b*) prescribing and regulating the construction, dimensions, ventilation, lighting, cleansing, drainage, and water-supply of dairies and cattle-sheds in the occupation of persons following the trade of dairymen or milk-sellers and providing for the inspection of milch cattle, and securing the cleanliness of milk stores, milk shops and vessels by milk-sellers or buttermen for milk or butter ;

(*c*) controlling and regulating the use and management of burial and burning-grounds, and fixing the fees to be charged where such grounds have been provided by the board, and prescribing or prohibiting routes for the removal of corpses to burial or burning-grounds ;

(*d*) regulating sanitation and conservancy ;

(*e*) declaring that no place, unless specially exempted, shall be used as a lodging-house, unless it has been duly licensed as such by the board, and prescribing the conditions subject to which such licences may be granted, refused, suspended or withdrawn, and fixing the fees payable for such licences ;

(*f*) providing, in default of a byelaw made under the preceding sub-head, for the registration and inspection of lodging houses, the prevention of overcrowding, the promotion of cleanliness and ventilation, and prescribing the notices to be given and precautions to be taken in the case of any infectious or contagious disease breaking out therein and generally for the proper regulation of lodging-houses ;

(*g*) prohibiting the digging of excavations, cess-pools, tanks or pits within specified areas except with the permission of the board, and specifying the conditions subject to which such permission may be given ;

(*h*) prohibiting or regulating, with a view to sanitation or the prevention of disease, any act which occasions, or which is likely to occasion, a public nuisance and for the prohibition or regulation of which no provision is made under this heading ;

J.—Miscellaneous.

(*a*) prohibiting or regulating any act which occasions, or is likely to occasion, a public nuisance for the prohibition or regulation of which no provision is made elsewhere by or under this Act ;

(*b*) providing for the registration of births, deaths and marriages, and the taking of a census within the municipality and for the compulsory supply of such information as may be necessary to make such registration or census effective ;

(*c*) for the protection from injury or interference of anything within the municipality being the property of His Majesty or of the board, or being under the control of the board ;

(*a*) fixing any charges or fees, or any scale of charges or fees to be paid for house scavenging or the cleansing of latrines and privies under section 196 (*c*) or for any other municipal service or undertaking, or to be paid under section 293 (1) or section 294 of the Act, and prescribing the times at which such charges or fees shall be payable, and designating the persons authorized to receive payment thereof ;

(*e*) providing for the holding of fairs and industrial exhibitions within the municipality or under the control of a board, and fixing the fees to be levied thereat ;

(*f*) requiring and regulating the appointment by owners of buildings and lands in the municipality of persons residing within or near the municipality to act as their agents for all or any of the purposes of this Act or of any rule or byelaw ;

(*g*) specifying the records and documents belonging to, or in possession of, the board of which inspection may be made or copies given and the charges to be levied for inspection or copies of such records and documents, and regulating inspection and the giving of copies ;

(*h*) providing for the granting of licences for the sale and for the dispensing of medicinal drugs.

LIST II.

FURTHER BYELAWS FOR A HILL MUNICIPALITY.

H.—Public Safety and Convenience.

(*n*) regulating or prohibiting the cutting or destroying of trees or shrubs, or the making of excavations or removal of soil or quarrying and providing for the alteration, repair, and proper maintenance of buildings and compounds, for the closing of roads and byepaths and for the general protection of the surface land or any hillside where such byelaws appear to the board to be necessary for the maintenance of a water supply, the preservation of the soil, the prevention of landslips or of the formation of ravines or torrents, the protection of land against erosion, or the deposit thereon of sand, gravel or stones ;

(*o*) prohibiting the lighting of fires in the top storey of a building which, by reason of its contiguity to other buildings, might be a source of danger to the latter in the event of a fire breaking out within it, and the walls of which storey do not exceed seven feet in height, or the placing of stands for lamps, and candles in any position which the board may deem to be dangerous to the public safety ;

(*p*) regulating the rule of the road ;

(*q*) rendering licences necessary within the municipality—

(*i*) for persons working as job porters for the conveyance of goods ;

(*ii*) for animals, vehicles and other conveyances let out on hire for a day or part thereof ; and

(*iii*) for persons impelling or carrying such vehicles and other conveyances ;

(*r*) prescribing the conditions subject to which such licences may be granted, refused, suspended or withdrawn ;

(*s*) regulating the charges to be made for the services of such job porters as aforesaid, and for the hire of such animals, vehicles and other conveyances and for the remuneration of persons who impel or carry such vehicles or conveyances ;

I.—Sanitation and Prevention of Disease.

(*i*) rendering licences necessary for using premises within bazars as stables or cowhouses or as accommodation for sheep, goats and fowls ;

(*j*) preventing overcrowding in houses and inhabited sites ; and

J. - Miscellaneous.

(*i*) providing for the registration, generally or within particular months, of persons entering or leaving the municipali

Sections 299-301 deal with the penalty for the infringement of the rules and byelaws and their previous publication and confirmation. They are given below :

299.—*Infringement of rules and byelaws.*—(1) In making a rule the Local Government, and in making a byelaw the board with the sanction of the Local Government, may direct that a breach of it shall be punishable with fine which may extend to five hundred rupees and, when the breach is a continuing breach, with a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

(2) The board may with like sanction prescribe a similar penalty for the breach of a rule lawfully made under the North-Western Provinces and Oudh Municipalities Act, 1873, and still remaining in force.

300. *Previous publication of rules, etc., made by Government.*—(1) The power of the Local Government to make rules or regulations under this chapter is subject to the condition of the rules or regulations being made after previous publication and of their not taking effect until they have been published in the Gazette.

(2) Any rule or regulation made by the Local Government may be general for all municipalities or for all municipalities not expressly excepted from its operation or may be special for the whole or any part of any one or more than one municipality as the Local Government directs.

301. *Confirmation, etc., of regulations and byelaws made by board.* The power of a board to make regulations under clauses *(e)* to *(m)* of sub-section (1) of section 297 shall be subject to the condition of the regulations not taking effect until they have been confirmed in the case of cities by the Local Government and in other cases by the Commissioner.

(2) The power of a board to make byelaws shall be subject to the condition of the byelaws being made after previous publication and of their not taking effect until they have been confirmed by the Local Government and published in the Gazette.

(3) The Local Government in confirming a byelaw or regulation and the Commissioner in confirming a regulation may make any change in its form that appears necessary.

(4) No alteration or rescission of a regulation made under clauses *(e)* to *(m)* of sub-section (1) of section 297 or of any byelaw by a board shall have effect unless and until it has been confirmed by the Local Government in the case of cities and in other cases by the Commissioner.

(5) The Local Government may, after previous publication of its intention, rescind any regulation or byelaw which it has confirmed, and the Commissioner may, in like manner, rescind any regulation which

he has confirmed, and thereupon the regulation or byelaw shall cease to have effect.

Sections 302 to 326 contain the procedure for issue of municipal notices under any section of the Act and the penalties for failure to comply with notices.

These sections further define the liability of occupiers and owners of property or premises, procedure in prosecutions and appeals from orders of the boards, etc. These sections are :—

302. *Fixation of reasonable time for compliance.*—Where any notice issued under any section of this Act or under any rule or byelaw requires an act to be done for which no time is fixed by such section or rule or byelaw, the notice shall specify a reasonable time for doing the same; and it shall rest with the court to determine whether the time so specified was a reasonable time within the meaning of this section.

303. *Service of notice.*—(1) Every notice or bill issued or prepared under any section of this Act or under any rule or byelaw shall, unless it is in such section or rule or byelaw otherwise expressly provided, be served or presented—

(*a*) by giving or tendering the notice or bill, or sending it by post, to the person to whom it is addressed, or

(*b*) if such person is not found, then by leaving the notice or bill at his last known place of abode, if within municipal limits, or by giving or tendering the notice or bill to some adult male member or servant of his family, or by causing the notice or bill to be fixed on some conspicuous part of the building or land (if any) to which the notice or bill relates.

(2) When a notice under this Act or under a rule or a byelaw is required or permitted by or under this Act, or under a rule or a byelaw to be served upon an owner or occupier of a building or land, it shall not be necessary to name the owner or occupier therein and the service thereof, in cases not otherwise specially provided for in this Act, shall be effected either—

(*a*) by giving or tendering the notice, or sending it by post, to the owner or occupier, or if there be more owners or occupiers than one, to any one of them, or

(*b*) if no such owner or occupier is found, then by giving or tendering the notice to an adult male member or servant of his family, or by causing the notice to be fixed on some conspicuous part of the building or land to which the same relates.

(3) Whenever the person on whom a notice or bill is to be served is a minor, service upon his guardian or upon an adult male member or servant of his family shall be deemed to be service upon the minor.

304. *Method of giving public notice.*—Subject to the provisions of this Act or of any rule, regulation or byelaw, in every case where public notice is to be given by a board, such notice shall be deemed to have been given if it is published in some local English or vernacular paper (if any) and posted upon a notice board to be exhibited for public information at the building in which the meetings of the board are ordinary held.

305. *Defective form.* No notice or bill shall be invalid for defect of form.

306. *Disobedience to public notice or provision of Act applicable to the public.*—Where by this Act or a notice issued thereunder the public is required to do or to refrain from doing anything, a person who fails to comply with such requisition shall, if such failure is not an offence punishable under any other section, be liable on conviction by a Magistrate to a fine not exceeding five hundred rupees for every such failure, and, in the case of a continuing breach, to a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the breach.

307. *Disobedience to notice issued to individual.*—If a notice has been given under the provisions of this Act or under a rule or byelaw to a person requiring him to execute a work in respect of any property, moveable or immoveable, public or private, or to provide or do or refrain from doing anything within a time specified in the notice, and if such a person fails to comply with such a notice, then—

(*a*) the board may cause such work to be executed or such thing to be provided or done, and may recover all expenses incurred by it on such account from the said person in the manner provided by Chapter VI ; and further

(*b*) the said person shall be liable, on conviction before a Magistrate, to a fine which may extend to five hundred rupees, and, in the case of a continuing breach, to a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

308. *Liability of occupier to pay in default of owner.*—(1) If the person to whom the notice mentioned in section 307 has been given, is the owner of the property in respect of which it is given, the board may (whether any action or other proceeding has been brought or taken against such owner or not) require the person (if any) who occupies such property or a part thereof under such owner, to pay to the board, instead of to the owner, the rent payable by him in respect of such property, as it falls due, up to the amount recoverable from the owner under section 307 ; and any such payment made by the occupier to the board shall, in the absence of any contract between the owner and the occupier to the contrary, be deemed to have been made to the owner of the property.

(2) For the purpose of deciding whether action should be taken under sub-section (1), the board may require an occupier of property to furnish information as to the sum payable by him as rent on account of such property and as to the name and address of the person to whom it is payable ; and if the occupier refuses to furnish such information he shall be liable for the whole of the expenses as if he were the owner.

(3) All money recoverable by the board under this section shall be recoverable in the manner provided by Chapter VI.

309. *Right of occupier to execute works in default of owner.*—Whenever default is made by the owner of a building or land in the execution of a work required by or under this Act to be executed by him, the occupier of such building or land may, with the approval of the board, cause such work to be executed, and the expense thereof shall, in the absence of any contract to the contrary, be paid to him by the owner or the amount may be deducted out of the rent from time to time becoming due from him to such owner.

310. *Procedure upon opposition to execution by occupier.*—(1) If, after receiving information of the intention of the owner of any building or land to take any action in respect thereof in compliance with a notice issued under this Act, the occupier refuses to allow such owner to take such action, the owner may apply to a Magistrate.

(2) The Magistrate upon proof of such refusal may make an order in writing requiring the occupier to allow the owner to execute all such works, with respect to such building or land, as may be necessary for compliance with the notice, and may also, if he thinks fit, order the

occupier to pay to the owner the costs relating to such application or order.

(3) If, after the expiration of eight days from the date of the Magistrate's order, the occupier continues to refuse to allow the owner to execute such work, the occupier shall be liable, upon conviction, to a fine which may extend to twenty-five rupees for every day during which he has so continued to refuse.

(4) Every owner, during the continuance of such refusal, shall be discharged from any penalties to which he might otherwise have become liable by reason of his default in executing such works.

311. *Recovery of cost of work by the occupier.*—When the occupier of a building or land has, in compliance with a notice issued under the provisions of this Act, executed a work for which the owner of such building or land is responsible, either in pursuance of the contract of tenancy or by law, he shall, in the absence of any contract to the contrary, be entitled to recover from the owner by deduction from the rent payable by him or otherwise the reasonable cost of such work.

312. *Recovery of expenses of removal by board under sections 211, 263, 264, 265 and 278.*—(1) The expenses incurred by the board in effecting any removal under section 263 or 265, or in the event of a written notice issued under section 211, 263, 264 or 278 not being complied with, under section 307 shall be recoverable by sale of the materials removed, and if the proceeds of such sale do not suffice, the balance shall be recoverable from the owner of the said materials in the manner provided by Chapter VI.

(2) If the expenses of removal are in any case paid before the materials are sold, the board shall restore the materials to the owner thereof, on his claiming the same at any time before they are sold or otherwise disposed of, and on his paying all other expenses, if any, incurred by the board in respect thereof, or in respect of the intended sale or disposal thereof.

(3) If the materials are not claimed by the owner thereof, they shall be sold by auction or otherwise disposed of as the board thinks fit, as soon as conveniently may be after one month from the date of their removal, whether the expenses of the removal have in the meantime been paid or not; and the proceeds, if any, of the sale or other disposal shall, after defraying therefrom the costs of the sale or other disposal, and, if necessary, of the removal, be paid to the credit of the municipal fund, and shall be the property of the board.

313. *Relief to agents and trustees.*—(1) When a person, by reason of his receiving, or being entitled to receive, the rent of immoveable property as trustee or agent of a person or society would, under this Act, be bound to discharge an obligation imposed by this Act on the owner of the property and for the discharge of which money is required, he shall not be bound to discharge the obligation unless he has or but for his own improper act or default might have had, in his hands funds belonging to the owner sufficient for the purpose.

(2) When an agent or trustee has claimed and established his right to relief under this section, the board may give him notice to apply to the discharge of such obligation as aforesaid the first moneys which come to his hands on behalf, or for the use, of the owner, and should he fail to comply with such notice, he shall be deemed to be personally liable to discharge such obligation.

Prosecutions.

314. *Authority for prosecution.*—Unless otherwise expressly provided, no court shall take cognizance of any of the offences punishable under this Act (whereof a list is given in Schedule VIII for the purpose merely of easier reference) or under any rule or byelaw, except on the complaint of, or upon information received from, the board or some person authorized by the board by general or special order in this behalf.

315. *Power to compound offences.*—(1) The chairman of a board or, in municipalities in which there is an executive officer, the executive officer, with the sanction, general or special, of the chairman, may, either before or after the institution of proceedings, compound an offence against this Act or a rule or byelaw, except the offences described in sections 237(4), 242, 246, 247, 281, 285 (5) and 295 and offences against any rules made under section 296 with reference to the matters specified in section 296 ; provided that no offence shall be compoundable which is constituted by failure to comply with a written notice issued by the board or on behalf of the board, unless and until the notice has been complied with, in so far as compliance is possible.

(2) When an offence has been compounded, the offender, if in custody, shall be discharged and no further proceedings shall be taken against him in respect of the offence so compounded.

(3) Sums paid by way of composition under this section shall be credited to the municipal fund.

317. *Compensation for damage to municipal property.*—If through an act, neglect or default on account whereof a person shall have incurred a penalty imposed by or under this Act any damage to the property of the board shall have been caused, the person incurring such penalty shall be liable to make good such damage as well as to pay such penalty ; and the amount of damage shall, in case of dispute, be determined by the Magistrate by whom the person incurring such penalty is convicted, and on non-payment of such amount on demand the same shall be levied by distress and such Magistrate shall issue his warrant accordingly.

317. *Powers and duties of police in respect of offences and assistance to municipal authorities.*—Every police officer shall give immediate information to the board of an offence coming to his knowledge which has been committed against this Act or against an Act referred to in clause (b) of sub-section (1) of section 114, or against any rule made under any of the said Acts ; and shall be bound to assist all members, officers, and servants of the board in the exercise of their lawful authority.

Appeals from orders of board, and suits against the board.

318. *Appeals from order of board.*—(1) Any person aggrieved by any order or direction made by a board under the powers conferred upon it by sections 180(1), 186, 205(1), 208, 211, 222(6), 241(2), 245, 278, 285, or under a byelaw made under heading G of section 298, may within thirty days from the date of such direction or order, exclusive of the time requisite for obtaining a copy thereof, appeal to such officer as the Local Government may appoint for the purpose of hearing such appeals or any of them, or, failing such appointment, to the District Magistrate :

Provided that if, in the latter case, the District Magistrate be himself a member of the board, the appeal shall lie to the Commissioner.

(2) The appellate authority may, if it thinks fit, extend the period allowed by sub-section (1) for appeal.

(3) No appeal shall be dismissed or allowed in part or whole unless reasonable opportunity of showing cause or being heard has been given to the parties.

319. *Reference to High Court.*—(1) If on the hearing of an appeal under section 318 any question as to the legality of the prohibition, direction, notice or order arises on which the officer hearing the appeal entertains reasonable doubt, he may, either of his own motion or on the application of any person interested, draw up a statement of the facts of the case and the point on which doubt is entertained, and refer the

statement, with his own opinion on the point, for the decision of the High Court.

(2) On a reference being made under sub-section (1) the subsequent proceedings in the case shall be as nearly as may be in conformity with the rules relating to references to the High Court contained in Order XLVI of the first schedule of the Code of Civil Procedure, 1908, or such other rules as are made by the High Court under section 122 of that Code.

320. *Costs*—(1) The Court deciding the appeal shall have power to award costs at its discretion.

(2) Costs awarded under this section to the board shall be recoverable by the board as if they were arrears of a tax due from the appellant.

(3) If the board fail to pay any costs awarded to an appellant under this section within ten days after the date of the communication of the order for payment thereof, the Court awarding the costs may order the person having the custody of the balance of the municipal fund to pay the amount.

321. *Finality of order of appellate authority*-(1) No order or direction referred to in section 318 shall be questioned in any other manner or by any other authority than is provided therein.

(2) The order of the appellate authority confirming, setting aside or modifying any such order or direction shall be final:

Provided that it shall be lawful for the appellate authority, upon application, and after giving notice to the other party, to review any order passed by him in appeal by a further order passed within three months from the date of his original order.

322. *Suspension of prosecution in certain cases.*—When an order of the kind specified in section 318 is subject to appeal and an appeal has been instituted against it, all proceedings to enforce such order and all prosecutions for a breach thereof may, by order of the appellate authority, be suspended pending the decision of the appeal, and, if such order is set aside on appeal, disobedience thereto shall not be deemed to be an offence.

323. *Appeals from certain orders of a court.*—Every order of forfeiture under section 201 and every order under section 202 or section 258 shall be subject to appeal to the next superior court to that by which the order was passed, but shall not be otherwise open to appeal or revision.

324. *Disputes as to compensation payable by board.*—(1) Should a dispute arise touching the amount of compensation which the board is required by this Act to pay it shall be settled in such manner as the parties may agree, or in default of agreement, by the Collector upon application made to him by the board or the person claiming compensation.

(2) Any decision of the Collector awarding compensation shall be subject to a right of the applicant for compensation to require reference to the District Judge in accordance with the procedure set forth in section 18 of the Land Acquisition Act, 1894.

(3) In cases in which compensation is claimed in respect of land, the Collector and the District Judge shall, as far as may be, observe the procedure prescribed by the said Act for proceedings in respect of compensation for the acquisition of land acquired for public purposes.

325. *Decision of disputes between local authorities*—(1) Should a dispute arise between a municipal board and any other local authority on any matter in which they are jointly interested, such dispute shall be referred to the Local Government whose decision shall be final.

(2) The Local Government may regulate by rule made under section 296 the relations to be observed between boards and other local authorities in any matter in which they are jointly interested.

326. *Suit against board or its officers.*—(1) No suit shall be instituted against a board, or against a member, officer or servant of a board, in respect of an act done or purporting to have been done in its or his offical capacity, until the expiration of two months next after notice in writing has been, in the case of a board, left at its office, and, in the case of a member, officer or servant, delivered to him or left at his office or place of abode, explicitly stating the cause of action, the nature of the relief sought, the amount of compensation claimed, and the name and place of abode of the intending plaintiff, and the plaint shall contain a statement that such notice has been so delivered or left.

(2) If the board, member, officer or servant shall, before action is commenced, have tendered sufficient amends to the plaintiff, the plaintiff shall not recover any sum in excess of the amount so tendered and shall also pay all costs incurred by the defendant after such tender.

(3) No action such as is described in sub-section (1) shall, unless it is an action for the recovery of immoveable property or for a declaration of title thereto, be commenced otherwise than within six months next after the accrual of the cause of action.

(4) Provided that nothing in sub-section (1) shall be construed to apply to a suit wherein the only relief claimed is an injunction of which the object would be defeated by the giving of the notice or the postponement of the commencement of the suit or proceeding.

Section 338—In this section the Local Government have power to apply or adapt to a notified area any of the provisions of this Act.

In schedules I and II given below the powers and duties of the board and the executive officer are detailed :—

SCHEDULE I.

THE POWERS AND FUNCTIONS OF A BOARD.

[*Sections* 50 *(e) (ii)*, 111 (1) *and* 112 (1) *(a)*].

1	2	3
Section.	Power or duty.	Remarks.
3 (2) (*c*)	To apply or consent that the municipality be declared a city.	
8 (3)	To declare expenditure to be an appropriate charge on the municipal fund.	
13	To direct that a casual vacancy be left unfilled till the next ordinary election.	
37	To allow remuneration to a member.	
40 (1) (*a*)	To accept as satisfactory the explanation of a member for absence from meetings	
43	To elect a chairman	
52	To require the chairman to furnish reports, etc.	
54	To elect, or accept the resignation of, a vice-chairman.	
57	To appoint an executive officer.	

SCHEDULE I.

[*The powers and functions of a board*].

1	2	3
Section.	Power or duty.	Remarks.
58	To punish or dismiss an executive officer.	
59	To appoint a person to officiate as executive officer.	
61	To entertain appeals from orders of the executive officer.	May be delegated.
63	To require the executive officer to furnish returns, etc.	
66	To appoint a secretary.	
67	To punish or dismiss a secretary.	
68	To appoint a health officer, an engineer or a water-works engineer or superintendent.	
69	To punish or dismiss any officer appointed under section 68.	
70 (*a*)	To prohibit the employment of temporary servants for any particular work.	
71	To determine the number and salaries of other servants.	
72	To appoint one person to discharge the duties of two or more offices.	
74	To appoint, punish or dismiss servants on a monthly salary exceeding fifty or, in a city, seventy-five rupees, or other minimum specified by regulation under section 297 (1) (*f*).	May be delegated.

SCHEDULE I.

[*The powers and functions of a board*].

1	2	3
Section.	Power or duty.	Remarks.
76 (2) (*b*)	To entertain appeals from orders of the chairman punishing or dismissing servants on a monthly salary exceeding ten but not exceeding fifty or, in a city, exceeding fifteen but not exceeding seventy-five rupees, or on a monthly salary between such other amounts as are specified by regulation under section 297 (1) (*f*).	May be delegated.
79 (2)	To establish a provident fund.	
79 (3) (4) and (5)	To grant a gratuity, or compassionate allowance or to grant or purchase an annuity.	
81	To institute a suit against a member.	
82 (2) (*f*)	To fix the amount up to which a member may be interested in occasional sales to the board.	
94 (6)	To modify or cancel a resolution.	
96 (1)	To sanction contracts for which budget provision does not exist or involving a value or amount exceeding Rs. 1,000 in the case of a contract by the board of a city and Rs. 250 in any other case.	
96 (2)	To empower a committee or officer or servant of the board to sanction other contracts.	
96 (3)	To empower engineer to sanction contracts.	

SCHEDULE I.

[*The powers and functions of a board*].

1	2	3
Section	Powess or duty.	Remarks.
97 (2) (*b*)	To empower engineer to execute a contract.	May be delegated.
99	To sanction a budget and to vary or alter a budget.	
104 (1)	To appoint and remove members of committees.	
104 (2)	To establish and appoint he members of advisory committees.	
105	To appoint persons other than members of the board to committees.	
106	To fill up vacancies in committees	
107 (1)	To appoint the chairman of any committee.	
109	To call for returns, etc., from a committee.	
110	To appoint joint committees and to vary or rescind any written instrument by virtue of which any joint committee has been appointed.	
112	To delegate powers or duties conferred or imposed on a board.	
115	To invest or place any portion of the municipal fund in deposit.	
117	To request the Local Government to acquire land.	

SCHEDULE I.

[*The powers and functions of a board.*]

1	2	3
Section.	Power or Duty.	Remarks.
118	To undertake the management or control of property entrusted to it.	
119	To manage, control and administer, and hold in trust the funds of public institutions.	
124	To transfer any property vested in the board.	
125	To make compensation out of the municipal fund.	
128 – 137	To take any action relating to a tax.	
141	To cause an assessment list to be prepared and to appoint a person to make the assessment list.	May be delegated.
143 (3)	To hear and decide objections, or to delegate the power to hear and decide objections.	May be delegated.
147 (1)	To amend an assessment list.	May be delegated.
156	To permit compounding for taxes.	
157 (1) & (2).	To exempt from taxation.	
187	To establish and maintain a fire brigade.	
189	To construct drains.	
190	To alter and discontinue municipal drains.	

SCHEDULE I.

[*The powers and functions of a board.*]

1	2	3
Section.	Power or duty.	Remarks.
196 (*a*) & (*b*)	By public notice to undertake the house-scavenging or cleansing of latrines or privies, and to relinquish such undertaking.	
197 (2)	To pass orders on an application for the exclusion of a house from a notice under section 196 (*a*).	May be delegated.
211	To issue a notice for the removal or alteration of projection, when compensation is payable.	
217 (1) (*a*)	To give a name to a street.	
219	To make, alter, divert or close a public street, to provide building sites thereon, to take steps to acquire land for such purposes, and to sell or dispose of land so acquired.	
221	To declare a street a public street.	
222 (1) to (3)	To define "the regular line of the street."	
224	To construct and alter waterworks.	
237 (1)	To fix premises for the slaughter of animals for sale.	
238	To fix premises for the slaughter of animals not intended for sale or slaughtered for religious purpose, and to prohibit such slaughter elsewhere.	
250 (1)	To require the muzzling of dogs.	

SCHEDULE I.

[*The powers and functions of a board.*]

1	2	3
Section.	Power or duty.	Remarks.
253 (provisio)	To direct that the section shall not apply to vehicles proceeding at not more than a walking pace.	
257 (1)	To direct that roofs and external walls shall not be made of inflammable materials without the board's consent.	
259	To prohibit the stacking or collecting of inflammable materials, etc.	
269	To require the removal of a nuisance from tanks and the like, when such removal involves the board acquiring or providing land.	
273 (1) (*b*) & (*c*)	To appoint places for disposal of offensive matter and rubbish and to issue directions as to the time, manner and conditions of removal thereof.	
275 (3)	To prescribe fees for the disposal of dead bodies of animals.	
282	To prohibit any cultivation, use of manure or irrigation injurious to health.	
285	To provide or close, or give permission for the making of burning and burial grounds, to except private burial places from a public notice, and to give permission to use an unrecognised burial or burning ground.	

SCHEDULE I.

[*The powers and functions of a board.*]

1	2	3
Section.	Power or duty.	Remarks.
286	To set apart bathing and washing places, to prescribe conditions for the use of such places and to prohibit bathing and washing at other places.	
290 (2)	To sanction execution of water-works or a work under sections 192, 267 and 268 at the charge of the municipal fund.	
290 (3)	To transfer the board's interest in appliances appertaining to a water or drainage work to the owner of a building or land.	
297	To make regulations.	
298	To make byelaws.	
299	To direct that the breach of byelaws shall be punishable with fine.	
General	Any power, duty or function which any rule requires to be exercised, performed or discharged by the board itself by means of a resolution.	

SCHEDULE II.

Scheduled Powers of Executive Officer.

Sections 60 (1) (*d*) *and* 61 (1) (*a*).

1	2	3
Section.	Nature of powers or duties.	Remarks.
79 (1)	To pay leave allowances to officer or servant.	
142	To give public notice of the place where an assessment list may be inspected.	
143 (1)	To give public notice of the time fixed for considering valuations and assessments and to give notice to owners or occupiers of property.	
143 (2)	To receive objections to valuations and assessments.	
147 (2)	To give notice to persons interested in an alteration proposed in an assessment list of the date on which the alteration will be made.	
148 (1)	To receive notice of a building newly built, rebuilt or enlarged.	
150 (2)	To exercise the option of levying the tax from the lessor.	
151(1)&(2)	To remit or refund a tax in case of a building, tenement or land remaining vacant and unproductive of rent.	
152 (1)	To receive notice of the re-occupation of a building or land.	
158	To call for information affecting liability to taxation.	

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
166	To present bills for taxes and other dues.	
168	To cause a notice of a demand to be served.	
169	To issue a distress warrant	
172(1)&(2)	Te sell goods distrained.	
172 (3)	To receive applications for a refund and to make a refund.	
173	To apply to a Magistrate for the issue of a warrant.	
176	To sue for a demand.	
178 (1)	To receive a notice of the intention to erect, re-erect or make a material alteration in a building, etc.	
179 (1)	To determine when information regarding such notice is satisfactory.	
179 (2)	To require plans, specifications and further information.	
186	To direct by a notice that the erection, re-erection or alteration of a building, etc., shall be stopped or that a building, etc., be altered or demolished.	Appeal lies against order directing alteration or demolition of building, part of a building or a well.
191 (1)	To give permission and to prescribe conditions for the connection of private drains with municipal drains.	

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
191 (2)	To require that a drain made in contravention of a byelaw or of the terms of permission or without permission shall be closed, etc.	Appealable.
192 (1)	To enforce a drainage connection with a public drain.	Appealable.
193	To receive applications, to call for objections, to issue orders thereon, to construct drains and recover cost of construction and compensation.	Appeal lies against an order recorded under sub-section 3.
194	To give permission for diversion of drain and to prescribe conditions for such diversion.	Appealable.
196 (*c*)&(*d*)	With the consent of an occupier, to undertake house-scavenging or the removal of night soil or other offensive matter or rubbish and to relinquish such undertaking.	
201 (1)	To complain to a Magistrate of the negligence of a customary sweeper.	
202 (1)	To complain to a Magistrate of the failure of an agriculturist to provide for proper house-scavenging.	
203 (1)	To receive notice of intention to make a street.	
204	To postpone the intended work or require further particulars.	

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
209	To give permission for projections.	Appeal lies from orders refusing permission.
211 (in part)	To issue a notice for the removal of a projection in a case where no compensation is payable.	Appealable.
213	To give permission for erection and repair of buildings, etc., and to issue orders regarding hoardings, etc,	
214	To require hedges and trees to be trimmed.	
215	To remove, and recover the expense of removal of, or to issue a notice requiring the removal of, an obstruction caused by fallen house, etc.	
216	To require the provision of troughs and pipes for rain water.	
217 (1) (*b*) and (*c*)	To affix the name of a street or a house number to a building or to require the owner or occupier to affix a number plate, and to cause or require such names and numbers to be altered.	
218	To attach posts and brackets to buildings for lamps, telegraph and telephone wires, etc.	
220	To give permission for the use or occupation of a public street or place.	

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
223	To provide fencing and lighting during repairs of public street, etc.	
225 (1)	To require private wells, etc., to be cleansed.	
225 (2)	To require a person to desist from using a private well, etc., or to close or fence the same.	Appealable
227	To require the removal or closing of drains, latrines, etc., near a source of water-supply.	Appealable.
229	To supply water by agreement.	
230	To charge for the supply of water.	
236	To remove or otherwise deal with unauthorised buildings over drains, etc., or to issue notice for the removal of such buildings, etc.	Appealable.
240	To authorise an officer to seize flesh brought within the municipal limits in contravention of a byelaw and to issue orders as to the disposal of such flesh.	
244 (1) & (2)	To seize articles exposed for sale which appear to be unfit for the consumption of man and drugs suspected of being adulterated or spent; and to produce such drugs before a Magistrate.	

SCHEDULE II.

Scheduled powers of Executive Officer.]

1	2	3
Section.	Nature of powers or duties.	Remarks.
245 (1)	To issue a notice regarding offensive trades.	Appealable.
249	To authorize a person to destroy or confine dogs suspected to be suffering from rabies, etc.	
250 (2)	To authorize persons to destroy or confine unmuzzled dogs.	
256	To give permission for the use of public land for halting animals or vehicles.	
257 (2)	To require the removal of a roof and wall, if inflammable.	Appealable.
258	To search for inflammable material and to seize any quantity in excess of the quantity permitted.	
260	To issue notices regarding dangerous quarrying and to put up hoardings and fences to prevent imminent danger.	
241	To give permission for the displacing of pavements, etc., and to recover expenses incurred by the board by reason of such displacement, etc.	
263	To require by notice buildings, etc., in a dangerous or ruinous state to be demolished or repaired, or wells, tanks, etc., to be repaired and enclosed, and to take immediate action where the danger is imminent.	Appeal lies against an order to repair or enclose a tank.

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
264	To require unoccupied building or land which occasions a public nuisance to be secured or enclosed.	Appealable.
265	To give written permission for the temporary obstruction of a street and to remove any obstruction from a street and to recover the cost of removal.	
266	To give permission for the removal of earth, etc., from open spaces.	
267	To require provision, alteration, removal, closing, cleansing and screening of private drains, cesspools, dustbins, latrines, etc.	Appeal lies against an order under clause (*a*) of sub-section (1) requiring an owner or occupier to close or remove, or under clause (*b*) of sub-section (1) to provide a latrine, urinal, water-closet, drain, cesspool, dustbin or other receptacle for filth, sullage-water, rubbish or refuse.
268	To require the provision and cleansing of latrines and urinals for factories, etc.	
269 (in parts).	To require the cleansing, repairing, covering, filling up or draining off of wells, tanks, etc.	Appealable.
270	To inspect drains, privies, etc., and to cause the ground to be opened.	

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
271	To require the cleansing of filthy buildings or lands.	
273 (1) (*a*)	To provide receptacles, and places for the temporary deposit of offensive matter.	
275 (1)	To arrange for the disposal of dead bodies of animals.	
275 (3) (in part).	To charge and recover fees for such disposal.	
276	To give permission for, and to prescribe conditions regarding, the discharging of sewage, etc.	
277	To enter and inspect a building and to direct that a building be disinfected, etc.	
278	To issue orders regarding buildings unfit for human habitation.	Appealable.
280	To remove to a hospital a cholera or small-pox patient, etc.	
283	To require an owner or occupier to clear away noxious vegetation.	
284 (1)	To require that excavations, etc., made in contravention of bye-laws or the conditions of a permission, shall be filled up or shall be drained.	
291	To apply to the Collector to recover rent of land.	

SCHEDULE II.

[*Scheduled powers of Executive Officer.*]

1	2	3
Section.	Nature of powers or duties.	Remarks.
293	To charge fees for the use or occupation of immoveable property vested in, or entrusted to the management of, the board, and to levy or recover such charge.	
294	To charge fees for licences, sanctions, and permissions.	
307	To cause a work to be executed and to recover the expenses thereof.	
308	To require an occupier to pay rent to a board instead of to the defaulting owner, and to require an occupier to furnish informa tion regarding the rent payable by him, etc.	
309	To approve the execution of a work by an occupier.	
312	To recover the cost of removal by sale of materials removed, to restore the materials to the owner under certain conditions, or to sell them when not claimed by the owner.	
313 (2)	To give notice to a trustee or an agent to apply moneys received on behalf of an owner to the discharge of obligations of the owner.	
314	To institute prosecution by making complaints and giving information, and to authorize other persons to make such complaints and give such information.	
317	To receive information from a police officer.	

In Schedule VIII given below, a list of offences and penalties will be found. The amount of fine in the last column is the maximum. In practice, however, in some towns fines of such small amounts as four annas are very common, with the result that the task of the medical officers of health is made very difficult.

SCHEDULE VIII.

LIST OF OFFENCES.

(Section 314*)*

Section.	Description of offences.	Fines that may be imposed.
148 (2)	Failure to report, for entry in property assessment list, a new or altered building.	Rupees 50 or ten times tax payable for three months.
152 (2)	Failure to report re-occupation of vacant building paying reduced tax.	Rupees 50 or ten times tax due since occupation.
155	Evasion of octroi ...	Rupees 50 or ten times octroi evaded whichever is greater.
158 (2)	Failure to make correct return of liability to a tax.	Rupees 100.
185	Illegal erection or alteration of a building.	Rupees 500.
191 (2)	Illegal construction or alteration of a drain connection.	Rupees 50.
201 (2)	Negligence by customary sweeper.	Rupees 10.
207	Illegal making of a street ...	Rupees 500.
210	Construction of unauthorised projection over street or drain.	Rupees 250
213 (3)	Failure to obtain permission for, and to safeguard dangerous tree-cutting and building operation.	Rupees 50 and Rs. 5 for each day that offence is repeated after conviction.

SCHEDULE VIII.

[*List of Offences.*]

Section.	Description of offences.	Fines that may be imposed.
317 (2)	Improper interference with street names and house numbers.	Rupees 25.
223 (2)	Interference with arrangements made during street repair, etc.	Rupees 50.
237 (4)	Slaughter on unlicensed premises of animals for sale.	Rupees 20 per animal.
242	Improper feeding of animals kept for dairy purposes or used for food.	Rupees 50.
245	Failure to obey a notice prohibiting or regulating the use of premises for an offensive trade.	Rupees 200 and Rs. 40 for each day that offence is repeated after conviction.
246	Loitering and soliciting for immoral purpose.	Rupees 50.
247 (2)	Disobedience to magistrate's order prohibiting use of house as brothel.	Rupees 25 per day.
248	Importunate begging ...	Rupees 20.
252	Neglect of the rule of the road	Rupees 10.
253	Driving vehicles without proper lights.	Rupees 20.
254	Failure to remove elephant, etc., to safe distance.	Rupees 20.
255 (1)	Allowing cattle to stray or be tethered in street.	Rupees 20.
256	Unauthorized use of municipal land as halting place.	Rupees 20 and Rs. 5 for each day that offence is repeated after conviction.

SCHEDULE VIII.

[List of offences.]

Section.	Description of offences.	Fines that may be imposed.
257 (3)	Unauthorized erection or continuance of inflammable constructions.	Rupees 25 and Rs. 10 for each day that offence is repeated after conviction.
261 (1)	Unauthorized interference with pavements and other municipal property.	Rupees 100.
262	Dangerous discharge of fire arms or fire-works and indulgence in dangerous games.	Rupees 20.
265	Obstruction of streets ...	Rupees 50.
266	Unauthorized digging on public land.	Rupees 50 and Rs. 10 for each day that offence is repeated after conviction.
272	Failure of owner or occupier to remove offensive matter.	Rupees 50 and Rs. 10 for each day that offence is repeated after conviction.
274	Improper disposal by owner or occupier of rubbish, night-soil, etc.	Rupees 20.
275 (2)	Failure to dispose of dead animals.	Rupees 10.
276	Improper discharge of sewage in or on to a street or drain.	Rupees 20.
279	Failure to give information of cholera, small-pox, etc.	Rupees 50.
281	Doing certain acts while suffering from infectious disorder.	Rupees 20.
285 (5)	Burial or burning of corpses in a place not recognized as a burial or burning ground.	Rupees 50.

SCHEDULE VIII.

[*List of offences.*]

1	2	3
Section.	Description of offences.	Fines that may be imposed.
295	Obstruction to municipal employees.	Rupees 50.
299	Contravention of rule or byelaw to the breach of which a penalty is attached.	Any sum not exceeding Rs. 500 prescribed, and Rs. 5 for each day that offence is repeated after conviction.
306	Disobedience to public notice or provision of the Act applicable to the public.	Rs. 500 and Rs. 5 for each day that offence is repeated after conviction.
307	Disobedience to notice issued to individual.	Rupees 500 and Rs. 5 for each day that offence is repeated after conviction.
310 (3)	Refusal by occupier to allow owner to take action required by notice.	Rupees 25 for each day of refusal.

Schedule IX gives the list of repealed enactments which were in force until July 1916.

SCHEDULE IX.

REPEALED ENACTMENTS.

Section 334 (1).

Year.	No.	Short title or Subject.
		Acts of the Lieutenant Governor in Council.
1900	I	The United Provinces Municipalities Act.
1901	V	The United Provinces Municipalities Amendment Act.
1907	I	The United Provinces Municipalities Amendment Act.
1891	I	The United Provinces Water Works Act.
1895	II	The United Provinces Water Works Amendment Act.
1901	I	The United Provinces Water Works Amendment Act.
1900	I	The United Provinces Water Works Amendment Act.
1892	I	The United Provinces Lodging House Act.
1894	III	The United Provinces Sewerage and Drainage Act.

We have enumerated at length all the sections of the Act especially affecting the Public Health. It will be seen that knowledge of a great many of the sections is essential to Medical Officers of Health. The potential power of a board is large but many boards are very chary of enforcing some of the admirable regulations enumerated above and it is the duty of the Medical Officers of Health to impress on the board the advisability of rigorously enforcing these regulations for the good of the public whose well-being has been placed in their care.

RULES AND ORDERS OF THE U. P. GOVERNMENT UNDER SECTIONS OF THE ACT RELATING TO PUBLIC HEALTH.

The following duties have been laid down in the U. P. Municipal Manual for Medical Officers of Health :

1. The general supervision of sanitation in the municipality. The most important duty of the health officer is the personal control of the town conservancy. He is also required of his own motion or by direction of the board or of the chairman or of the executive officer to make any sanitary inspection, to report on sanitary defects and to make recommendations as to sanitary improvements.

2. The supervision of vaccination within the municipality.

3. The control, as mortuary registrar, of the registration of vital statistics in the municipality.

4. If so empowered by the board the inspection of foodstuffs, their seizure and removal, if unfit for human consumption, under section 244 of the Act, the purchase of samples, if suspected of adulteration, for transmission to the public analyst under the United Provinces Prevention of Adulteration Act. In towns in which municipal laboratories are established the health officer will confine his work in the laboratory to the chemical and rough bacteriological analysis of the town water-supply, if suspected of pollution, and where the United Provinces Prevention of Adulteration Act is applied, to the chemical examination of milk suspected of adulteration.

5. The inspection of building sites and of the plans required under the building byelaws for the erection or re-erection of buildings.

6. Any duties which, with the previous sanction of the Sanitary Commissioner, may be assigned to him by the board or the chairman or the executive officer.

The conditions of service of Medical officers of Health in India are different to those in England. In the latter country the passing of the Public Health (Officers') Act, 1921, provides that a whole time Medical Officer of Health shall not be appionted for a limited period and shall not be removed from his office except with the consent of the Minister of Health. This Act has had a retrospective effect in respect to Medical Officers of Health appointed prior to that date.

It would allay the feeling of the insecurity of tenure among the Medical Officers of Health in India if a similar provision is made by the passing of an enactment.

Water supply rules for Municipalities in U. P.

(With reference to section 235).

1. **Preliminary.**—In these rules, unless there is something repugnant in the subject or context:—

(1) "communication pipe" means any pipe or system of pipes, along with all fittings thereto, by means of which water is supplied to a building or land from a municipal supply main ;

(2) "connection pipe" means any pipe from ferrule to the stopcock, connecting a municipal supply main with a service pipe ;

(3) "ferrule" means a ferrule connecting a connection pipe with a supply main ;

(4) "service pipe" means any pipe, other than a connection pipe, by means of which water is supplied to a building or land and

(5) "Stopcock" means a stopcock fitted at the end of a connection pipe furthest away from the supply main, for the purpose of shutting off or regulating the supply of water from the main to any building or land.

2. All sums due under the provisions of these or any other rules relating to the supply of water by any municipality shall be recoverable in the manner provided by chapter VI of the Act.

3. Where any fee or charge is declared by any such rules to be recoverable from the occupier of any buildings or land and there are more occupiers than one, the owner of the building or land shall be deemed to be the occupier.

Private supply – General.

4. *Applications.*—Before a person begins the laying, alteration or extension of any communication pipe, he shall fill up and deliver at the municipal office an application in the printed form prescribed in schedule I attached to these rules, and signed by the owner of the property concerned or by the person primarily liable for the payment of property taxes on the said property.

5. With an application for a connection with a municipal main a fee of Rs. 2 shall be paid.

NOTE.—This rule shall not apply to the municipality of Naini Tal.

6. If the applicant wishes to employ a licensed plumber (and not the board) for the purpose of making the connection, the application shall be delivered at the municipal office by the plumber.

7. If the applicant wishes to employ the board for the purpose of making or altering a connection, he shall in his application set forth the work to be executed, and on receipt of an estimate of the cost of executing the work shall, if he desires the board to proceed with the execution of the work, deposit the estimated sum in the municipal office.

8. For the purpose of facilitating replacement, all pipes and fittings shall be exact duplicates of the standard samples kept in the office of the municipal engineer or water-works superintendent.

9. All pipes shall be of iron galvanized or coated with an anti-corrosive substance and of a quality approved by the municipal engineer or water-works superintendent. When first fitted they shall be new and capable of withstanding a pressure of a column of water 200 feet (or, in the case of the municipalities of Nani Tal and Mussoorie, 600 feet) in height.

10. Ferrules shall be of brass or gunmetal and shall be screwed into the connection pipe and the supply main. All threads shall be cut to standard gauge and the bore of each ferrule shall correspond accurately to the dimensions prescribed for the ferrule. Every ferrule shall be covered with an iron bell cover resting on the supply pipe to protect it from contact with the earth.

11. Galvanized iron tubing shall be of a thickness not less than prescribed in the following scale :—

If of $\frac{1}{2}''$	diameter,	then	$\frac{1}{8}''$	in thickness.
If „ $\frac{3}{4}''$	„	„	$\frac{3}{16}''$	„
If „ $1''$	„	„	$\frac{7}{32}$	„

12. No more bends or elbows than are absolutely necessary are permissible and no bend shall be effected by heating, nor shall there be any such gradual bend or long sweep as to cause risk of splitting.

13. The point of discharge of all pipes shall be above ground and easily visible.

14. Connection pipes shall be not less than two feet below the surface of the ground and all pipes above ground shall, so far as is practicable, be screened from exposure to the sun.

NOTE.—This rule shall not apply to the municipalities of Naini Tal and Mussoorie.

15. Whenever a communication pipe is laid across a sewer or open drain or any place where, in the opinion of the municipal engineer or water-works superintendent, it is liable to injury, it shall be passed through an exterior glazed stone-ware or cast iron pipe of sufficient length and strength to afford due protection to it.

16. On every communication pipe a brass stopcock having the same waterway as the pipe shall be placed at or near the entrance to the premises, and except with the permission in writing of the chairman or executive officer, outside the premises, such stopcock for the purpose of indicating its situation, shall be provided with a footway cover box resting on brickwork foundation. The box shall be arranged for locking and the key shall remain under the control of the municipal engineer or water-works superintendent. The stopcock shall be capable of adjustment so that the supply to the premises may be regulated by it.

17. Except with the sanction in writing of the municipal engineer or water-works superintendent no tap shall exceed ½" or be of a kind other than that known as "spring-cock" or "push-tap," or be fixed outside the walls of any building unless the water-supply is controlled by meter.

18. *Meters.*—Every meter shall be placed as near to the stopcock as possible and in a position where it can be conveniently examined.

19. No meter shall be disconnected from the service pipe or otherwise interfered with, except with the permission of the municipal engineer or water-works superintendent.

20. The register of meter shall be *primâ facie* evidence of the quantity of water consumed.

21. Where a meter is out of order for any period exceeding one week, the board or the executive officer shall estimate on such available data as it or he considers most reliable, the amount of water consumed during such period and the amount so estimated shall be deemed the amount actually consumed but no rent shall be charged for a meter for the period that it is out of order.

22. Within 15 days of receipt by an occupier of the record of water registered by a meter for any month, the occupier may request the board to test the meter. Should the meter prove to be less than five per centum fast, the cost of testing will be borne by the occupier : in any other case, such cost will be borne by the board and the estimated overcharge refunded pro rata for the month in respect of which the accuracy of the meter is disputed. The charge for testing a meter shall be Rs. 5 (or, in the case of the municipalities of Allahabad, Benares and Agra, Rs. 2).

23. *Cisterns, troughs, water-closets, etc.*—Every cistern shall be provided with a ball valve and a detective or warning pipe and with proper means of access and inspection and, if used for drinking water,

with a dust proof cover. No cistern other than a cistern for the purpose referred to in the next rule shall be placed immediately over or in the same room as a privy.

24. All water-closets shall be provided with water from a cistern and not direct from a service pipe, or by a tap of any kind. Every cistern for the supply of water closets shall be fitted with an efficient waste-preventing apparatus, shall be so constructed as to prevent a continuous discharge or a discharge of more than three gallons of water at each flush, and shall be of sufficient size to contain water for at least eight flushes.

25. All urinal shall be provided with water either from a cistern or from a pipe fitted with a cock. Every cistern for the supply of water to urinals shall be fitted with an efficient waste-preventing apparatus and shall be so constructed as to prevent a continuous discharge or a discharge of more than half a gallon at each flush.

26. Every boiler for generating steam shall be supplied with water from a cistern, and not by direct connection with the service pipe.

27. All watering-troughs for cattle shall be fitted with a proper ball-cock under cover.

28. Hydrants for fire or other purposes shall only be permitted with the special sanction of the board.

29. **Agency and supervision.**—Where a new connection is made with a municipal main or other water-work or an existing connection therewith requires renewal, the connection pipe and all fittings thereto shall be supplied by the board and fitted by municipal agency (through the medium of a contractor or otherwise) at the expense of the person on whose application the connection is made or renewed.

30. No supply pipe or other fitting shall be laid down or attached otherwise than by or under the supervision of an officer or servant of the board appointed in this behalf by the chairman or the executive officer, and such officer or servant shall upon the completion of the fitting in a satisfactory manner and upon due provision being made for the draining off of waste water give a certificate of such completion. The person by or at whose instance the work is done shall pay in advance the cost of supervision and of the certificate at the rates applicable to the municipality concerned.

NOTE.—Any board that desires to require all plumbing work in connection with the water supply to be done by municipal agency can effect this by making a byelaw under section 290 of the Act. In such case the board should apply to be exempted from all the rules relating to agency and supervision.

31. No connection with any municipal main or water work shall be made, renewed, repaired or cut off except by municipal agency (through the medium of a contractor or otherwise).

32. Any connection or supply pipe and any fitting there to laid down, altered or attached in contravention of any rule may be removed, re-laid or re-attached by an order of the chairman or the executive officer and at the expense of the consumer.

33. No person shall perform any work connected with the supply of water until he has been admitted and enrolled as a licensed water works plumber, and has entered into an agreement to conform to, and comply with, the rules of the board. A plumber's licence may be granted to a person who is himself qualified or who engages a qualified workman. The board may prescribe such examination as it deems necessary for the purpose of satisfying itself as to qualifications.

34. The agreement referred to in rule 33 shall include the following conditions, namely :—

(*a*) that the licensed plumber, in all matters in which he may be employed, shall afford every assistance in his power to the board and all municipal officers in carrying out and enforcing the rules for the time being in force ;

(*b*) that the licensed plumber shall, in every case in which he may employed, as far as his employment extends, comply with the rules in force at the time and such orders as may be issued by the municipal engineer or water works superintendent and are applicable to the circumstances of the case.

(*c*) that if any time the licensed plumber or any workman employed by him breaks or evades the said rules, his name may, at the discretion of the board or where there is an executive officer, of such officer, be erased from the list of licensed plumbers, and that in such event he shall at once return his licence to the municipal office ;

d) that if such plumber, acting under a road-opening order, opens any road and fails to repair any damage caused to any road in a proper and workman-like manner to the satisfaction of the municipal engineer or water works superintendent, the road shall be put in proper order at the cost of the said plumber, to be recovered in the manner prescribed in chapter VI of the Act ;

(*e*) that the licensed plumber shall repair any leakage in a communication pipe or cistern connected therewith within 12 hours from the time of being engaged to do so by any person in compliance with rule 48 ;

(*f*) that the licensed plumber shall start the work of making a new connection within a fortnight from the receipt of the orders of the board and shall finish the work within a reasonable time.

35. All fittings of a communication pipe shall be tested and stamped by the municipal engineer or water works superintendent or by some one duly authorized by him, before they are fixed, and the following fee shall (except in the case of the Meerut municipality) be charged for testing :—

Fitting.	Annas.
Stopcock	2
Bib-cock and stop-tap	2
Bath and lavatory fittings	2
Ball-top	3
Water-closet cistern	3
„ „ with ball cock	6
Galvanised iron tank	8
„ „ pipe	6 per 100 linear feet.

No fitting will be tested which is not stamped with the name of the maker.

36. Samples of standard fittings, approved by the Superintending Engineer, Public Health Department, shall be open to inspection at the office of the municipal engineer or water works superintendent.

37. Sample fittings presented to the municipal engineer or water works superintendent shall, if approved by the Superintending Engineer, Public Health Department, be stamped and placed among the standard fittings.

38. *Powers of board.*—The board, or where there is an executive officer, such officer, may take temporary charge, for such period as appears desirable, of any connection pipe.

39. The board may, if it thinks fit, take over any connection pipe occupying any street or land vested in the board, and thereafter such pipe shall vest in, be maintained by, and be at the disposal of, the board as a municipal water-work.

40. The board, or where there is an executive officer such officer may make an inspection of any building or land connected with a municipal main in order—

(*a*) to remove, test, examine, and replace any meter, or

(*b*) to examine the communication pipe and any storage cisterns connected therewith, or,

(*c*) to see if there be any waste or misuse of water.

41. Where any defect is found to exist in any communication pipe or cistern belonging to the owner or occupier of any building or land the board, or where there is an executive officer, such officer, may require such owner or occupier to remedy the defect.

42. The board, or where there is an executive officer, such officer, may without prejudice to any other power conferred by or under the Act, at any time stop a private connection or sever a connection pipe from the main in any of the following events, namely,—

(*a*) in default of payment of water tax or other charges in respect of the private connection within 15 days of the date of the presentation of the bill, till all arrears are paid ;

(*b*) in the case of breakage or damage to the communication pipe, till the breakage, damage or defect is made good to the satisfaction of the municipal engineer or water-works superintendent ;

(*c*) in the case of waste of water, till measures are taken to the satisfaction of the municipal engineer or water-works superintendent to prevent the recurrence of such wastage ;

(*d*) in the case of the communication pipe being without the permission of the board, or, where there is an executive officer, of such officer, extended beyond what is shown in the sanctioned plan, until such extension is cut off ;

(*e*) in the case of the house or land being unoccupied ;

(*f*) if any such officer as is referred to in rule 40 is refused admittance into any house or land for the purposes mentioned in the said rule, or is prevented from making such examination as is referred to in the said rule, until free access is permitted ;

(*g*) if after receipt of a written notice from the board, or, where there is an executive officer, from such officer, requiring him to refrain from so doing, the owner or occupier of any building or land connected with a municipal main continues—

(*i*) to use the water, or to permit the same to be used in contravention of any rule for the time being in force or of any condition prescribed with regard to such private connection by the board, or, where there is an executive officer, by such officer, or,

(*ii*) where the supply is not controlled by meter, to prevent any person not residing in or on the building or land to carry away the water therefrom.

43. *Duties and prohibitions.*—When any private connection has been stopped or connection pipe severed from the main by the board or the executive officer, no person shall reopen such connection or re-connect the connection pipe with the main, except with the permission of the board, or, where there is an executive officer, of such officer.

44. When a connection pipe is severed from the main for any reason, the board, or, where there is an executive-officer, such officer may remove any portion of the communication pipe that has been laid underneath a municipal road or public land, and the cost of doing so and of plugging the main may be recovered from the owner or occupier of the building or land concerned.

45. Except with the sanction in writing of the board, or where there is an executive officer, of such officer, no building or land belonging to one owner shall be supplied with water from a communication pipe from which water is supplied to a building or land belonging to another owner, nor shall any house or tenement have more than one connection pipe.

46. The occupier, or, in the case of a vacant house, the owner, of a building or land connected with a municipal main or water work shall, if the connection is stopped or the connection pipe is severed from the main or water work by the board in exercise of its powers under these rules or on the application of such owner or occupier, pay to the board a fee of Rs. 2 (or Re. 1 in the case of municipalities of Allahabad, Benares and Meerut) for re-opening or re-connection.

In the case of the Cawnpore municipality no fee shall be charged by the board for stopping or severance of connection from the main or water-work in any case, but a fee of Rs. 3 shall be charged for re-opening or re-connection in case of unmetered connections and of Rs. 5 in case of metered connections which has been cut off.

47. The occupier, or in the case of a vacant house, the owner, of a building or land connected with a municipal water-work shall keep in repair every communication pipe and every cistern connected therewith so as to effectually prevent the water from running to waste.

48. If any leakage occurs in a communication pipe or cistern connected therewith, the occupier of the building or land shall within 48 hours apply to the board to effect the necessary repairs or engage for the purpose a licensed plumber.

49. A person shall not attach or cause to be attached any pipe to any municipal main or water pipe or to any apparatus connected therewith, whether belonging to the board or not, or extend, alter or disconnect any communication pipe without the permission of the board, or, where there is an executive officer, of such officer.

50. An occupier of any building or land connected with a municipal main shall not waste or sell water supplied therefrom nor apply it to purposes other than those for which he is entitled to use it, nor, except where the supply is controlled by meter, allow any person not being an occupier of the premises to use the same.

51. No person shall fraudulently—

(*a*) alter the index to any meter or prevent any meter from duly registering the quantity of water supplied, or

(*b*) abstract or use water before it has been registered by a meter set up for the purpose of measuring the same.

Explanation.—The existence of artificial means under the control of the occupier for causing any such alteration, prevention, abstraction or use shall be evidence that he has fraudulently effected the same.

52. No person shall wilfully or negligently—

(*a*) injure or suffer to be injured any meter belonging to the board or any of the fittings of such meter,

(*b*) break, injure or open any lock, cock, valve, pipe, work, or engine appertaining to any municipal water-work,

(*c*) obstruct the flow of flushes, draw off, divert or take water from any such water-work,

(*d*) do any act whereby the water in, or derived from any municipal water-work shall be wasted,

(*e*) obstruct, divert or in any way injure or alter any water main or duct, or

(*f*) without sanction, use for other than domestic purposes any water supplied for domestic purposes or supplied to any stand pipe or pump situated in a street.

53. No person shall—

(*a*) bathe in, at or upon any municipal water-work, or wash, throw or cause to enter therein any animal, or

(*b*) throw any rubbish, dirt, filth or other noisome thing into any water-work, or wash or cleanse therein any cloth, wool, leather, or skin of any animal, or any clothes or other things, or

(*c*) cause the water of any sink, sewer or drain or any steam engine or boiler or any other filthy water belonging to him or under his control to turn or be brought into any water work, or do any other act whereby the water in any water-work is fouled or is likely to be fouled.

54. If it shall be shown that an offence against some provision of these rules has occurred on any premises to which a private supply of water is furnished by the board it shall be presumed, until the contrary is proved, that such offence has been committed by the occupier of the said premises.

Penalty.

In exercise of the power conferred by section 299 (1) of the Act, the Local Government hereby directs that every person committing a breach of any of the provisions of the above rules shall be liable on conviction to a fine which may extend to Rupees one hundred, and where the breach is a continuing one, to a further fine which may extend to Rupees five for every day after the date of the first conviction during which the offender is proved to have persisted in the breach.

Disinfection of a municipal water supply.

The instructions for the disinfection of a municipal water supply on the occurrence of an epidemic of typhoid fever or cholera, drawn up by the Superintending Engineer, Public Health Department, U. P. for the guidance of the boards are given below.

On the occurrence of an epidemic of typhoid fever or cholera which is proved to be in any way traceable to the water supplied from municipal water-works the engineer in charge, on receipt of orders from the Superintending Engineer, Public Health Department, shall at once proceed to disinfect clear water reservoirs and distribution pipes in the manner described below :—

The depth in one compartment of the clear water reservoir should be lowered until only 200,000 gallons of water is left in the reservoir.

Ten pounds (avoirdupois weight) of permanganate of potash (previously dissolved in buckets or in an iron tank) should then be gradually added at about six or seven o'clock in the evening. At 11 p. m. by which time the demand for drinking purposes will have ceased, the pumps should be started and the pink water slowly pumped through the distribution system. Where there is a raised reservoir this should be emptied by opening some of the scour valves before pumping is commenced, so that the disinfectant may thoroughly wash out the reservoir as well as the pipes.

Arrangements should be made, while the pumping is in progress to have all the scour valves opened in rotation to ensure a proper circulation of the disinfecting fluid.

When the reservoir has been pumped empty the supply from the filters should be turned on, and as soon as sufficient water has collected, the pumps should be re-started and clear water pumped slowly through the system for half an hour.

By starting pumping at 11 p.m. it should be possible to have the whole operation completed by three or four o'clock in the morning before water is required for domestic purposes.

The above procedure is to be observed in the case of an outbreak of typhoid; the only difference in the event of the epidemic being one of cholera is that 10 gallons of commercial hydrochloric acid should be added to the solution of permanganate of potash in the clear water reservoir. The hydrochloric acid should, of course, be previously diluted in buckets of water before being put in the reservoir.

Infectious diseases.

The Local Government has notified the diseases of diphtheria, measles, and scarlet fever as infectious diseases which, in addition to the diseases of cholera, plague and small pox, are to be notified under section 297 of the United Provinces Municipalities Act, 1916, to such officer as the board of any municipality may appoint in this behalf.

Infectious diseases hospitals. - 1. The necessity for providing infectious diseases hospitals in all large towns, and more especially in all places to which pilgrims and other resort periodically in large numbers for religious or other purposes has been emphasized by the Pilgrim Committee. When every lodging house and "dharamshala" is full to overflowing and crowds of visitors are camped thickly in every grove or other available space the isolation of such sporadic cases of infectious disease as may occur is obviously necessary but at the same time almost impossible unless a proper hospital has been provided. Early reporting of all cases is also indispensable if effective measures for isolation are to be taken, and this can only be obtained if the confidence of the public has been gained by the establishment of suitable hospitals in which proper treatment is immediately available.

2. The amount of accommodation required in such hospitals can only be gauged by the past experience of each locality, but it is patent that what should be aimed at is the minimum establishment capable of sufficiently rapid expansion to cope with a severe outbreak among the visiting population. Other important considerations are :—

(1) patients should not be deterred by a refusal to admit one or two relatives to the hospital along with them ;

(2) promiscuity of patients of all classes should be avoided and separate wards provided for such as are prepared to pay for their treatment and food ;

(3) the rapid advance in the treatment of cholera has largely increased the percentage of recoveries and so necessitated the provision of more accommodation than was formerly required ;

(4) the too early discharge of convalescents owing to lack of accommodation can only lead to a recrudescence of the epidemic and the necessity for avoiding this must also be considered in deciding the extent of the arrangement necessary ;

(5) the wards for different diseases should, if possible be in separate enclosures, as otherwise there is danger of infection being spread among the various attendants. Similarly there should be separate wards for male and female patients.

3. All municipal boards proposing to establish an isolation hospital for infectious diseases, and so fulfilling one of the elementary duties of a local administration, should apply to the Director of Public Health for standard plans and for advice on any aspects of the question which are not clear to them.

Instructions for the prevention of the spread of cholera in urban areas.

A case of cholera under unhygienic conditions is a source of danger to its neighbours, and much can be done by early and suitable treatment of environment to prevent the extension of the malady. The following measures, whenever and so far as practicable in the local conditions obtaining, should be adopted forthwith on the occurrence of the first cases. Their general application, once the disease becomes epidemic, is almost impossible. The co-operation of the leading local residents should invariably be secured :—

1. If possible, a sweeper should be told off to each house in which there is a patient suffering from cholera. He should be supplied with hycol or cyllin solution of the strength of 1—100 and with some earthenware *gamlas*, preferably glazed.

The sweeper should remove and disinfect the dejecta and vomit of the patient, and should disinfect the floor and house latrine.

2. As soon as the patient dies or recovers, the floor, if *pakka*, and the walls and beds, should be washed down with the same solution. If the floor is *kachcha* either (1) the earth should be removed to a depth of four inches, quickline sprinkled on the ground, and four inches of fresh clean earth substituted ; or (2) the floor should be thickly covered with quickline or covered with grass which should be set alight.

3. Upon the death or recovery of the patient all the clothes worn by him should, if possible, be boiled or disinfected, or if likely to be spoilt by boiling or disinfection, be exposed in the sun for eight hours. When necessary to overcome opposition, compensation may be paid and the clothes burnt. All rags and articles of no value which have come into contact with the patient should be burnt. The *charpoy* upon which the sufferer has been lying, as also any other furniture with which he has come into contact, should be also washed down with hycol or cyllin solution.

4. Upon visiting the house in which a case of cholera has occurred the officials should at once ascertain as to what latrine has been used by the sufferer. Usually it will be a latrine in the house. In this case the sweeper should be sent for, and it should be ascertained to what filth depot or elsewhere the excreta have been removed. The receptacle and carts at such depot should at once be thoroughly washed out and disinfected with hycol or cyllin and re-tarred.

The soil of the depot itself should also be dug to the depth of four inches, disinfected, removed and burnt or treated as in paragraph 2.

Where a public latrine has been used, the entire latrine should be thoroughly washed down and treated with hycol or cyllin and re-tarred.

5. The latrine in the house needs particular attention. It should be dealt with whether the sufferer is stated to have used it or not. The whole of the interior of the structure—floor, walls and ceiling should be well washed down with hycol or cyllin solution, and in addition, if the floor be *kachcha*, the earth to the depth of four inches must be removed

and fresh, clean earth substituted. The *gamlas* should also be thoroughly disinfected, broken up and buried. If the sufferer be dead, these measures will suffice ; but if he be alive, the official should provide *gamlas* (preferably glazed) four inches in depth for the latrine and sick room and also furnish the house sweeper with hycol or cyllin solution and instruct him and the family to disinfect each stool before removal. The *kachcha* floor should be sprinkled thickly with quicklime or treated as in paragraph 2.

6. Almost every private latrine (and nearly every dwelling has a private latrine of some sort) has a drain, *pakka* or *kachcha*, communicating with a drain or cutting outside the house or hut. It can well be understood that it is highly dangerous for the washing from the latrine which has been used by a cholera case to pass into the public surface drains in the crowded streets of a town or city. While the patient is still alive, and until death or recovery, all these drains should be disinfected daily as although the latrine may not be used by the sufferer, the residents of the house will probably throw foul matters into it.

7. A very large portion of houses (and even huts) in a town have a private well in the compound. The water in the well usually being "bitter" (from nitrates, nitrites and chlorides) is not often used for drinking purposes, except on an emergency, and the resident will usually say so ; but it is used for washing plates and the utensils and other purposes, and if it is contaminated or likely to become so it is distinctly dangerous. As the well mouth is usually flush, or nearly flush, with the ground, and as people bathe and wash clothes, etc., in its immediate vicinity, its pollution sooner or later is almost a matter of certainty. Where a case of cholera has occurred, the well should be treated with an ounce of permanganate of potash and sufficient hydrochloric acid to cause the water to slightly redden litmus paper. It should then be closed for a month, or, if further cases occur in the same house, for a month after the recovery or death of the last case.

A useful measure, as tending to prevent the contamination of a public well, is the supply of water by the local authority to the inmates of an infected house.

8. A diffused and extensive outbreak should draw attention to the public water-supply, and especially to the common use of a public well by those attacked ; a more localized outbreak to the source of food-supply ; and an isolated case or cases to the possibility of the introduction of disease from without. The procedure in each case is clearly indicated. A filtered supply should be analyzed and suitably dealt

with; a public well closed or disinfected. A bania's stock may have to be purchased and destroyed. But the last contingency will not often occur. In the majority of cases it is believed the origin of the disease will be found in the contamination of the water-supply; very possibly by an arrival from an infected area.

9. In small urban areas, in which the number of wells is limited and supervision is possible, all the wells with the exception of one or two of the best should be closed temporarily with boards and sods. The wells left open should be permanganated, and for them *Kahars* (water-drawers) should be appointed. No person except the *Kahar* appointed for this purpose is permitted to draw water from these wells. The *Kahars* should be furnished with a new rope or one that has been well soaked in permanganate. At each end of the rope should be affixed an iron bucket or a kerosine oil tin. These tins and *dols* should never be removed from the well during the outbreak. The *Kahars* furnish water by pouring it into a hollow bamboo or tin *purnalla*, below one end of which is presented the water vessel which requires filling. This method is commonly known as the *piau* system. The services of the *Kahars* should be retained for six days after the occurrence of the last cholera case.

Rules regarding disinfectants and disinfection.

1. Boiling clothes, etc., for 20 minutes is a most efficacious method of disinfection.

2. Mercuric chloride is not used in the disinfection of cholera discharges as the mercury combines with the albumen forming an insoluble precipitate and its bactericidal action is lost. In strengths of 1 in 1,000 it is useful for the disinfection of rooms and clothes after small pox, measles, etc.

3. Cyllin and hycol are coal-tar derivatives and are non-poisonous; they are 18 times stronger bactericides than carbolic acid. The disadvantage in their use is a tendency to stain clothes.

4. Bleaching powder is an excellent disinfectant but rapidly loses its strength in this country especially in hot damp weather, the whole of the disinfecting powers being lost in three weeks after a closed drum has been opened.

5. Kerosine or kerosine oil emulsion is used for killing insects such as bugs, fleas and lice which carry the infection of kala azar, relapsing fever or plague. In relapsing fever kerosine must be rubbed into the body to kill lice and their nits.

Disinfectants for water supplies.

6. —(a) *Permanganate of potash* should be used in the disinfection of wells of a strength of ·5 gr. per gallon. That is to say a sufficient quantity should be added to give a perceptible pink colour remaining visible for at least six hours. For ordinary wells 5 feet in diameter and containing six feet of water one ounce should be dissolved in a bucket of water before adding to the well to be disinfected; the water in the well should be agitated by the bucket after the addition of the solution.

(b) *Bleaching powder* is issued in small sealed tins covered with paraffin or in bottles. When freshly received from the manufacturers a 2 oz. tin or bottle is sufficient for a well five feet in diameter containing six feet of water, but, as the strength of the contained chlorine rapidly diminishes, for thorough disinfection in most cases two tins will be required as also where the well is larger than five feet in diameter.

Disinfection of materials.

1. *Clothes*, etc., should be boiled for 20 minutes.

2. *Silk fabrics*, which are liable to be injured by boiling should be placed in the sun for three periods of eight hours each.

3. *Bedding, tents, carpets* should be soaked some hours in an acidified mercuric chloride solution 1 in 1,000.

4. *Bedstead* should be washed down with cyllin or hycol 1 in 200 or kerosine oil where plague or kala azar has occurred.

5. *Metal vessels* should be washed in cyllin or boiled in water.

6. *Leather goods* should be carefully wiped over with formalin.

7. *Cholera.*—Rules for the prevention of the spread of cholera are given elsewhere. These deal minutely with the disinfection required. Cholera stools, vomit, etc., should be disinfected with cyllin or hycol 1 part in 200 or evaporated to dryness in the gumlah into which they are passed, over an ordinary Indian *Chula* specially kept for the purpose. Soiled clothes should be boiled or steeped for 24 hours in cyllin or hycol in a strength of 1 in 400. In using disinfectant with discharges care must be taken that the working strength of the disinfectant used is maintained. If, for example, a given disinfectant is known to kill bacteria at a strength of 10 per cent. it is useless to add a 10 per cent. solution if no regard is paid to securing the presence of the disinfectant to the extent of 10 per cent. of the whole weight or volume of the material to be treated. An intimate mixture of the fæcal mass and the

disinfectant must be secured by means of a stout stick. The average volume of a stool is not less than eight ounces. If we are using hycol as a disinfectant, of which the working strength is 1 to 200 we must add eight ounces of 1 in 100 dilution to obtain a final dilution of 1 in 200.

8. *Rooms and walls* should be washed down with mercuric chloride 1 in 1,000. When disinfection for cholera is required cyllin or hycol 1 in 200 or bleaching powder and water should be used in place of mercury. The walls should then be re-whitewashed.

9. *Floors*, when pakka, should be treated as walls ; when *kachcha* they should be covered with lime to the depth of one inch.

10. *For drains*, hycol, cyllin, bleaching powder or lime should be used.

Quantities of disinfectants to be kept with the medical officer of health should be :

Mercuric chloride	2 lbs.
Hydrochloric acid	4 ,,
Cyllin or hycol	20 gallons.
Permanganate of potash	10 lbs.

Recipe for preparation.

(1)	Mercuric chloride	$\frac{1}{2}$ oz.
	Hydrochloric acid	2 ozs.
	Water	3 gallons.
	Aniline blue	1 gr. (may be added to give colour).
(2)	Cyllin or hycol	1 part.
	Water	200 parts.

This is for walls, etc. For clothes 1 in 400 parts.

(3) Kerosine emulsion.
Hard soap, shaved fine, $\frac{1}{2}$ pound.
Water, 1 gallon.
Kerosine, 2 gallons.

Dissolve the soap in the water, which should be boiling ; remove from the fire and pour it into the kerosine while hot. Churn this with a spray pump till it changes to a creamy, then to a soft, butter-like mass. Keep this as a stock, using 1 part in 8 of water for soft-bodied insects or stronger in certain cases.

Instructions as to the registration and the compilation of births and deaths.

1. In order to establish an accurate and uniform system of vital statistics a board should prescribe the duties of the public by bye-

laws under section 298 (2) heading J (b) of the Act. Model byelaws under this section are given elsewhere.

2. It is incumbent on the chairman, or the executive officer of a board which employs such an officer, to prescribe by executive order the duties of the municipal staff in checking and supplementing the reports of births and deaths made by the public in accordance with the board's byelaws.

3. The byelaws framed under section 298 (2), heading J (b), should deal with reporting alone. To secure accuracy, it is essential that there should be a double compulsory report of these events, on the one hand by the public at a recording station, on the other by the sweepers to the officer in immediate control of them, who, in addition to recording the reports, should also exercise a check on the information given. It is essential that the duties of the public in general should be kept separate from the duties of sweepers. The latter will form the official agency. Experience has shown that it is most necessary to reward reporting sweepers, and the rate of one pice a head which has been adopted in some municipalities appears to be suitable. Punishment on failure of the municipal staff to report would be inflicted by departmental action, while proceedings against the non-official public should be taken on the report of the mortuary registrar. The agents to whom the public should be directed to report will vary locally. Vaccinators, octroi muharrirs, public dispensaries, and paid ward registrars have been suggested. It should be noted that the police cannot be so employed (vide G. O. no. 736-XI-64E dated the 11th March 1911) and that the use of the same agent for the public and the sweepers is entirely contrary to the principle here described.

4. The duties of the registration muharrirs should consist solely in the recording of the report in the form prescribed and in forwarding the same to the municipal office. The duties of the sanitary inspectors will be the same as are assigned to the registration muharrirs, but in addition they should be required to check the reports received from the sweepers.

5. The orders issued to the staff should be divided into three groups dealing respectively with the registration muharrir for public reporting, the sanitary inspector, and the mortuary registrar. It is intended that both registration muharrirs and sanitary inspectors should keep counterfoil report books in identical form, and that the reports received from them weekly at the municipal office should be there compared.

In the larger municipalities it will probably be necessary to employ a full-time clerk wholly on the duties of compilation and comparison.

6. The mortuary registrar will be the medical officer of health in municipalities where such officers are employed. In other cases it will be necessary to specially appoint an officer for this duty other than the officer to whom reports are made by sweepers. It will be advantageous to provide for assistance to the mortuary registrars in their check. Ward members of the board should be encouraged to supervise, and the medical officer of health should take every step to keep in close touch with private medical practitioners through whose help greater diagnostic accuracy as to the cause of death can be obtained. It has been suggested than the latter should be supplied with a form of the nomenclature of the diseases of which returns are required and a packet of postcards addressed to the medical officer of health giving name, age, sect, caste, ward, the cause of death and the signature of the medical man who attended. The mortuary registrar can also employ cemetery muharrirs, "mahabrahmans' and "takiadars" as checks in the case of deaths, and dhais as checks for births. Sanitary inspectors should be responsible for inspection of cemeteries within their circles and for reporting the number of new graves at such intervals, not exceeding a fortnight, as may be prescribed.

But it is important that these subsidiary checks should be external to the normal registration system which has been described, the regular and accurate working of which should be maintained by the attention of the boards and by the prompt punishment of delinquents.

Inspection of municipal works and institutions by Government officers.

The following officers have been appointed by the Local Government under section 33 for the inspection of municipal works and institutions :—

The Superintending Engineer, Public Health Department, The Director of Public Health, The Assistant Directors of Public Health, All Civil Surgeons, All Executive Engineers, All Inspectors of Schools,	United Provinces.

MODEL BYELAWS.

MODEL BUILDING BYELAWS.

(Under section 298, heading A).

Sub-head (a).

1. The board requires, with reference to sub-section (2) of section 178, that notice be given in the case of all buildings wheresoever situated within municipal limits.

Sub-head (c).

2. Every notice of intention to erect, re-erect or make a material alteration in a building or to make or enlarge a well shall be accompanied by plans, in duplicate, as prescribed in the following byelaw. Each such notice shall also be accompanied by a key plan, showing the precise situation of the building.

NOTE —A key plan is not required in small municipalities or in municipalities where there are no detailed plans of the municipal area.

3. The plans shall be drawn to a scale of not less than 8 feet to the inch. The scale used shall be marked on the plans ; and the position of the north point relative to the site plan of the house shall also be clearly indicated. All plans must be signed by the applicant. They must show all details necessary to enable the board to judge as to the suitability of the proposed building. In particular, the following matters must be clearly shown on the plans :—

(*a*) The situation of the proposed building, relative to the streets or lanes adjoining it and to the adjoining houses or other properties ; the names of the owners of the adjoining houses or other properties, together with the number of the *Mahal*, block, *chuk*, and of the house should always be given. The breadth of all adjoining streets or lanes must be shown. In case the breadth is not uniform, the narrowest width should also be shown.

(*b*) Gutters and down spouts should be clearly marked on the plans.

(*c*) The position of, and full details regarding, all wells, drains, latrines, and other sanitary conveniences should be clearly given.

(*d*) When sanction is required in respect of a well, the internal diameter and distance from the nearest privy should be shown.

(*e*) The plans must show, *inter alia*, the following :—

1. the ground floor and the position of the building relative to adjoining streets, properties, and unoccupied spaces ;

2. the first or upper floor and each additional floor ;

3. the elevation of the building on the main frontage line ;

4. at least one cross-section of the building including the streets on which it abuts, showing the correct levels of courtyards and open spaces, drains, streets, lowest floor, and plinth of the building ;

5. the size of windows, doors, and ventilation openings for each room on every storey ;

6. the materials to be used for external walls, partywalls, foundations, roofs, ceilings, floors, and bath-rooms ;

7. the means of access to served privies ; and

8. the purpose for which it is intended to use the building ;

(*f*) All new work should be indicated on the plan by a distinctive colour, and a key to the colours used should be given on the plans.

Sub-head (e)

4. With reference to section 181, the period for which a sanction shall remain in force is six months.

Sub-head (f)

5. (*a*) All buildings to be erected or re-erected must be *pukka* or, *kachcha-pukka*, except in the following areas :—

(*b*) No sheds or lean to roofs shall be allowed to abut on any street.

Sub-head (g)

6. No mosque, temple, church or other sacred or religious building shall be erected (a) unless the frontage is at least 15 feet from the centre of the street on which it abuts, and (b) unless it is situated at a distance of not less than 100 yards from any other sacred or religious building: provided that this byelaw will not apply to the erection of a temple at any one of the following places :—

Sub-head (h) (i)

7. Except in the areas mentioned in byelaw 5 above, the outer covering of all roofs must be made of tiles, iron sheets or other non-inflammable materials.

Sub-head (h) (ii)

8. (1) Every person who erects or re-erects a building which is within 100 feet of the sewer and the water main shall link the privies and sullage drains in such building with the sewer.

(2) No served privy shall be placed in a masonry building situated in a street which has been sewered.

(3) No served privy, urinal, latrine or refuse water-pit shall in any buildings be situated within 15 feet from the cooking place.

9. No *sandas* or drop latrine shall be allowed in any building.

No room other than a bath-room or privy shall be placed over or below a served privy.

10. All persons who erect or re-erect buildings must conform to the standard types of privies prescribed by the board for :—

(*a*) privies connected with the sewer ;

(*b*) servants' latrines for bungalows in civil lines and *ahatas* in the city ;

(*c*) privies on first and higher floors. Sanction will not be given unless these plans and all the conditions imposed in respect thereof are adhered to.

11. No latrine shall be allowed to open on any public street, unless it is screened by a second door at least 5 feet in height or a wall at least 8 feet high between the latrine door and the second door or screen wall.

12. Every urinal, or served privy, shall be placed in such a position as to admit of all filth being removed therefrom and from the premises in which such privy may be situated without being carried through any room in which any person may reside or may be employed.

13. All privies connected with the sewer must be properly trapped and the plumbing and pipe work must conform to the specification prescribed by the drainage byelaws.

14. Every privy, water-closet, and urinal situated in or adjacent to a building must have an opening of not less than 3 square feet in area in one of the walls of the privy, water-closet, or urinal as near the top of the wall as may be practicable and communicating directly with the open air. The door must have a space of 6 inches below it to admit a current of air.

15. (1) The floor of every privy and urinal—

(*a*) shall be made of unglazed polished tiles, stone, slate flags or impervious cement laid in panels or other non-absorbent material not less than half an inch thick.

(*b*) shall be in every part at a height of not less than 9 inches and preferably one foot 6 inches above the level of the surface of the ground adjoining the privy or urinal.

(2) The floor of every served privy and every urinal shall have a fall or inclination of at least half an inch to the foot towards the drain prescribed by byelaw 17.

(3) The floor of every connected privy in which the opening of the pan is placed on the level of the floor shall have a fall or inclination towards the pan of at least half an inch to the foot.

16. (1) The whole privy shall, as regards both internal and external walls, be constructed of first class pakka masonry in lime up to a height of 3 feet from the floor and plastered with coaltar. Above this height *kachcha-pakka* masonry with lime plaster may be used.

(2) In the case of served privies, the entire surface of the walls below the platform or seat shall either be rendered in cement, or be made as prescribed in byelaw 15 (1) (*a*).

(3) In the case of connected privies, the walls must be up to a height of at least 3 feet above the platform or seat, made as prescribed in byelaw 15, clause (1) (*a*)

17. (1) A drain must be provided for every served privy and every urinal. The composition of drains shall be of lime concrete 6 inches—cement plaster ¾ of an inch, or of glazed earthenware pipes resting on 6 inches of lime concrete foundation.

(2) Such drain must connect the floor of the privy or urinal

(*a*) with a public sewer, or,

(*b*) with an impervious cess-pool containing a removable bucket or a removable bucket the contents of which can be deposited in a municipal sewer by hand or in carts for removal to the place appointed by the board. Catch buckets shall be placed on the ground level on a cement platform 1 foot by 1 foot.

(3) (*a*) The drain provided under clause (2), when discharging into an impervious cess-pit, shall be provided with a spout 6 inches in length constructed to allow a bucket 1 foot 6 inches in height to be placed under it.

(*b*) The impervious cess-pit shall be 2 feet in diameter by 2 feet in depth of a circular shape with the edges raised at least 6 inches above ground level and furnished with rounded base and protected from rain water by a cover.

(4) Every served privy must be provided with a moveable receptacle or receptacles for excreta.

(5) The space beneath the platform of privy must be of such dimensions as to admit of a moveable receptacle for excreta, of a capacity not exceeding two cubic feet, being placed and fitted beneath the platform in such manner and position as will effectually prevent the deposit, otherwise than in such receptacles, of any excreta falling through the aperture of the platform.

(6) The privy must be so constructed as to afford adequate access to the said space for the purposes of cleaning such space and of placing therein, and removing therefrom, a proper receptacle for excreta. The said space shall have an impermeable floor, and when the platform or seat is of masonry, the roof of this aperture shall be arched from side to side.

(7) The said receptacle must be water-tight and must be of metal, enamelled iron or glazed earthenware or stoneware and must be of such construction and shape as will admit of its being easily removed and emptied of its contents.

(8) The door for the insertion and removal of the receptacle must be made so as to completely cover the aperture.

18. The platform or seat of every connected privy must either be plastered with cement or be made of some water-tight non-absorbent material. The seat of every served privy must be of iron, stone or of cement, of a standard pattern approved by the board.

19. The house drains through which waste or sullage water is likely to pass must be made of half-round or whole earthenware glazed pipes not less than 6 inches in diameter, properly laid upon a bed of concrete not less than 4 inches thick, and shall be connected with the sewer, where a sewer exists within 100 feet of the building. In other cases the drain must be a *pakka* masonry cemented or glazed earthenware drain and all joints must be rendered tight with cement. These latter drains must be connected with the roadside drain, where a roadside drain exists, within 100 feet of the premises.

20. The building shall be provided with iron gutters and down pipes to take all the rain water which falls on its roof, *chajjas* or other projections. The gutters and down pipes shall be securely fixed and the latter shall discharge into the surface drains by an elbow piece, the orifice being not more than 1 foot above the level of the bed of the drain and discharging in the direction of the flow of the drain.

Definition.—"Privy" means a house latrine.

(*a*) A connected privy is a latrine connected to the main sewer.

(*b*) A served privy is a latrine from which the excrementitious matter are removed by hand and not by water-carriage.

(*c*) A "sandas" or chimney latrine means privy on upper storey, the excrementitious matter from which fall through an opening to the ground floor.

Sub-head (h) (iv).

21. When a building is used for dwelling purposes not more than two-thirds of the total area of the site shall be built or roofed over. [Alternative 21. -(1) When a building is erected for dwelling purposes, not more than two-thirds of the total area of the site shall be built or roofed over, (2) When a building is re-erected for dwelling purposes not more than three-fourths of the total area of the site shall be built or roofed over].

Sub-head (h) (v).

22. The lowest point of the plinth shall be at least $1\frac{1}{2}$ feet above the highest point of the road opposite the house.

Every interior courtyard must be raised at least 1 foot above the level of the centre of the nearest street and must be drained to the satisfaction of the sanctioning authority.

Sub-head (h) (vi).

23. The height of each wall measured from the floor to the corner where the ceiling roof meets the wall shall not be less than that laid down in the following scale :

First story	12 feet.
Subsequent storys	10 feet.

[Alternative 23.—The height of each wall measured from the floor to the corner where the ceiling roof meets the wall shall not be less than 10 feet if the building be placed at the edge of a street which was bounded by buildings at the time when these byelaws came into force and in other cases shall not exceed that laid down in the following scale :

First story – 12 feet.

Subsequent story - 10 feet].

24. (1) The term "story" shall be held to mean a room or set of rooms in a building the floors of which are at or near the same level.

(2) The height of a building shall be held to mean—

(*a*) in the case of pent roofs, the greatest height to top of walls (excluding gable walls) above the level of the centre of the streets on which the building abuts;

(*b*) in the case of flat roofs, the top of the parapet above the level of the centre of the street.

(3) If a building be placed at the edge of a street the height of front of the building measured from $2\frac{1}{2}$ feet above the street edge must not exceed the width of the street on which it faces but if the building or one or more of its storys be set back from the edge of the street, the height of such building or of the portion set back may be increased beyond the height otherwise allowed by this byelaw by the distance that it is set back.

[Alternative 24 (3).—(*a*) If a building be placed at the edge of a street which was not bounded by buildings at the time when these byelaws came into force, the height of the front of the building, measured from $2\frac{1}{2}$ feet above the street edge, must not exceed the width of the street on which it faces, but if the building or one or more of its storys be set back from the edge of the street, the height of such building or of the portion set back may be increased beyond the height otherwise allowed by this byelaw by the distance that it is set back.

(*b*) If a building be placed at the edge of a street which was bounded by buildings at the time when these byelaws came into force, the height of the front of the building, measured from $2\frac{1}{2}$ feet above the street edge, must not exceed twice the width of the street on which it faces, but if the building or one or more of its storys be set back from the edge of the street, the height of such building or of the portion set back may be increased beyond the height otherwise allowed by this byelaw by twice the distance that it is set back].

(4) The number of storys shall not in any case exceed four and the aggregate height shall not exceed 60 feet, except with the special permission of the Public Works Committee.

(6) If a building abuts on two or more streets of different widths, the building shall be deemed for the purpose of this byelaw to face upon the street that has the greater width and the height of the building shall be regulated by the width of that street and may be continued at this height to a depth of 44 feet along the narrower street, where the width of narrower street is not less than 12 feet, or where the width of the narrower street is less than 12 feet, if the applicant gives up to the

board that portion of the site which is within 6 feet of centre of the street.

(6) There shall be in the rear of every building an open space of not less than 12 feet extending in depth along the entire width of the building.

[Alternative 24 (6).—If a building be placed at the edge of a street which was not bounded by buildings at the time when these byelaws came into force, there shall be in the rear of such building an open space......desired].

Provided that if the back of a building abuts on a public street which is less than 12 feet in width, the owner, on giving up to the board that portion of his land which is within a distance of 6 feet from the centre of the public street, shall be exempted from the operation of this byelaw. The part of a building shall not exceed in height 24 feet above plinth level, except where it abuts on an open space exceeding 12 feet in width in which case the height shall not exceed twice the width of such open space :

Provided that extra height may be allowed on condition that third or subsequent storys are set back to a depth equal to the extra height desired.

[Where the alternatives mentioned above are adopted the following byelaw should also be made for the purposes of alternative byelaws 23 and 24 :—

A street shall be deemed to be bounded by buildings when there are buildings situated in the direction of both ends of the street from the site in question, whether such buildings are on the same side of the street or on the opposite side].

Sub-head (h) (viii).

25. Every room intended for human habitation (*a*) shall have a clear superficial area of not less than 80 square feet excluding the staircase (if any) and a minimum width of 8 feet ;

(*b*) shall be provided with windows or iron-barred apertures of a total area not less than one-tenth of the floor area opening directly into the external air or into an open verandah ;

(*c*) shall be built so that no part of it is more than 20 feet from any window or aperture provided for in clause (*b*) ;

(*d*) shall have every such window so constructed that the whole of it can be opened ;

(*e*) shall [where only window or closeable iron-barred apertures are provided under (*b*)] be provided for purposes of ventilation with at least two ventilating openings of a superficial area of not less than 12 square inches opening directly into the external air ;

(*f*) where the windows or apertures do not reach to within 2 feet of the ceiling or where there is no ridge ventilator, shall have at least one clerestory ventilating window, at a level of not more than 2 feet below the ceiling and opening directly into the external air. The area of such clerestory windows shall be not less than $\frac{1}{25}$ of the wall of the room on which they are to be constructed ;

(*g*) where not provided with clerestory windows or ridge ventilation, shall have roof or ceiling ventilators or a ventilator opening at the level of the ceiling or junction of the roof with the outer wall of the room of an area of not less than 24 square inches per 500 cubic feet of room space. No such single ventilator shall exceed in area 60 square inches.

Definitions :—

(1) An open varandah for the purpose of this byelaw means a verandah whose exterior face is not obstructed to the extent of more than one-third at any one point in its length.

(2) Any part of a room divided off by a partition above 6 feet 6 inches in height shall, for the purpose of this byelaw, be considered a separate room.

(*h*) In every building intended to be occupied in flats the principal common staircase must be adequately ventilated upon every story.

26. No building shall be erected for residential purposes on any site which has a frontage of less than 25 feet or a depth of less than 40 feet.

Sub-head (h) (ix).

27. No wells shall be sanctioned unless they are *pakka* throughout. If built inside a house, the internal diameter must be at least 3 feet. No well shall be sanctioned within 20 feet of a served privy unconnected with the sewer.

Projection byelaws.

[Under heading E, sub-head (*c*) and heading J, sub-head (*d*) of section 298].

NOTE.—The model building byelaws just described merely cover the erection or re-erection of buildings on the builder's own land and do not cover the erection or re-erection of projections over public streets or drains. Sub-section (2) of

section 184 of the new Act especially provides that sanction to the erection or material alteration of a building "shall not operate to relieve any person from the obligation imposed by section 291 to obtain separate sanction for any structure referred to therein". Moreover, under the provisions of section 209 no board may give permission for the erection or re-erection of projections over any streets or drains unless it has made byelaws for the purpose and any permission so granted must conform with the conditions prescribed in such byelaws. If, therefore, boards desire to have power to grant permission for such projections, they must first make byelaws for that purpose.

Draft byelaw 8 contains useful provisions ; while draft byelaws 9 and 10 relate to the power that has been conferred upon boards by sections 293 and 298-J (*d*) of the Act to charge fees for the occupation of public ground by such projections. For the purposes of draft byelaw 9 and the schedule a board should form as many class of streets as may be necessary to differentiate between lands of widely different values. In forwarding their proposals boards are required to state what relation the fees which they propose to charge bear to the market value of the frontages on the streets. A board, it may be explained, may make the fees applicable not only to new projections but also to existing projections, and in the latter case boards may find it advisable to charge higher rates for projections in narrow streets in which it is necessary to discourage projections. Number 10 is a byelaw which boards may consider necessary in order that shopkeepers may not be charged separately for a shop-board and the sunshade above it.

1. Every application for permission to erect or re-erect any projection over a street or drain shall be accompanied by the following plans, in duplicate prepared in the manner prescribed in byelaws :—

(*a*) a key plan of the locality showing the precise situation of the building concerned ;

(*b*) a plan indicating the situation of the building concerned in relation to the streets or lanes adjoining the building and to the adjoining buildings or land and indicating the breadth of the adjoining streets or lanes and in the case of a street or lane of which the breadth is not uniform, the width in the narrowest part ; and

(*c*) where an open municipal drain has to be closed, a plan and section showing clearly how it is proposed to cover the drain in question and, where a culvert is to be built, showing the exact tunnel size of the culvert.

2. The plans shall be drawn to a scale of not less than five feet to the inch. The scale used shall be marked on the plans and the position of the north point shall also be clearly indicated. All plans must be signed by the applicant and show all details necessary to enable the board or the executive officer to judge as to the suitability of the proposed projection. The names of the owners of adjoining buildings or lands, together with the muhalla and house number shall be given. All projected work shall be indicated by a distinctive colour and key to any colour used displayed on the plan.

3. The dimensions and position of proposed projections must conform with the condition hereinafter prescribed.

4. No projection from a ground floor shall be allowed, except for the purpose of permitting access across a drain to a building.

5. Under every projection over a drain other than a culvert a space of not less than one foot must be left open towards the street.

6. No balcony, verandah, chajja or other projection shall be allowed from an upper story of a building over a street which has a width of less than 20 feet at any point in front of the building. In measuring the street the width shall be taken from the edge of the drain nearest to the roadway on the side of the building concerned up to the edge of the drain nearest the roadway on the opposite side.

7. No projection, such as is described in the preceding byelaw, shall exceed three feet in width except in the following streets (except over a street exceeding——feet in width at every point in front of the building concerned).

8. Projections over public streets or drains may be permitted only on the following conditions :

(*i*) that the owner or occupier shall daily remove all refuse from the land over which his projection extends and keep the land clean ;

(*ii*) that the owner shall keep any open drain over which the projection extends in good working order and free from depressions in which liquid can stagnate ;

(*iii*) that the owner or occupier shall, at any time, on demand vacate the surface of his projection for a period of not more than six hours to permit of municipal servants inspecting or repairing or cleaning any covered drain therein ;

(*iv*) that the owner shall duly pay in advance the fees prescribed by the next following byelaw.

9. Subject to byelaw 10 the annual fees for projections shall be as shown in the accompanying Schedule.

10. When two or more projections from the same storey cover the same ground the highest fees chargeable for any one of such projections shall be levied and no other.

11. Nothing in these byelaws shall be construed to derogate from the powei conferred on the board by section 211 of the Act to remove encroachments and projections over streets and drains, notwithstanding that such encroachments and projections may have been sanctioned.

SCHEDULE.

ANNUAL FEES FOR PROJECTIONS.

(*Vide Rule 9*).

A.—In Streets of Class I.

Frontage	Fees according to frontage when the projection into street perpendicular to its border is—			
	one foot or less.	over one foot and not over two feet.	over two feet and not over three feet	over three feet and not over four feet.
	Rs.	Rs.	Rs.	Rs.
Six feet or less				
Over six feet and not over nine feet				
Over nine feet and not over 12 feet, ...				
and so on				

B.—In Streets of Class II.

Frontage.	Fees according to frontage when the projection into street perpendicular to its border is—			
	one foot or less.	over one foot and not over two feet.	over two feet and not over three feet.	over three feet and not over four feet.
	Rs.	Rs.	Rs.	Rs.
Ten feet or less...				
Over 10 feet and not over 15 feet				
Over 16 feet and not over 20 feet				
and so on				

MODEL BYELAWS FOR DRAINS PRIVIES AND CESSPOOLS, etc.

[UNDER SECTION ; 298 HEADING *B*.]

PIPES.

1. All drains for private drainage shall be constructed of stoneware socketed pipes or of C. I. socketed pipes of the following dimensions :—

(*a*) Stoneware pipes.

Length of pipe exclusive of socket.	Thickness of pipe.	Internal diameter of pipe.	Depth of socket.	width of space for joining materials.
2 feet 2 feet 6 inches or 3 feet.	Not less than $\frac{1}{12}$ of the internal diameter of the pipe.	4 inches. 6 do. 9 do. 12 do.	Not less than 2" $2\frac{1}{4}$ inches. $2\frac{1}{2}$ do. $2\frac{3}{4}$ do.	$\frac{3}{8}$ inch. $\frac{3}{8}$ do. $\frac{1}{2}$ do. $\frac{1}{2}$ do.

(*b*) Cast iron pipes.

Length of pipe exclusive of socket.	Internal diameter of pipe.	Thickness of metal	Weight of one length of pipe.	Depth of socket.	Space for joining materials.
			Cwt. qr. lb.		
9 feet ...	4 inches. 6 do. 9 do. 12 do.	$\frac{3}{8}$ inches. $\frac{7}{16}$ do. $\frac{17}{32}$ do. $\frac{19}{32}$ do.	1 1 14 2 1 14 4 2 1 6 2 1	3 inches. $3\frac{1}{2}$ do. 4 do. 4 do.	$\frac{1}{4}$ inch. $\frac{3}{8}$ dn. $\frac{2}{3}$ do. $\frac{3}{8}$ do

The stoneware pipes, traps, bends and junctions shall be capable of standing an internal pressure of not less than 20 lb. per square inch without leaking.

They shall be highly vitrified and salt-glazed in a kiln, perfectly smooth, free from fire cracks, bubbles, blisters, and other imperfections, uniform in bore and thickness, the sockets and spigots absolutely square to the length of the pipe, the straight pipes shall be perfectly straight and the bends formed to a regular radius.

2. Pipes will be rejected which will not admit of a disc $\frac{1}{4}$ of an inch less in diameter than the specified pipe, being passed freely through it.

3. The cast iron pipes, traps, bends and junctions shall be of good tough grey iron from the second melting, smooth inside, true in section and uniform in thickness, the straight pipes to be perfectly straight and the bends formed to a regular radius, the metal to be free from air holes sand holes, or other defects and the whole of the internal and external surfaces thoroughly coated while the pipe is hot with Dr. Angus Smith's solution.

Jointing material.—Joint of stoneware drains shall be made with one or two strands of tarred gaskin and Portland cement mortar composed of one part best Portland cement and one part sharp sand well pressed home in the socket and finished externally with a fillet.

Joints of C. I. drains shall be run with molten lead and well caulked.

4. The stoneware or cast iron pipe drains must be laid at a gradient to be governed by circumstances, but must in all cases be approved by the municipal engineer.

All main and branch drains shall be laid in straight lines with a uniform inclination throughout their length. Inspection chamber shall be provided at each point where the inclination or direction of the drain changes.

All stoneware drains shall be laid in and completely surrounded with 6" thickness of good lime concrete. Cast iron drain shall be laid in 6" thickness of good lime concrete.

Joint holes shall be left at each joint and filled in with concrete after the drains have been inspected and tested by the board's officer.

5. After the drains have been inspected and approved by the municipal engineer or a municipal servant deputed by him, the excavated earth shall be carefully replaced in the trench, care being taken to pack over and round the drains with selected soft material to a depth of 12 inches. The remainder of the earth shall then be filled in 6 inches layers and each layer well rammed and consolidated.

Inspection chamber.—All inspection chambers shall be built of first class brickwork in good lime mortar on a foundation of at least 6 inches of good lime concrete. The thickness of brick work shall in no case be less than 9 inches.

In the case of chambers on stoneware pipe drains the inverts shall be formed of semi-circular glazed stoneware socketed channels with joints made with cement mortar.

The benchings shall be formed of fine Portland cement concrete finished with ½ inch plaster of Portland cement trowelled to a smooth face.

6. Branch drains shall be built into the walls of the inspection chamber and continued across the benching in half or three-quarter section glazed stoneware bends discharging over the main half pipe channels. The interior of the inspection chamber shall be either (*a*) first class glazed brickwork, with the joints raked out ½ inch deep and pointed with Portland cement mortar or (*b*) first class brickwork with the joint raked out ½ inch deep and the whole face pointed with Portland cement mortar.

Each inspection chamber shall be finished as to be perfectly watertight.

Inspection chambers on C. I. drains where a C. I. inspection box or junction box with a bolted down cover is provided shall be constructed in a similar manner to those on stoneware drains except that the benching may be omitted and the interior of the chamber shall be of first class brickwork with the joints raked out and pointed with Portland cement.

7. *Inspection chamber covers.*—Covers for inspection chambers shall be of cast iron, with sealed joints in cast iron frames, securely bedded on the brickwork of the chamber with Portland cement mortar.

8. *Testing.*—All drains, manholes and inspection chambers, soil pipes and antisiphonage pipe shall be tested with smoke, air or water or any other method at the discretion of the municipal engineer and shall remain perfectly tight when subjected to a pressure equal to 2 feet head of water over the highest point of the drains or pipes.

PRIVIES AND WATER-CLOSETS.

9. The walls of every connected privy or water closet up to a height of at least 12" above the platform shall be constructed of thoroughly well-burnt bricks, plastered and not merely lined with cement or if the engineer do direct of glazed brick, artificial stone or cement.

10. Every connected privy, water closet or urinal situated in a building must have an opening of not less than 3 square feet in area in one of the walls thereof, as near the top of a wall as may be practicable and communicating directly with the open air and enclosed by wire-mesh netting.

11. Every connected privy or water closet must, if required by the engineer, be provided with a reserve tank of not less than 30 gallons capacity for one seat, 50 gallons for 2 seats and 80 gallons for 3 seats. Every such tank shall be of galvanised or black iron of a thickness not less than no. 14 B. U. G.

12. Every connected privy or water-closet must be provided with a flushing cistern approved by the engineer and of 3 gallons capacity, neither more nor less, connected with the pan by a flush pipe, and such flush pipe must not be less than $12\frac{1}{2}''$ in diameter.

13. Every privy or water-closet shall have a syphon trap with at least 3" water seal and in every case where two or more water closets or privies are connected to one soil pipe antisiphonage pipe at least $1\frac{1}{2}''$ diameter shall be connected to each trap not more than 12 inches distant from the highest point of the trap. Each branch antisiphonage pipe shall be connected to a main antisiphonage pipe of 2 inches internal diameter which shall be carried at least 6 feet above the level of the roof or alternatively shall be connected to the main soil and ventilation pipe at a point higher than the level of the uppermost water closet connection. Antisiphonage pipe shall be of cast iron with caulked lead joints or with the permission of the municipal engineer of drawn lead pipe.

Soil pipes shall be of cast iron at least $\frac{3}{16}$ inches thick of the following weights :—

Internal diameter			Weights. Weight per 6 ft. length
4 inches	...	...	54 lb.
5 "	...	...	69 "
6 "	...	...	84 "

All soil pipes, bends and branches shall have socket joint run with molten lead and caulked.

Every branch pipe shall be connected to the main pipe with a proper cast junction piece provided with a screw cap 3 inches diameter so placed as to be accessible for cleaning purposes.

All soil pipes shall be outside the main external walls of the building.

No pipe shall be placed sc as to abut on or project over any adjacent building site or land which may be used as a building site.

The water closets or privy pans shall be of glazed porcelain and of such pattern and dimensions as may be approved by the health officer. Each pan shall be provided with flushing rim and suitable connection for the down pipe from the flush tank. The trap as before mentioned must have at least 3" water seal and may be cast in one piece with the pan or if separate it must be either of the same material as the pan or of cast iron of soil pipe weight and description. The joint between the pan and a cast iron trap shall be made with Portland cement.

Ventilation of drains.—Every soil pipe shall be carried up as a ventilator to a point at least 5 feet above the level of the roof of the building to which it is attached and in addition shall discharge in such a position as not to be likely to cause a nuisance to the occupiers of any premises.

At the head of every main drain and (if required by the municipal engineer) at the head of every branch thereof more than 20 feet in length from the main drain a cast iron ventilating pipe exactly similar to a soil pipe shall be carried up in the manner prescribed for soil pipes.

Intercepting trap.- On every main drain at a point as near as may be practicable to the sewer an intercepting trap of a pattern approved by the municipal engineer shall be fixed on the drain in a properly con structed inspection chamber. Such intercepting trap shall have a water seal of at least 3 inches and shall be provided with a cleansing and with an airtight stopper.

All soil and ventilation pipes shall be protected at the head by means of cages formed of tinned copper wire.

14. Every connected privy situated in a building must be separated by a masonry wall from kitchens, habitable rooms in which any person is or is intended to be employed in any manufacture, trade or business.

URINALS.

15. Every connected urinal shall have a proper cistern and appliances for flushing purposes and be provided with an approved soil pipe

Every connected urinal shall be provided with a syphon trap which must be proof against syphonage.

CISTERNS.

16. Cisterns for flushing, if supplied with $1\frac{1}{4}''$ discharge pipe, shall be placed at the height of at least 4 feet from the pan of the connected privy.

CONNECTION PIPES.

17. All pipe connections for privies, water closets or urinals, shall be laid with the spigot end of each pipe in the direction of the flow of sewage.

CESSPOOLS.

18. Cesspools should be made either of concrete lined cement or of brickwork so lined (the cement in every case being not less than $\frac{1}{2}''$ in thickness) or of any other impervious material approved by the Engineer,

VENTILATORS.

19. Except with the special sanction of the health committee previously obtained, every inlet for the admission of pure air to the master trap of any premises shall be at least 5 feet away from a door, window, ventilating grating or chimney of any building.

AGENCY TO BE EMPLOYED FOR CONSTRUCTION OF DRAINS, PRIVIES, ETC.

20. No connection of any house drain, privy, water closet or urinal shall be made with the municipal sewer, except with the written permission of the engineer, and substantially in accordance with the approved plans kept in the office of the board.

The agency, by which the works described in the foregoing byelaws shall be constructed, shall be either the municipal board or a licensed plumber, but no connection shall be made between a communication pipe and the sewer except by the engineer.

21. The fees prescribed for connection are as follows and must be paid in advance :—

(*a*) for a manhole connection ... ... Rs. 4
(*b*) for a brick sewer connection ... ... " 6
(*c*) if pit is required ... ... " 17
(*d*) extra fees will be charged to cover special charges, such as the restoration of a paved footpath as the engineer may direct. Additional fee Re. 1 per foot run from termination of work constructed by the owner or occupier to point of connection. This includes the cost of restoring the road surface.

PENALTY.

In exercise of the powers conferred by section 293 (1) of the Act, the board hereby directs that a breach of any of these byelaws shall be punishable with fine which may extend to Rs. 100, and when the breach is a continuing one, with a further fine which may extend to Rs. 5, for every day after the first conviction, during which the breach exists.

MODEL WATER-SUPPLY RULES.

1. The following model rules have been framed by the local Government for the regulation in individual municipalities of the matters connected with water-supply, under sections 235 and 296 of the Act and are supplementary to the general rules which have been given before.

2. The board shall maintain a system of water-supply through pipes throughout the municipality.

3. The pressure at which water shall be laid on shall be a pressure of......feet at the engine house, and such pressure shall be maintained between the hours of......A.M. and......P.M.

4. The intervals at which standpipes or pumps shall be erected in all the chief streets, or portions thereof, in which mains have been laid, shall not exceed......yards.

5. The board shall arrange for the chemical analysis, by a qualified analyst approved of by the Government, of one sample taken from a standpost in the municipality in May and September of each year and for the bacteriological analysis, by a qualified analyst approved of by the Government, of one sample from the settling tank intake once a week in September and of one sample from each filter well, taken 24 hours from the time that a well is re-started after the renewal or scraping of the sand and taken subsequently every seventh day during the time that the filter runs without being scraped or the sand renewed.

PRIVATE SUPPLY.

(*Statutory.*)

6. The minimum water tax payable in respect of any building or land which shall entitle the owner or occupier thereof to connect his building or land with a supply main, shall......be......rupees per annum.

7. A connection pipe laid down by any person in the exercise of the right conferred by section 228 (1) (b) of the Act shall not exceed, in its inside diameter, half an inch.

8. The inside diameter of a ferrule and the number of taps in a service pipe shall not exceed the following scale, namely :—

	Size of ferrule.	Number of taps.
For a building or land assessed to water tax for Rs.... (or less) per annum.	1/8"	...
For a building or land assessed to a water tax of Rs.... (or less) per annum.	1/4"	...
For a building or land assessed to a water tax of Rs.... (or less) per annum.	3/8"	...
For a building or land assessed to a water tax of Rs.... (or less) per annum.	1/2"	...
For a building or land assessed to a water tax of Rs.... (or more) per annum.	1/2"	...

Proviso I.—Where the owner or occupier of a building or land assessed to water tax is desirous of using a ferrule of a diameter, or taps of a number, exceeding that permitted by the above scale, such owner or, with the permission of the owner, such occupier, may present to the executive officer a notice of his intention to use same and of his willingness to pay as a charge, in addition to his water tax, the sum by which that tax falls short of a water tax of an amount permitting the use of the required diameter or taps of the required number ; and thereupon he shall become liable for the payment of such charge and entitled to use such ferrule and taps on or from and until the date specified in rule 12.

Proviso II.—If any building or land is so situated that a ferrule of the size prescribed by the above scale is too small to pass in any six hours a quantity of water equal to......gallons for every rupee of water tax annually assessed on the building or land, the executive officer may permit the use of a ferrule of a larger size.

9. Nothing in the preceding rule shall be construed to prevent the board entering into an agreement with any person for the supply of water subject to control by meter through a connection pipe or ferrule of a greater size, or through taps of a greater number than that prescribed in rule 8.

10. The amount of water which the board is required to deliver into a storage cistern for the purpose of compliance with section 228 (1) (c) of the Act shall be—

for a building or land assessed	Gallons.
to a water tax of Rs................(or less) per annum	50.
" " " "	"
" " " "	"
" " (or more) per annum	500.

11. No storage cistern for the purpose of section 228 (1) (c) of the Act shall be erected at an altitude exceeding :—

	Feet.
In ward A	......
" " B	......

PRIVATE SUPPLY.

(By agreement).

12. The executive officer may agree on behalf of the board with the owner or occupier of any building or land to allow the building or land to be connected with the municipal main by means of a communication pipe of the size, and fitted with a ferrule of the size and with taps of the

number, prescribed in the following scale, for the purpose of supplying to such building or land water for domestic purposes at the annual rates prescribed in the scale below which shall be payable—

(*a*) in the case of a new connection, on the date on which the municipal engineer certifies that the connection is complete, and

(*b*) in the case of an existing connection, on the first day of April of each year, and

(*c*) until such owner or occupier has given notice in writing to the executive officer for the discontinuance of the connection :

Provided that the rates in the case of a school, dispensary, hospital, "dharamshala", orphanage, temple, mosque, or church shall be one-half of the rates prescribed in the scale below :—

Scale of rates etc.,

Size of connection pipe.	Size of ferrule.	Number of taps.	Rate per annum.
$\frac{1}{2}''$	$\frac{1}{8}''$	...	Rs......
$\frac{1}{2}''$	$\frac{1}{4}''$	...	Rs......
$\frac{1}{2}''$	$\frac{3}{8}''$	...	Rs......
$\frac{1}{2}''$	$\frac{1}{2}''$	...	Rs......
$\frac{1}{2}''$	$\frac{1}{2}''$	...	Rs......

13. The executive officer may also in like manner agree to allow any building or land to be connected for domestic purposes with a municipal main by means of a larger communication pipe, or a communication pipe fitted with a larger ferrule or greater number of taps than that prescribed in the preceding rule or for non-domestic purposes, on condition that the water is taken by measurement : provided that the board may, by resolution, and with the previous sanction of the Commissioner allow the use of water for non-domestic purposes on any other conditions that it deems fit.

14. It shall be deemed a condition of every agreement whereby a board undertakes to supply water by measurement that the board

shall supply a meter, and that the occupier shall pay a monthly rent for the same according to the following scale : —

Scale of rent.

Size of meter.					Monthly rent. Rs.	a.	p.
$\frac{3}{8}''$	...	...	...	...			
$\frac{1}{2}''$	...	...	...	...			
$\frac{3}{4}''$	...	...	...	...			
1″	...	...	...	...			
$1\frac{1}{4}''$	...	...	...	...			
$1\frac{1}{2}''$	...	...	...	...			
2″	...	...	...	...			
3″	...	...	...	...			
4″	...	...	...	...			

PRIVATE SUPPLY.

(General)

15. Where the supply of water to any building or land (whether such supply be required by the Act or by an agreement under the Act) is controlled by meter the charge shall be Rs. 1 per......thousand gallons :

Provided that the rates in the case of a school, dispensary, hospital, "dharamshala", orphanage, temple, mosque or church shall be one-half of the aforesaid amount.

16. Notwithstanding that the supply of water to any building or land is not otherwise subject to control by meter, whenever the executive officer has reason to believe that :—

(*a*) in the case of water supplied under section 228 (1) (*b*) of the Act, the amount of water consumed in any one month exceeds... gallons for every rupee of water tax assessed on the building or land, or

(*b*) in the case of water supplied by agreement under rule 12 such amount of water exceeds ...... gallons for every rupee of the amount payable in respect of the supply under the said rule, or

(*c*) that water is being used for a purpose other than that for which it is supplied or is being wasted, he may attach a meter to any part of the connection pipe and thereafter the supply of water shall be subject to control by the meter and the occupier shall pay rent for the meter according to the scale mentioned in rule 14.

17. With reference to Rule 30 of the United Provinces Municipal Water-supply Rules the rates for the supervision of work connected with the laying down of supply pipes or attachments of other fittings and of giving a certificate of completion shall be according to the following scale :—

Scale of rates for supervision etc.

Nature of pipe or fitting.	Cost.
......	Rs......

Note—The following instructions should be borne in mind by boards in framing drafts of these rules :—

Rule 2—is required for the purposes of section 228 (1) (*a*) (*i*) of the Act. The area or areas to be prescribed in this rule should be the area or areas in which a water tax is in force. In most municipalities the water tax is in force in the whole municipality, but in some municipalities the tax is in force only in specified areas and in such cases the words "throughout the municipality" in this rule should be replaced by a description of the area or areas.

Rule 3—is required with reference to section 228 (1) (*a*) (*ii*). The pressure should, as far as possible, be sufficient to deliver water at a height of 25 feet above the level of any street in any area in which the water tax is in force. Twenty five feet is suggested with a view to enabling water to be delivered into a cistern in the second storey of a building. A board should in forwarding its proposals state how far it has been found possible to reach or approximate to the pressure recommended.

Rule 4 - is required by the provisions of section 228 (1) (*a*) (*iii*) of the Act. The minimum interval prescribed should be double the radius fixed by rule for the purpose of section 129 (*a*) of the Act. See model rule for water tax at page 336 of the Municipal Manual (edition of 1922).

Rule 6—is rendered necessary by the provisions of section 228 (1) (*b*). The minimum tax prescribed should be equal in amount to the minimum rate fixed under rule 12 for water supplied by agreement to a house that is not assessed to the water tax.

Rules 7 and 8 are required by the provisions of the same sub-section. No private connection should be allowed with a connection pipe having a diameter of more than ½" unless the supply is metered, as a $\frac{1}{2}''$ connection pipe should be sufficient in all cases for the supply of water for domestic purposes only. It necessarily follows that the minimum diameter of a ferrule of an unmetered supply is also restricted in rule 8 to $\frac{1}{2}''$. In proviso II to rule 8 the number of gallons to be entered is the number of gallons prescribed by rule 15, divided by 365.

Rule 10—Ten gallons per head is a sufficient allowance for domestic purposes, and a minimum of 50 gallons and a maximum of 500 gallons per day should be a sufficiently liberal allowance for a household under this rule.

Rule 11 The maximum altitude or altitudes to be prescribed under this rule will be determined by the pressure prescribed under rule 3.

Rule 12—This rule fixes the rate to be charged for ferrule connections (i.e. non-metered supplies) for water for domestic purposes to houses and lands not assessed to the water tax. As noted in connection with rule 6, in fixing the rate under this rule, the principle should be observed that the charges for such connections should be at least as high as the amounts of water tax fixed by rule 8 in the case of connections to buildings or lands assessed to the water tax. The charges in some municipalities for schools and for buildings specified in the proviso are half the ordinary rates; boards which do not give such concession rates for such buildings should omit the proviso, while those that give concession rates should substitute the particular rate or rates that they allow. The classes of buildings entitled to the concession rates should be specified in detail. Following the principle laid down in rules 7 and 8 no connection should be allowed with a diameter of more than $\frac{1}{2}''$ unless the supply is metered.

Rule 13—The proviso under this rule is intended to cover cases where boards allow persons to compound for water used for non-domestic purposes, e.g., where water used for building purposes is charged for on the basis of the measurement of the building or of an estimate of the masonry work in the building concerned.

Rule 15—Some boards charge a universal rate of Re. 1 per......gallons except in the case of classes of buildings mentioned in the proviso to this rule, where half the usual rate is charged. Other boards, however, have differential rates for domestic and non-domestic purposes; while others again differentiate between the rates for the price of water deducted from the bills under section 230 (2) on account of water tax paid and the price for water used in excess of such quantity. In the

FORM A (*see rule* 15.)

Births registered during the month of and liable to compulsory vaccination during the month of in vaccination circle of municipality.

Consecutive number from the 1st January 19 .	Reporting agency and date.	Name of circle.*	Name of muhalla and house number.	Date of birth.	Name of father or guardian.	Name of child, if any fixed.	CASTE AND SEX OF CHILD.										Signature of recording officer.	Date when a child should be vaccinated.	Legal notice issued one week before required date of vaccination.	PRIMARY.													CAUSE OF NON-VACCINATION.						RE-VACCINATION.								Date of verification by vaccinator.	Signature of vaccinator.	Initials of inspecting officer.
							CHRISTIAN.				HINDU.		MUHAMMADAN.		OTHER CLASSES.					FIRST TIME.			SECONDARY VACCINATION.				FINAL RESULT			Date of verification by vaccinator.	Signature of vaccinator.	Initials of inspecting officers.	POSTPONED ON MEDICAL CERTIFICATE.			Died (date).	Left the town or excused on account of scars of small-pox (date of verification).	Unaccounted for (date of verification).	FIRST TIME.			SECONDARY RE-VACCINATION.		FINAL RESULT.					
							European or Eurasian.		*Indian.*														*Second time.*		*Third time.*								*First time.*		Extended to—														
							Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.				Age at time of vaccination.	Date of operation.	Number of the lymph used.	Date of operation.	Number of the lymph used.	Date of operation.	Number of the lymph used.	Successful.	Unsuccessful.	Unknown.				From—	To—					Age at time of re-vaccination.	Date of operation.	Number of the lymph used.	Number of the lymph used.	Date of operation.	Successful.	Unsuccessful.	Unknown.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
																												Total ...														Total ...							

* Vaccination circle should include one or two registration circles.

NOTE.—As soon as a child is vaccinated entries are made in columns 21, 22 and 23. If on inspection at the end of seven days the vesicles are found to be good, letter S is inserted in column 28 and entries are also made in columns 31 and 32. If unsuccessful, column 28 is left blank. If a second vaccination is attempted entries are made in columns 24 and 25, and if a third attempt is made in columns 26 and 27, but these are recorded as secondary vaccinations. The total number of primary vaccinations is obtained by totalling the number of entries in columns 22, 24 and 26. The total number of persons primarily vaccinated is obtained by totalling the entries in columns 28, 29 and 30. The total number of successful primary cases is obtained from column 28, that of unsuccessful cases from column 29, and unknown from column 30.

Similarly, the total of persons re-vaccinated is obtained from the total of entries in columns 45, 46 and 47, the total number of re-vaccinations from the total of entries in columns 41 and 44, that of successful re-vaccinations from column 45, unsuccessful from column 46, and unknown from column 47. Total of entries in column 44 gives secondary re-vaccinations.

Form B.

Showing children brought into the ——————— municipality and liable to compulsory vaccination.

Consecutive number from the 1st January, 19 .	Name of place and district from which brought in.	Name of circle.*	Name of muhalla and number of house where residing.	Date of entry in this register.	Name of father or guardian.	Name of child, if any fixed.	Age of child.	CASTE AND SEX OF CHILD.										Signature of recording officer.	Date when a child should be vaccinated.	Legal notice issued one week before required date of vaccination.	PRIMARY.													CAUSE OF NON-VACCINATION.						RE-VACCINATION.								Date of verification by vaccinator.	Signature of vaccinator.	Initials of inspecting officer.
								Christian.				Hindu.		Muhammadan.		Other classes.					First time.			Secondary vaccination.				Final result.			Date of verification by vaccinator.	Signature of vaccinator.	Initials of inspecting officer.	Postponed on medical certificate.			Died (date).	Left the town or excused on account of scars of small-pox (date of verification).	Unaccounted for (date of verification).	First time.			Secondary re-vaccination.		Final result.					
								European or Eurasian.		Indian.														Second time.		Third time.								First time																
								Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.				Age at time of vaccination.	Date of operation.	Number of the lymph used.	Date of operation.	Number of the lymph used.	Date of operation.	Number of the lymph used.	Successful.	Unsuccessful.	Unknown.				From—	To—	Extended to—				Age at the time of re-vaccination.	Date of operation.	Number of the lymph used.	Number of the lymph used.	Date of operation.	Successful.	Unsuccessful.	Unknown.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
																																														Total ...				

* Vaccination circle should include one or two registration circles.

case of these latter boards the words "the charge shall be Re. 1 per... thousand gallons" should be replaced by the following words:—

	Per...thousand gallons.		
"For quantities not exceeding in any one month.....gallons for every rupeee assessed as water tax on the building or land to which the water is supplied	Rs.	a.	P.
	1	0	0

(N.B.—The entry to be made in the blank space after the words, "in any one month" will be $\frac{1}{12}$ of the number of gallons entered in the marginal entry "Re. 1 per......thousand gallons)". For quantities in excess of the above—

	Per thousand gallons.		
	Rs.	a.	p.
(*a*) If taken for domestic purposes	...	...	...
(*b*) If taken for non-domestic purposes	...	...	...

Where concession rates are charged the classes of buildings to which such concession rates are applicable must be specified in detail in this rule as well as in rule 12.

Rule 16.—The number of gallons to be entered here is one-twelfth of the amount fixed under rule 15. Where different amounts are fixed under rule 15 this rule must be amended accordingly.

Wherever the words "executive officer" occur in these rules the boards of municipalities where there is no executive officer should substitute the word "board". The powers thus conferred upon the board may then be delegated by the board by a regulation under section 297 read with section 112 of the Act to the Chairman or Water-Works Superintendent or such other officer or servant as may be deemed advisable, or in default of such delegation the powers referred to will vest in the Chairman under the provisions of section 50 of the Act.

Similarly where the words "municipal engineer" occur they should be replaced by the words "Water-Works Superintendent" in the case of municipalities where the municipal engineer is not in charge of the water works.

MODEL BYELAWS FOR THE REGISTRATION OF BIRTHS AND DEATHS IN MUNICIPALITIES.

Under Section 298 J (*b*).

1. The head of every family resident in or on a visit to the municipality, and the keeper or person in charge of every lodging house, "dharamsala", sarai, hospital or other similar institution therein shall,

within three days of the occurrence of any birth or death in his family or among persons staying in the said premises, report the same personally or by an agent or in writing in accordance with the provisions of the following byelaw.

Note.—In this and all following byelaws "births" shall include "still-births", which shall be distinctly specified.

2. The report shall contain the following particulars :—

A.—Regarding birth.

1. Date and time of birth.	7. Profession of parent.
2. Name (if any) of child.	Name of muhalla.
3. Whether still-born.	8. Number of house according to door-plate.
4. Name of father or mother.	9. Name of reporter.
5. Sex.	10. Signature of recording officer with date.
6. Caste.	

B.—Regarding death.

1. Date and time of death.	7. Name of muhalla.
2. Name of deceased and name of father, husband or guardian.	Number of house according to door-plate.
3. Sex.	8. Place of cremation or burial.
4. Caste and profession.	9. Name of medical practitioner who attended deceased during the last illness.
5. Age.	10. Name of reporter.
6. Cause of death attested by a medical practitioner in case when a medical Practitioner is in attendance.	11. Signature of recording officer.

Provided that, if the deceased be a pardahnashin woman, *i.e.*, one who does not come out in public the entry of her name shall not be necessary; in such cases it will be sufficient to enter the relation which she bears to the head of her family.

3. The report shall be made at such a place and to such a person as the board shall proclaim by beat of drum and public notice for the recording of such events within the local area concerned.

4. The sweeper of each *muhalla* shall report personally within three days the occurrence of any birth or death in his *muhalla* to the circle sanitary inspector, or to the officer directly responsible for conservancy work where no sanitary inspector is employed.

NOTE.—In the places where reports by *muhalla* sweepers are not possible the duties of the sweeper should be imposed on the conservancy jamadar.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that any person bound by byelaw 1 and any person bound by byelaw 4 above to report the occurrence of any birth or death and failing to do the same shall be liable respectively to a fine of rupees ten and rupees five.

MODEL DAIRY BYELAWS.

[UNDER SECTION 298, HEADING I, SUB-HEADS (a) AND (b)].

Cattle-sheds and dairies.

PART I.

Cattle-sheds and cow-houses.—1. Every cattle-shed and cow-house must be well paved with asphalt, stone, brick-on-edge with cement-pointing, or flagstones set in cement, or with some other suitable impervious material, approved by the chairman (or executive officer).

2. (1) The floor of every cattle-shed and cow-house must incline to a channel or gutter sloping towards and draining directly into a gully pit communicating with sewer situated immediately outside the shed or house :

Provided that, in the unsewered area :—

(*a*) such channel or gutter must drain directly into a cesspool similarly situated, the contents whereof shall be removable, and

(*b*) such cesspool must be constructed of bricks set in cement and cement plastered, or of some other suitable impervious material approved by the $\frac{\text{chairman}}{\text{executive officer,}}$ and must be so constructed as not to admit rain-water.

(2) The slope of the floor must be made so as to incline away from the heads of animals, and, in the case of floors of sheds or houses hereafter constructed and accommodating two rows of animals, must be made so as to incline outwards.

3. Every cattle-shed and cow-house in which cattle are kept for sale or for the sale of their produce must have, for purposes of light and ventilation, an opening of not less than one foot in width, on all sides below the junction of the eaves and the wall of the building.

4. Every cattle-shed and cow-house must have one story only, and there shall be no construction, arrangement or fixture permitting of any lofts or sleeping places, either over the roof or within the interior over the stalls:

Provided that—

(*a*) the $\frac{\text{chairman}}{\text{executive officer}}$ may sanction the erection of an upper story if the floor thereof be constructed of impervious material to his satisfaction; and

(*b*) an appeal shall lie to the health committee in any case in which the $\frac{\text{chairman}}{\text{executive officer}}$ refuses such sanction.

5. The interior fittings of every cattle-shed and cow-house must be so constructed and placed as to provide for each animal kept in the shed or house a clear superficial floor space of at least 40 square feet and a clear lateral space of at least 5 feet.

6. The walls of every cattle-shed or cow-house must be at least seven feet in height from the level of the floor up to the junction of the eaves with the walls.

7. (1) No cattle-shed or cow-house in which cattle are kept for sale or for the sale of their produce shall be so constructed as to provide for the storage of milk or milk-vessels therein.

(2) For every cattle-shed or cow-house in which milch cows or milch buffaloes are kept there shall be provided a separate shed or place for the temporary storage of milk and milk-vessels.

(3) Such shed or place shall not communicate directly with any cattle-shed or cow-house and shall not, without the special permission of the $\frac{\text{chairman}}{\text{executive officer}}$ be placed within a distance of 15 feet from any privy connected with a sewer or 25 feet from any service privy or urinal.

PART II.

Inspection of milch cattle and cleansing, drainage and water-supply of dairies and cattle-sheds in the occupation of persons following the trade of dairymen or milk-sellers.--

8. In this part—

(*a*) "cattle-shed" means any place in which milch cattle are kept, and

(*b*) "dairyman" means any person following the trade of cow-keeper, milk-supplier or milk-seller.

9. Every occupier of a cattle shed, every person having the care or control of milch cattle, and every dairyman, shall afford all reasonable assistance and facility to the executive officer, medical officer of health, the sanitary inspector, and any other servant of the board appointed to inspect milch cattle, whenever he is so required by any such servant desiring to inspect such cattle.

10. Every dairyman—

(*a*) shall cause every part of the interior of every cattle-shed in his occupation to be thoroughly cleansed from time to time and as often as may be necessary to secure cleanliness, and

(*b*) shall cause the floor of every such shed to be thoroughly swept and all dung and other offensive matter to be removed, at least twice every day, and

(*c*) shall, after the floor is so swept, cause it to be swilled with fresh water.

11. Every dairyman shall cause the drainage of every cattle-shed in his occupation to be so arranged that all liquid matter which falls or is cast upon the floor shall be drained off by suitable means to be approved by the $\frac{\text{chairman}}{\text{executive officer}}$

12. (1) Every cattle-shed in which milch cattle are kept for the sale of their produce and which is within a radius of 600 feet from a municipal standpost, must be provided with an adequate supply of filtered water to the satisfaction of the $\frac{\text{chairman}}{\text{executive officer}}$,

(*a*) for the cattle to drink,

(*b*) for washing utensils used for milk, and

(*c*) for flushing purposes,

(2) No unfiltered water shall be supplied to any such cattle- shed.

PART III.

Cleanliness of milk stores, milk shops and milk-vessels.—13. In this part, "dairyman" means any person following the trade of cow-keeper, milk supplier or milk-seller.

14. Every dairyman who is in occupation of a milk-store or milk-shop shall cause every part of the interior of such store or shop to be thoroughly cleansed from time to time, and as frequently as may be necessary, to maintain the store or shop in a thorough state of cleanliness.

15. Every dairyman shall—
   (*a*) cause every vessel used by him for containing milk to be thoroughly cleansed with steam or boiling water immediately after such use ; and
   (*b*) take all proper precautions for maintaining every such vessel in a constant state of cleanliness.

PART IV.

Procedure on the occurrence of contagious disease.— 16. In this part—
   (*a*) "dairy" includes any farm-house, cattle-shed cow-house, milk-stall, milk-shop or other place from which milk is supplied or in which milk is kept for the purpose of sale, and
   (*b*) "dairyman" includes any owner or occupier of a dairy, as defined in clause (*a*) of this byelaw, and any person following the trade of dairyman, milk supplier or milk seller.

17. Every dairyman shall, whenever any milch animal in his dairy is affected with any contagious disease, forthwith give notice to the medical officer of health.

18. Every dairyman shall, in order to prevent infection or contamination, forthwith remove or cause to be removed from his dairy and from the proximity of other animals any animal therein which is found to be suffering from any contagious or infectious disease.

19. On the outbreak of any contagious or infectious disease, every dairyman shall, if so required by notice from the medical officer of health—
   (*a*) cause his dairy to be temporarily emptied of all animals, and,
   (*b*) cause the whole interior surface of the dairy to be disinfected or limewashed, or both.

20. No dairyman shall at any time permit any person suffering from any dangerous disease to enter or remain in his dairy or the precincts thereof.

21. No dairyman shall sell or permit to be sold the milk of any animal suffering from any contagious or infectious disease (including tubercular disease of the udder), or shall add such milk or permit it to be added to any milk of other animals which is intended for sale or for human consumption.

22. No dairyman shall deposit or keep any milk which is intended for sale—
   (a) in any room or place where it would be liable to become in-

fected or contaminated by impure air, or by any offensive, noxious or deleterious gas or substance, or by any noxious or injurious emanation, exhalation or effluvium, or

(b) in any room used as a kitchen or inhabited room, or

(c) in any room or part of a building which is used for sleeping, or

(d) in any room, place or part of a building in which there is any person suffering from any dangerous disease, or

(e) in any room, place or part of a building which has been used by any person suffering from any dangerous disease, unless it has been thoroughly disinfected to the satisfaction of the medical officer of health, or

(f) in any room or part of a building in which there is any urinal or privy or any direct inlet to any drain, or

(g) otherwise than in covered receptacles.

23. No dairyman shall cause or permit any cow belonging to him or under his care or control to be milked for the purpose of obtaining milk for sale or for human consumption—

(a) unless at the time of milking the udder and teats of such cow are thoroughly clean, and

(b) unless the hands of the person milking such cow are thoroughly clean and free from all infection or contamination.

24. No person shall—

(a) carry any milk for sale or for human consumption in any vessel unless such vessel be made of some impervious material and be provided with a suitable covering, or

(b) allow any milk, while being so carried, to be exposed to dirt, dust or any other offensive matter.

PART V.

25. If any person commits a breach of any of the foregoing byelaws, the $\frac{\text{chairman}}{\text{executive officer}}$ may, in his discretion, send him written notice to discontinue such breach.

PART VI.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that every breach of any of the foregoing byelaws shall be punishable with fine which may extend to twenty rupees, and, in the case of continuing breach, with a fine which may extend to five rupees for every day during which the breach continues after the date of the first conviction.

MODEL BYELAWS FOR THE REGULATION AND INSPECTION OF PLACES FOR THE MANUFACTURE, PREPARATION OR SALE OF SWEETMEATS.

[UNDER SECTION 298 F (d) AND I (h)].

1. In these byelaws "sweetmeat" means all food stuff prepared by *halwayis*, *khaunchawalas* and *tandurwalas*, and includes *poories*, *kachauries*, bread, *samosas*, vegetable curries and *chat* intended for human consumption.

2. Nothing in these byelaws shall apply to any house or building used for making or storing sweetmeats intended for private consumption only.

3. No shop proper or storeroom shall be used for residential purposes.

4. No sweetmeats shall be prepared or stored in any building or place which has not been approved of as sanitary and suitable by an officer of the board duly appointed for the purpose.

5. Sweetmeats intended for sale shall not be placed in or on dirty utensil or exposed for sale without protecting them for flies and dust.

6. All substances used in the preparation of sweetmeats must be free from harmful adulteration and of good quality.

7. No person suffering from any contagious or infectious disease shall be employed in a shop where sweetmeats are made or sold.

8. Water kept for cleaning utensils and for use in the preparation of sweetmeats, and for drinking by customers shall be obtained from the municipal pipe supply or from a pure source sanctioned by the medical officer of health. Water thus obtained must be stored in clean vessels provided with covers adequately to protect it from contamination.

9. No cupboard, case, utensil or other apparatus shall be used in any such place while in a dirty condition or in a condition that fails to secure, so far as is possible, the immunity of all sweetmeats, articles or ingredients used in or for the making thereof, from contamination by dust, insects or other injurious things.

10. Every such place shall be adequately lighted and ventilated and shall be whitewashed at least once quarterly.

11. No lamp or other light shall be used in any such place which is likely by reason of its construction or condition, to cause smoke or soot.

12. In any such place no vessel shall be used for keeping *achars*, (pickles) or other articles containing acids or vegetable matter, unless it is constructed of stone, china or glass or is enamelled, tinned or electroplated ware.

13. All such places shall be open during business hours to inspection by the board and the occupiers thereof shall be bound to comply with all reasonable directions consistent with the purposes of these byelaws issued to them by the board.

PENALTY.

In exercise of the powers conferred by section 299 (1) of the Act, the board hereby directs that a breach of any of the provisions of these byelaws shall be punishable with fine which may extend to rupees fifty and in the event of a continuing breach, with a further fine which may extend to rupees five for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

MODEL BYELAWS FOR THE REGULATION AND CONTROL OF BAKERIES.

[UNDER SECTION 298 (2) F (d)].

1. "Bakery" means a building in which European confectionery is prepared for sale.

Confectionery includes all sorts of bread, biscuits, sweetmeats or the like.

2. No person shall establish a bakery or cause a bakery to be established within 100 feet of any cow-house, stable, public latrine, open sewage, cesspit or public dust-bin.

3. Every owner or occupier of a bakery shall comply with the following conditions :—

(*a*) He shall not maintain a privy on the premises, unless it is separated from the bakery by an open passage at least six feet wide and is situated more than 21 feet from the bakery window and has no direct communication with the bakery.

(*b*) He shall cause any drains or drain pipes or sewers for carrying off sullage or sewage matter which run under or near the bakery to be constructed to the satisfaction of the medical officer of health.

(*c*) He shall not cause or suffer any room adjacent to the bakery to be used as a living or sleeping room, unless it be separated from the bakery by a substantial wall, and unless it contains a window opening directly on a passage or space open to the sky not less than eight feet wide.

(*a*) He shall provide the bakery with a window or windows with an aperture for the passage of light of one-tenth of the floor area and capable of being opened, and shall cover the windows with wire gauze of such a mesh as will keep out flies, and (if considered necessary by the medical officer of health) shall cause the bakery to have self-closing doors with panels partly wood and partly filled in with galvanised gauze netting.

(*e*) He shall cause a good impermeable floor to be provided over the whole area of the bakery.

(*f*) He shall cause the kneading tables or troughs, if not of masonry, to be covered with galvanized iron or zinc sheeting or tin or other impermeable material.

(*g*) He shall cause the bakery to be open to the inspection of the chairman, executive officer, medical officer of health, or any other member or officer duly authorized in this behalf.

(*h*) He shall not himself dwell or sleep or suffer any other person to dwell or sleep in the bakery.

(*i*) He shall not suffer any animal to be kept in the bakery.

(*j*) He shall not suffer any "hookah" or other appliance for smoking, or any bedding or soiled clothes or other articles not required for purposes of the bakery to be kept in the bakery.

(*k*) He shall cause kneading tables, troughs, and all utensils used in the bakery to be thoroughly scrubbed and washed with water daily.

(*l*) He shall not use or suffer to be used in the preparation of confectionery any unwholesome materials.

(*m*) Water kept for cleaning utensils and for use in the preparation of bread, confectionery, etc., shall be obtained from the municipal pipe supply or from a pure source sanctioned by the medical officer of health. Water thus obtained must be stored in clean vessels provided with covers to protect it from contamination.

(*n*) He shall cause all dough and other materials used in preparing the products of the bakery and all products of the bakery to be kept in clean receptacles and to be cleanly covered to the satisfaction of the medical officer of health.

(*o*) He shall cause all the inside walls and the ceiling of the bakery, whether plastered or not, and all passages to be limewashed at least once in every three months.

(*p*) He shall not cause or suffer any person other than employees or a member or official of the board to enter the bakery.

(*q*) He shall not employ in the bakery any person suffering from any contagious or infectious disease or allow any such person to sell confectionery on his behalf.

(*r*) He shall not carry or cause to be carried confectionery for sale or delivery to a customer except in tins or other suitable metal boxes provided with properly fitted covers.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board directs that any breach of byelaws 2 and 3 shall be punishable with fine, which may extend to Rupees one hundred, and when the breach is a continuing breach, with a further fine which may extend to Rupees five for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

MODEL BYELAWS FOR CONTROLLING THE MANUFACTURE AND SALE OF AERATED WATER.

(NOTE.—These byelaws may be applied *mutatis mutandis* to ice factories).

[UNDER SECTION 298 (2) F (d)].

1. No person shall establish the business of an aerated water factory within 100 feet of any cow-house, stable, public latrine, cesspit or public dust-bin.

2. Every owner or occupier of an aerated water factory shall comply with the following conditions :—

(*a*) He shall not maintain a privy on the premises unless it is separated from the factory by an open passage at least six feet wide and is situated more than 20 feet from the factory windows and has no direct communication with the factory.

(*b*) He shall not cause or suffer any room adjacent to the factory to be used as a living or sleeping room unless it is separated from the factory by a substantial wall, and unless it contains a window opening directly into a passage or space open to the sky not less than eight feet wide.

(*c*) He shall cause any drains, pipes or sewers for carrying off sullage and sewage matter which run under the factory to be constructed to the satisfaction of the medical officer of health.

(*d*) Where drains communicating with municipal drains cannot be constructed, he shall cause a separate receptacle to be kept for the reception of all foul water, and the contents thereof to be removed daily to such place as the medical officer of health may direct.

(*e*) He shall provide that the premises shall have a window or windows with an area for the passage of light of at least one-tenth of the floor area of each room and that each window shall be capable of being opened and shall be covered by wire gauze of such a mesh as will keep out flies, and (if considered necessary by the medical officer of health) he shall provide for the premises self-closing doors partly of wood and partly of gauze netting of a similar mesh to that covering the windows.

(*f*) He shall cause the floors, drains and the walls, to a height of six feet, to have a smooth, non-absorbent surface.

(*g*) He shall cause the water used in the manufacture of aerated water to be drawn from the municipal filtered supply or, if such a supply is not available, from a well of a type approved by the medical officer of health.

(*h*) When a filtered water supply is available he shall provide a standpipe and tap within the factory.

(*i*) He shall provide within the factory three tanks or receptacles—

(*i*) one a special covered cistern to contain water to be used in æration, which he shall connect directly to the supply tap or pump, and shall so locate as to be free from sources of contamination, but to admit of being readily cleansed;

(*ii*) one for washing and disinfecting the bottles and brushes; and

(*iii*) one for finally washing out bottles before re-filling.

(*j*) He shall cause the premises to be open to the inspection of the chairman, executive officer, medical officer of health or any other member or officer duly authorized in this behalf.

(*k*) He shall not himself dwell or sleep or suffer any other person to dwell or sleep in the factory, (*l*) He shall not suffer any animal to be kept in the factory.

(*m*) He shall not suffer any ***hookah*** or other appliance for smoking or any bedding or soiled clothes, or other articles not required for the purposes of the factory, to be kept in the factory.

(*n*) He shall cause the utmost cleanliness to be observed in the various processes of manufacture and the premises and appliances to be kept in a thoroughly clean and sanitary condition.

(*o*) He shall cause all the inside walls, above the height of six feet, and all the ceilings or roofs of the factory, whether plastered or not and all passages to be limewashed at least once in every three months.

(*p*) He shall not use or suffer to be used in the manufacture of ærated water, sugar, acid and essence or flavouring agents which are not of good quality.

(*q*) He shall not allow water used in the factory to be carried in *massakhs* or otherwise than in metal vessels.

(*r*) He shall cause all bottles to be filled direct from the tap in the storage water cistern and shall not suffer any dippers to be used for filling the bottles.

(*s*) He shall cause the brushes used for scrubbing the interior of dirty bottles and the bottles themselves to be cleaned in a solution of permanganate of potash of the strength of five grains to a gallon of water and shall cause the bottles after the preliminary soaking and cleaning in one tank to be finally washed out in or from a second tank, which shall contain a tap water solution of permanganate of the strength of half a grain to the gallon. When the permanganate in the second tank has turned brown, he shall cause it to be renewed.

(*t*) He shall cause the three tanks to be well cleaned and rinsed out once a week with permanganated water of the strength of half a grain to a gallon.

(*u*) He shall not suffer any rubber rings to be used in the bottles unless they are in good order and shall cause any ring which has deteriorated to be destroyed.

(*v*) He shall cause labels bearing the address of the factory and the name of the owner or manager to be affixed to each bottle.

(*w*) He shall not employ on the premises a person suffering from any contagious or infectious disease.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board directs that any breach of any of the provisions of the above byelaws shall be punishable with fine which may extend to Rupees one hundred, and when the breach is a continuing breach, with a further fine which may extend to Rupees five for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

MODEL BYELAWS FOR THE REGULATION AND INSPECTION OF SLAUGHTER-HOUSES.

[UNDER SECTION 298 F (2) (d) AND J (d)].

1. *Inspection of animals for slaughter.*—No animal shall be slaughtered in any slaughter-house unless it has been inspected and passed by the inspecting officer appointed in this behalf.

2. The board shall give public notice of the time and place whereat inspections of cattle intended for slaughter in the municipal slaughter-house are held.

3. At the time and place so appointed, the inspecting officer shall examine every animal produced before him, and satisfy himself that the animal—

(*i*) is fit for use as human food,

(*ii*) is not diseased, or advanced in pregnancy,

(*iii*) is not very infirm or excessively old :

Provided that an animal which has met with an accident, rendering it unfit for further work, shall not be rejected merely on this account.

4. If the inspecting officer is satisfied as above, and not otherwise, he shall fill up, or cause to be filled up under his signature, columns 1 to 6 of a pass with its counterfoil in form A appended to these byelaws and give it to the person producing the animal for inspection. The animal shall then, in the presence of the inspecting officer, be marked on the head, hair or skin with a municipal seal or branded with a municipal brand, as the board may prescribe.

5. Any animal produced for inspection, which is affected by any contagious disease, or which may reasonably be suspected of being so affected, shall, if the inspecting officer so directs, be forthwith seized and removed to the cattle infirmary for treatment at the expense of the owner; or the animal may be disposed of in accordance with section 244 of the Act.

6. Any animal produced for inspection, which is in a dying condition, but not so affected as to be dealt with under the preceding byelaw, shall, if the inspecting officer so directs, be forthwith seized and disposed of in such manner as the inspecting officer may direct:

Provided that this byelaw shall not apply to an animal which has met with an accident.

7. *Officer in charge of slaughter-house.*—A municipal officer shall be on duty at the slaughter-house throughout the hours prescribed for slaughter and such officer shall be deemed to be the officer in charge of the slaughter-house.

8. The officer in charge shall keep up a daily register showing the sex, age, the value and description of every animal slaughtered at the slaughter-house and shall send a monthly abstract of this register to the municipal office. Separate registers shall be maintained for animals slaughtered for the Burma meat trade and for animals slaughtered for local consumption.

9. *Slaughter-house fees.*—Every butcher using the slaughter-house shall pay fees at the following rates, which shall be posted up at the door of the slaughter-house:—

For each animal slaughtered.

	Annas per head.
Bullocks	
Buffaloes	,,
Goats, sheep, kids, and lambs	,,
Horned cattle	,,
Other animals	,,

10. Unless the collection of fees is farmed, every person from whom any such fees are leviable shall pay them to the officer in charge.

11. On receipt of the fee the officer in charge shall fill up a ticket and counterfoil in the form B attached to these byelaws, and hand the former with the coupon attached to the person who paid the fee. The

progressive total of the daily receipts shall be entered in the place provided at the foot of each counterfoil as each ticket is issued.

12. The holder of a ticket shall produce the ticket when called upon to do so by the executive officer (secretary or any other officer of the board duly authorized in this behalf). Such officer shall, after such examination as he may think necessary, fill up the counterfoil and shall return the ticket to the holder after initialling it.

At the slaughter-house. - 13. No animal shall be admitted, and no person shall bring any animal, into the slaughter-house, unless it is covered by a pass in form A, as prescribed in byelaw 4 above, and unless the fee prescribed in byelaw 9 has been paid. The pass must be presented at the slaughter-house within three days of the time of issue.

Explanation.—If any animal covered by a pass is not brought to the slaughter-house within three days of the issue thereof, a fresh pass shall be obtained.

NOTE.—In this byelaw the period of three days prescribed appears to be excessive, at least in cases where the place for the inspection of the cattle is at the slaughter-house, and it is suggested that in such cases a period of 24 hours should be sufficient.

14. The officer in charge shall receive the pass, and if it is in order and the fee prescribed in byelaw 9 above has been paid, he shall allow the animal or animals covered thereby admission into the slaughter-house, filling up columns 7 to 9 of the pass. The passes shall be dealt with in such manner as the board may direct.

15. Except with the general or special permission of the board, no one but the butchers, their assistants, and the municipal officers connected with the slaughter-house shall enter or be allowed to enter the premises during the process of slaughtering, skinning, or cutting up the carcasses.

16. No person affected with leprosy, or with any skin disease, shall enter, or be allowed to enter, the slaughter-house permises.

17. No dogs shall be admitted into, or be allowed to enter, the slaughter-house. All dogs found there shall be destroyed.

18. No animal shall be admitted, and no person shall bring any animal into the precincts of the slaughter-house unless it is intended for immediate slaughter. All cattle awaiting slaughter shall be kept in pens attached to the slaughter-house and there properly secured with ropes until required for slaughtering.

19. Butchers shall make their own arrangements for the feed of their cattle while in the pens, and shall have their own servants to look after them.

Within the slaughter-house.—20. No person shall slaughter any animal except at such hours as may from time to time be fixed by the board. These hours shall be notified in some conspicuous place in the slaughter-house.

21. Each butcher shall have a place assigned to him by the officer in charge for slaughtering: and he shall slaughter his cattle immediately over the central drain so as to prevent the blood of the animals from flowing upon the floor.

22. Immediately after the slaughter of an animal the butcher shall cause the portion of the slaughter house assigned to him to be carefully washed and cleaned.

23. Every carcass shall, after slaughtering, skinning and cleaning, be presented for the inspection of the officer in charge of the slaughter-house, and no butcher shall remove from the slaughter-house, except in accordance with the next clause of this byelaw, any carcass which appears to the officer in charge to show signs of any contagious disease, or other disease rendering the meat unfit for human consumption.

If any such carcass be found, it shall be disposed of in accordance with the provisions of section 244 of the Act. In the event of a dispute arising under this byelaw the matter shall be referred to the medical officer of health of the board, whose decision shall be final.

24. If, on the inspection prescribed by the preceding byelaw, the carcass is found to be fit for human consumption, each piece of meat cut therefrom shall have impressed thereon or affixed thereto, under the supervision of the officer in charge, such stamp or seal as the board may from time to time prescribe.

25. The skin of an animal whose carcass has been condemned under byelaw 23 above shall, if the officer in charge, or the medical officer of health so direct, be disposed of in the same manner as the carcass.

26. Skins, entrails, and offal shall be removed from the slaughter-

house by the butchers; and any skin, entrails or offal not removed before the time at which the slaughter-house is closed for the day shall become the property of the board, and may be disposed of in such manner as seems to it fit:

Provided that, if the board so prefers, it may delegate to the officer in charge the power to have such skins, entrails or offal removed at the owner's or butcher's expense; and the officer in charge may refuse to such butcher or owner or his servant any subsequent admission to the slaughter-house until such expense is made good to the board.

27. No person shall remove any skins, entrails and offal from the slaughter-house until they have been properly washed and cleaned.

28. The solid contents of the entrails shall not be washed into the cesspools, but shall be cleaned up and removed by the butchers or their assistants at the same time as the entrails and offal are removed under byelaw 26 above.

29. Meat, entrails, and offal shall be removed from the slaughter-house in covered carts or covered baskets or vessels, of a patern to be approved by the board, and the officer in charge of the slaughter-house shall daily inspect the said carts, baskets or vessels, and see that they are kept clean and in good order. He shall not allow any meat to be removed in a cart, basket or vessel that is not clean or in good order.

30. No person shall employ the process of insufflation (the blowing of carcasses) in the slaughter-house.

31. No butcher or other person shall sell, or allow to be sold, meat on or at the slaughter-house premises.

32. Butchers or private individuals using the slaughter-house shall be responsible for any damage wilfully or negligently caused to the slaughter-house either by their own act or the acts of their servants, and any butcher and private person using the slaughter-house, who refuses to pay such damage, shall be excluded from the slaughter-house until he pays the cost of damage done.

33. No butcher or other person shall remove, deface, or alter any seal or brand impressed in accordance with byelaw 4 above, or any stamp or seal impressed upon or affixed to any piece of meat in accordance with byelaw 24 above.

FORM A.

Counterfoil of Pass Book No.— No.—						Pass. Book No.— No.— ....Municipality.								
Serial Number.	Date of pass.	Name of the owner of cattle, with parentage, caste, and address.	Kind of animal.	Description of animal.	Initials of inspecting officer.	Serial number.	Date of pass.	Name of the owner of cattle, with parentage, caste and address.	Kind of animal.	Description of animal.	Signature of inspecting officer.	Signature of the officer in charge of the slaughter-house attesting the animal, with its description.	Name of slaughter-house.	Remarks.
1	2	3	4	5	6	1	2	3	4	5	6	7	8	9

Note.—Each head of cattle should be entered separately in the pass, but one pass may be used for as many cattle belonging to the same person as can be entered thereon.

FORM B.

Counterfoil of slaughter-house ticket.

Book No—

No.—

Date.	Name of butcher.	No. and description of animals or area of space used, i.e. particulars according to which the fee is levied.	Amount.			Signature of Muharrir.
1	2	3	4			5
			Rs.	As.	P.	

Total brought forward.
Progressive total carried over.

(This ticket is available only for the animals specified therein and is neither transferable nor renewable).

Slaughter-house-ticket.

Book No.—

................Municipality.

No—

Date.	Name of butcher.	No. and description of animals or area of space used, i.e. particulars according to which the fee is levied.	Amount.			Signature of Muharrir.
1	2	3	4			5
			Rs.	As.	P.	

Slaughter-house coupon.

Book No.—

No—

Name.........

Amout.........

Date...........

Signature of inspecting officer.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that a breach of any of the provisions of byelaws 9, 10, 12, 13, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 and 33 shall be punishable with fine which may extend to Rupees fifty, and when the breach is a continuing breach, with a further fine which may extend to Rupees five for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

MODEL BYELAWS REGULATING THE SALE AND TRANSPORT OF MEAT.

[UNDER SECTION 298 F (a), (b), (c)].

Definition.—1. In these byelaws "meat" means the flesh of horned cattle, goats, swine or sheep intended for human or animal consumption.

2. No person shall sell or expose for sale any meat within the limits of the municipality, unless he has been granted a licence in this behalf.

3. The............shall be the licensing officer for the purpose of these byelaws.

4. A licence granted under these byelaws shall be subject to the following conditions :—

(1) No one shall sell or expose for sale the flesh of any animal which has died from a natural cause, or any meat which has been blown up or artificially stuffed.

(2) No one shall place any meat intended for sale in or on a dirty basket or board, or expose such meat without covering it with a clean cloth.

(3) The shop for the sale of meat shall have chicks hung up on all the open sides, so that the meat kept for sale may not be seen by the passers-by.

(4) The floor of the shop must be paved with bricks, plastered all over, and it must be thoroughly washed every day before the shop is closed.

(5) The shop itself must be whitewashed once a month.

(6) The licensee shall not sell meat at any place other than that mentioned in the licence.

A breach of any of these conditions shall involve forfeiture of the licence.

5. On receipt of an application for a licence, the licensing officer shall either grant the licence or, for reasons to be recorded, may refuse to grant it.

6. The licensing officer may cancel or suspend a licence for breach of any the conditions specified in byelaw 4.

7. An appeal shall lie to the board (or chairman or health committee) from an order of the licensing officer refusing or cancelling or suspending a licence provided that the appeal is made within 10 days of the date of the receipt of the order.

[UNDER SECTION 298 J (a)]

8. No one shall carry meat through any street or public place except in a clean receptacle and covered with a clean cloth.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board directs that any breach of the provisions of byelaw 2 or 8 shall be punishable with fine which may extend to fifty rupees, and when the breach is a continuing breach, with a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

NOTE.—If a board desires to charge a fee for such licences it must make a byelaw for the purpose under heading J (d).

MODEL BYELAWS FOR REGULATING IMPORTATION OF MEAT FOR SALE INTO THE MUNICIPALITY.

[UNDER SECTION 298 F (e)].

No person shall introduce within the municipal limits for the purpose of sale the flesh (other than cured or preserved meat) of any cattle, sheep, goats or swine slaughtered outside municipal limits, unless it has been inspected and passed by the officer appointed by the board in this behalf. The inspection shall take place at.........between the hours of... and......

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that a breach of the provisions of the above byelaw shall be punishable with a fine which may extend to two hundred and fifty rupees.

MODEL BYELAWS FOR THE PREPARATION OF DRIED MEAT.

[UNDER SECTION 298 G AND J (d)].

1. In these byelaws "dried meat" means the flesh of horned cattle, goat, swine, or sheep dried by exposure to the atmosphere.

2. No person shall use or suffer to be used any place within municipal limits for the preparation of dried meat, unless a licence has been granted for the same in accordance with the following byelaws.

3. No licence shall be granted for any place within 300 feet of any dwelling house or for any place which is not fully exposed to the air on at least two sides.

4. No licence shall be granted for any place which does not contain the following premises:—

(1) A room in which the meat is cut into strips and stored before drying. This room shall be constructed with a pakka floor and fly-proof doors and windows. The floor shall be so sloped as to be capable of being drained into a drain connecting with a cesspool. The room shall contain one or more platforms for the cutting up and storing of the meat and these platforms must be paved with reinforced concrete or stone, cement pointed, and must slope towards the drain. The walls of the room shall be plastered with lime or cement to a height of 6 feet from the ground.

(2) An open yard with a pakka floor throughout in which the strips of meat are dried. Slabs or platforms of cement, reinforced concrete or other material of smooth and impervious surface must be provided for the drying of the meat. These slabs or platforms must be at least one foot from the ground with intervening passages two feet in width. The yard shall be covered over with wire netting or rope netting.

(3) In cases where gut scraping or hide curing is carried on, an open yard with a pakka floor of brick-on-edge, cement pointed, or of stone or concrete, sloped and draining into a cesspool, should be provided. This yard must also be roofed over with wire netting or rope netting.

5. No licence shall be given for any place containing a privy or cesspool.

6. All licences granted under these byelaws shall be subject to the following conditions : –

(1) The floors, platforms and the walls of the room shall be washed daily after work has ceased, to a height of 6 feet from the ground.

(2) The platforms in the open yard shall be swept with a cloth before spreading strips of meat on them.

(3) Strips of meat, when spread for drying, must be covered with clean gauze or muslin.

(4) Salted strips of meat shall not be left unprotected during rain.

(5) Mats or dirty baskets shall not be used.

(6) No person suffering from any dangerous or infectious disease shall take part in the preparation, storage or transport of the meat.

(7) The walls and ceiling of the room shall be limewashed every three months.

(8) No part of the premises shall be used for human habitation.

(9) No dogs shall be allowed to enter the premises.

(10) Shreds of meat, refuse, etc., shall be placed in a suitable vessel of non-absorbent material and removed within 24 hours.

(11) No bones shall be allowed to remain within the premises for more than 24 hours, and shall be removed to a godown set apart for the purpose, constructed at a distance of not less than 100 feet from any dwelling house.

7. The licensing officer may cancel or suspend a licence if the licensee breaks any of the conditions prescribed in the foregoing byelaw.

8. Every licence granted under these byelaws shall be for the period ending on the 31st March next following and any application for the renewal of a licence must be made at least three months before the expiration of the existing licence.

9. A fee of Rs.........shall be charged for every licence granted under these byelaws.

10. Every application for a licence under these byelaws shall contain full particulars of the situation and bounds of the place for which the licence is required and of the premises constructed.

11. An appeal shall lie from any order of the licensing officer passed under these byelaws to the health committee (or board) if made within ten days after the passing of the order.

NOTE.—In municipalities where there is no executive officer the following additional byelaw should be made :—

"The.........shall be the licensing officer for the purpose of these byelaws".

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that any breach of any of the provisions of these byelaws shall be punishable with fine which may extend to rupees one hundred and if the breach is a continuing breach, with a further fine which may extend to five rupees, for every day after the date of the first conviction, during which the offender is proved to have persisted in the offence.

MODEL BURIAL AND BURNING GROUND BYELAWS.

[UNDER SECTION 298 1 (c)].

1. No person shall bury, or cause to be buried, the body of any person, or, being the owner or person in charge of the burial ground, shall permit a body to be buried in a burial ground otherwise than in accordance with the following conditions :—

(1) The body shall be interred within eight hours after its arrival at the burial ground.

(2) The body shall not be buried in any grave in which another body has been already interred.

(3) The grave shall not be less than six feet deep, and shall not be less than two feet distant from the nearest grave.

2. No one shall burn the dead body of any person, or cause a dead body to be burned, or being the owner or person in charge of the burning *ghat* permit a dead body to be burned otherwise than in accordance with the following conditions :—

(1) The body shall be burned within eight hours after its arrival at the burning ghat.

(2) No part of the body shall remain unconsumed.

(3) No part of the body shall be removed from the *ghat* until it is completely reduced to ashes.

3. No person shall remove wood or coal that has been employed in the pyre from the burning ground. The owner or person in charge of the ground must see that all such wood or coal is reduced to ashes.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that a breach of any of the provisions of the above byelaws shall be punishable with fine which may extend to... rupees.

BYELAWS REGULATING OFFENSIVE TRADES.

Section 120 of the Act of 1900 required every person who carried on any of the offensive trades specified in the section to register the same and provided that no place should be newly used for the purpose of any of the said trades, except under a licence from the board. Section 245 of the present Act gives the board power to issue orders for the purpose of preventing nuisances being caused by any such trade, but does not give the board a power to require a licence for such trade. Boards therefore which intend to continue the previous procedure of requiring licences to be taken out for such trades must make byelaws under heading G of section 298. Again, sub-section (4) of section 120 of the Act of 1900 provided that a board might charge fees for licences according to a scale approved of by the Local Government, and that he board might impose such conditions in respect of such licences as it might think necessary. Boards that desire to charge such fees or to prescribe conditions regarding licences for such trades must therefore make byelaws under sub-head (b) of heading G and sub-head (d) of heading J of section 298.

Some boards desire to absolutely prohibit the carrying on of particular trades in particular areas. In order to effect this they must make byelaws under sub-head (a) and (b) of heading G of section 298 prohibiting the use of any place for such purpose without a licence and prescribing that licences for such places shall not be granted in such specified areas. Such boards may be referred to the set of the following model byelaws for regulating bone godowns :

MODEL BYELAWS FOR THE REGULATION OF THE STORING OF BONES.

[UNDER SECTION 298 G (a), (b)].

1. No person shall use any place within municipal limits for storing bones unless a licence has been granted for the same.

2. Licences may be granted for the storing of bones within any part of the municipality except certain specified wards.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that a breach of the provisions of byelaw 1 shall be punishable with fine which may extend to rupees five hundred and, in the case of a continuing breach, with a further fine which may extend to rupees five for every day after the date of the first conviction during which the offender is proved to have persisted in the breach.

MODEL BYELAWS FOR STORING HIDES OR SKINS AND FOR TANNING.

[UNDER SECTION 298 G(a) (ii) AND (iii)].

1. No person shall use any place within municipal limits for storing hides, horns or skins or for tanning unless he has been granted a licence in this behalf or otherwise than in accordance with the terms and conditions of a licence so granted.

2. Every licence granted under these byelaws shall contain the condition that in sewered areas the licensee shall connect with the sewer all the drains of his factory or place of business intended for the discharge of foul water or refuse, and no licensee shall allow to be discharged any foul water or refuse of the factory or place of business into the river Ganges or into any other reservoir of water intended for bathing or drinking.

3. Every licence under these byelaws shall be for the period ending on the 31st March, next following.

4. For every licence under these byelaws a fee of Re. 1 shall be charged.

5. A licensee shall not cause or suffer any skin or hide which, by reason of decomposition, has become useless for the purpose of leather dressing, to be kept for a longer time than may be necessary in any part of the licensed premises.

6. Every licensee shall, at the close of every working day, cause every floor or pavement upon the licensed premises thoroughly swept. He shall at the same time cause all filth or refuse deposited on the floor or pavement to be collected in suitable vessels or receptacles furnished with closely fitting covers and to be forthwith removed therein from the premises.

7. Every licensee shall cause the supply of water in every tank or other receptacles used upon the licensed premises for the washing or soaking of any skin or hide and not being a lining pit to be renewed as often as may be necessary to prevent the emission of noxious or injurious effluvia from the contents of the tank or other receptacles.

8. He shall cause every such tank to be furnished with a suitable cover and, when not required to be open, to be kept covered.

He shall cause every part of the tank or other receptacle, when emptied, to be thoroughly cleansed, and shall cause all filth which has been removed therefrom, to be forthwith conveyed from the premises in suitable vessels or receptacles furnished with closely fitting covers.

8. Every licensee shall cause all waste lime, which has been taken out of any pit upon the licensed premises, to be forthwith deposited in suitable vessels or receptacles or in a properly constructed cart or carriage, which, when filled or loaded, shall be covered in such a manner as to prevent the emission of noxious or injurious effluvia from the contents thereof, and shall, with all reasonable despatch, be removed from the premises.

9. Every licensee shall cause every beam, table, bench, knife, hammer, or other implement or apparatus used upon the licensed premises for the purpose of unhairing, fleshing, breaking, scraping, rounding, scudding, or stocking any hide, butt or pelt or in any other process of his trade to be cleansed from time to time as often as may be necessary to prevent any accumulation of filth upon the beam, table, bench, knife, hammer, implement or apparatus.

10. Every licensee shall cause all filth, which has been splashed upon any part of the internal surface of any wall of any building upon the licensed premises, to be removed by scraping or by some other effectual means of cleansing at least twice in every year, that is to say at least once during the periods between the first and twenty-first day of March, and the first and twenty-first day of September respectively. He shall at the same time cause every part of the internal surface above the floor or pavement of the building to be thoroughly washed with hot lime wash :

Provided always (i) that the foregoing requirements as to lime-washing shall not apply to any part of the internal surface of any building which is painted or covered with impervious material and may be otherwise properly cleansed and (ii) that this byelaw shall not apply to any part of any such building which is used only for the storage of dry leather.

11. Every licensee shall cause every part of the internal surface of the walls of any building and every floor or pavement upon the licensed premises to be kept at all times in good order and repair so as to prevent the absorption therein of any liquid filth or refuse, or any

noxious or injurious matter which may be splashed or may fall or be deposited thereon.

12. Every licensee shall cause every part of the interior and exterior of every tub or other vessel or receptacle used upon the licensed premises to hold a solution of the material known as "puer" to be thoroughly cleansed by scrubbing or by some other effectual means once at least in every week.

13. In cases in which the fleshing meat is dried for subsequent sale for the manufacture of glue or jujubes, etc., the drying area should be covered by wire netting to prevent carrion birds from carrying away the material and dropping it in the vicinity of inhabited areas.

NOTE—This byelaw is suggested because some of the larger tanneries expose the fleshing on roofs and cause a nuisance to the priests of the neighbouring temples on which the carrion birds settle.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that any breach of the provisions of these byelaws shall be punishable with fine which may extend to five hundred rupees, and when the breach is a continuing breach, with a further fine which may extend to five rupees for every day after the date of the first conviction, during which the offender is proved to have persisted in the offence.

MODEL BYELAWS IN RESPECT OF PLACES USED FOR THE PREPARATION AND STORAGE OF GUT.

[UNDER SECTION 298 G AND J (d)].

1. No person shall use any place within the municipality for the preparation or storage of gut, unless a licence for the use of the same for such purpose has been granted or otherwise than in accordance with the conditions of a licence so granted.

2. The......shall be the licensing officer for the purposes of these byelaws.

3. Every licence granted under these byelaws shall be subject to the following conditions :—

(*a*) The licence shall not be operative until the medical officer of health has certified that the premises are furnished with satisfactory ventilation and drainage and are otherwise suitable for the preparation and storage of gut.

(*b*) No portion of the premises shall be used for residential or sleeping purposes, and no room within the same building as the licensed premises shal be used as a living or sleeping room, unless it is separated from the premises by a substantial wall, and contains a window or windows opening directly to the sky and of dimensions not less than one-tenth of the superficial area of the room.

(*c*) No person suffering from any contagious or infectious disease shall be employed on the premises.

(*d*) All undried gut received at the premises and not required for immediate use must be kept, until required, in properly constructed and covered vessels of galvanised iron or some other non-absorbent material. These vessels must be kept covered until it is necessary to remove the contents for actual use.

(*e*) At the close of every working day every floor. or pavement upon the premises shall be thoroughly cleansed, and all fragments of gut or other matter detached in the process of scraping and all garbage, filth or other offensive matter shall be collected and placed in suitable vessels or receptacles to be forthwith removed, with their covers affixed, from the premises. Each such vessel shall be constructed of galvanised iron or of some other non-absorbent material and furnished with a closely fitting cover and shall contain a sufficient quantity of a deodorant solution.

(*f*) At the close of every working day every bench, table, tub, vessel, utensil or implement which has been in use during the day shall be thoroughly cleansed with water containing a deodorant.

(*g*) At the close of every working day all filth or refuse which has been splashed upon any inside portion of the premises shall be removed by scraping or other effectual means.

(*h*) Every vessel or receptacle, when not in use, shall be kept thoroughly clean.

(*i*) Within each first ten days of March, June, September and December the interior of the premises above the floor or pavement shall be thoroughly washed with hot lime wash if they have been in use since the last occasion on which they were so washed :

Provided that this byelaw shall not apply to any such part as is covered with impervious material, in which case it shall be sufficient thoroughly to cleanse the same by washing with water.

(*j*) The interior of the premises shall not be allowed, by reason of want of repair to the surface thereof, to facilitate the absorption of any liquid filth or refuse or other noxious or injurious matter.

4. The licensing officer may cancel or suspend a licence, if the licensee breaks any of the conditions imposed under the foregoing byelaws.

5. Every licence granted under these byelaws shall be for the period ending on the 31st March next following, and any application for the renewal of a licence must be made at least a fortnight before the expiration of the existing licence.

6. A fee of rupee one shall be charged for every licence granted under these byelaws.

7. An appeal shall lie to the board from any order of the licensing officer refusing a licence to any premises or cancelling or suspending a licence, provided that such appeal is made within ten days of the communication of the order to the applicant.

PENALTY.

In exercise of the powers conferred by section 299 (1) of the Act, the board, with the sanction of the Local Government, hereby directs that a breach of byelaws 1 or 4 shall be punishable with fine which may extend to rupees two hundred and, in the case of continuing breach, with a further fine which may extend to rupees five for every day after the date of the first conviction, during which the offender is proved to have persisted in the offence.

MODEL BYELAWS FOR REGULATING BRICK AND LIME KILNS.

[UNDER SECTION 298 G (a) (vii) AND J (d)].

1. A person shall not use any place within municipal limits for burning lime or bricks, unless such place is licensed in that behalf under these byelaws or otherwise than in accordance with the conditions of the licence.

2. A licence shall not be granted, though it may be renewed, for the burning of lime at any place within 300 feet of a building used for

the storage, for purposes of trade, of petroleum, jute, cloth, cotton, or other inflammable article or for the burning of bricks within 1,000 yards of a building so used.

3. No place shall be licensed under these byelaws, unless there is sufficient room therein for the loading or unloading of materials.

4. Every licence granted or renewed under these byelaws shall expire on the 31st day of March next following the date from which it purports to be in force.

5. No licence shall be renewed except on application made on or before the last day of February in any year.

6. Any licence granted under these byelaws may impose such conditions as in the opinion of the licensing officer appear necessary for the safety or convenience of the public or any portion of the public.

7. A fee of Rs......shall be charged for a licence for burning lime and of Rs......for one for burning bricks.

8. Every application for the grant of a licence under these byelaws shall contain full particulars of the situation and boundary of the place for which the licence is required and of the materials for which the licence is required. An application for the renewal shall be accompanied by the licence to be renewed.

9. The licensing officer under these byelaws shall be the...

NOTE.—This byelaw is not required in municipalities where there is an executive officer. See section 60 of the Act.

10. The licensing officer may cancel or suspend a licence if the licensee breaks any of the conditions imposed under the foregoing byelaws.

11. An appeal shall lie from any order of the licensing officer passed under these byelaws to the health committee, if made within ten days after the passing of the order.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board hereby directs that a breach of any of the provisions of these byelaws shall be punishable with a fine which may extend to rupees one hundred and in the event of a continuing breach, with a further fine which may extend to rupees five for every day after the date of the first conviction, during which the offender is proved to have persisted in the offence.

MODEL BYELAWS REQUIRING THE LICENSING OF DOGS.

[UNDER SECTION 298 (2), HEAD (H) SUB-HEADS (h) TO (l)].

NOTE.—It is suggested that in most municipalities it will be found convenient to abolish the present dog tax and replace it by byelaws under the sub-heads. It is to be noted that the fee to be fixed under byelaw 2 should include the cost of the token, since sub-head (k) of heading H requires that such tokens shall be issued by the board and the board may not therefore charge separately for such token. Byelaw 5 provides for the destruction of unregistered dogs not wearing the token prescribed. Boards that so desire may replace these provisions by a provision for the seizure and confinement or confiscation of dogs.

1. Every dog of the age of six months or over, which is kept within the municipal limits, shall be registered every year in a register to be kept in the office of the board for this purpose. Such registration shall hold good up to the 31st March next following.

2. Every owner of a dog which is required to be registered under the preceding byelaw shall apply to the $\frac{\text{executive officer}}{\text{secretary,}}$ for registration of such dog, within one month from the date on which the dog has become liable to registration. The application shall state (1) the sex, (2) the colour, and (3) the breed (if known) of the dog.

A fee of......shall be sent along with the application for registration and no dog shall be registered until such fee has been paid.

3. The owner of a dog registered under the preceding byelaw shall, on or before the 1st of April of each year, apply to the $\frac{\text{executive officer}}{\text{secretary}}$ for the renewal of the registration of his dog and shall send with his application the fee prescribed in the preceding byelaw.

4. After a dog has been prescribed; the owner shall be given a metal token which shall bear the same number as that shown in the register. Every registered dog shall wear a collar to which this metal token shall be attached.

5. Any dog that is found in any public place shall, unless registered and wearing such token, be liable to be destroyed.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board directs that a breach of byelaw 2 or 3 shall be punishable with a fine which may extend to rupees twenty.

MODEL BYELAWS FOR REGULATING THE STORING OF HAY, STRAW, ETC.

[UNDER HEADING G AND SUB-HEAD (d) OF HEADING J OF SECTION 298.]

1. No person shall use any place within municipal limits for storing hay, straw, thatching-grass, wood, coal or dangerously inflammable material, unless a license has been granted for the same in accordance with the provisions of the following byelaws.

Exception—No license is necessary if the aggregate quantity of the inflammable material stored in one place does not exceed 25 maunds.

2. No licence shall be granted for the storing of more than 1,000 maunds of inflammable material in one place.

3. In granting licences the licensing officer shall not exceed the following scale :—

Area of site.	Number of maunds permissible.
100 square yards	50 maunds.
150 ,, ,, ...	100 ,,
200 ,, ,, ...	400 ,,
500 ,, ,, ...	1,000 ,,

and no licence shall be granted where the area of the site is less than 100 square yards.

4. No licence shall be given under these byelaws for any place within 500 feet of any building used for the storage of petroleum or cloth or of articles made of jute or cotton.

5. No place shall be licensed under these byelaws, unless there is sufficient room therein for the loading and unloading of materials.

6. All licences granted under these byelaws are subject to the following conditions :—

(1) A space of at least five feet shall always be left clear between the inflammable material and the nearest walls of any building.

(2) The space occupied by such material shall be enclosed by a fence or wall and no person shall be permitted by the licensee to reside within 10 feet of any stack.

(3) No person shall smoke, introduce any light into or ignite any substance in any space licensed under these byelaws.

(4) One ***ghara*** or ***balti*** filled with water shall be kept for every five maunds which the licensee is permitted to store : provided that no licensee shall be required to keep more than 50 ***gharas*** or ***baltis*** under this byelaw.

7. No person shall stack the material to a height exceeding 15 feet.

8. The licensing officer may cancel or suspend a license if the licensee breaks any of the conditions imposed under the foregoing byelaws or stores materials in excess of the quantities specified in the license.

9. Every license granted under these byelaws shall be for the period ending on the 31st March next following and any application for the renewal of a license must be made at least three months before the expiration of the existing license.

10. A fee of Re. 1 shall be charged for every license granted under these byelaws.

Note.—Instead of charging a universal fee boards may find it more suitable to vary the fee in proportion to the maximum quantity of inflammable material which may at any time be stored under the provisions of the license.

11. Every application for a license under these byelaws shall contain full particulars of the situation and bounds of the place for which the license is required and of the materials and the maximum quantity for which the license is required.

12. An appeal shall lie from any order of the executive officer, passed under these byelaws, to the health committee, if made within 10 days after the passing of the order.

PENALTY.

In exercise of the power conferred by section 299 (1) of the Act, the board, with the sanction of the Local Government, hereby directs that a breach of any of the provisions of these byelaws shall be punishable with a fine which may extend to Rs. 100 and, in the event of a continuing breach with a further fine which may extend to Rs. 5 for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

Note.—In municipalities where there is no executive officer the following additional byelaw should be made.

"The......shall be the licensing officer for the purpose of these byelaws."

THE VACCINATION ACT.

The provisions of this Act have been applied to all the Municipalities, notified areas and cantonments in the United Provinces. The Act was passed to give power to prohibit inoculation and to make vaccination compulsory. All medical officers of health should read this Act and be conversant with its provisions. Its chief provisions are :—

(1) that all children between the ages of six months and (if male) 14 years, (if female 8 years) residing in an area, where the Act applies, for more than 1 month must be vaccinated, (sec. 9),

(2) that the parent or guardian shall be responsible for having this done, (sec. 9),

(3) that, if in ill health, vaccination may be postponed, (sec. 9),

(4) that a certificate of successful vaccination should be given (sec. 11),

The vaccination returns often enable the medical officer of health to elucidate errors in birth and death registers by finding children's names on the vaccination registers which have not been notified, and *vice versa*.

"A copy of the Act is appended herewith."

ACT NO. XIII OF 1880.

An Act to give power to prohibit inoculation and to make the vaccination of children compulsory in certain Municipalities [and] Cantonments [and notified areas].

Preamble.

Whereas it is expedient to give power to prohibit inoculation, and make the vaccination of children compulsory in certain municipalities [and] cantonments [and notified areas as defined in section 193 of the United Provinces Municipalities Act, 1900] ; It is hereby enacted as follows :—

Short title.

1. This Act may be called "The Vaccination Act, 1880" and

Application.

it shall apply only to such municipalities [and] cantonments [and notified areas] situated in the territories administered respectively by the Lieutenant-Governors of the North-Western Provinces and the Punjab, and the Chief Commissioners of Oudh, the Central Provinces, British Burma, Assam, Ajmere and Coorg, as it may be extended to in manner hereinafter provided.

Interpretation clause.

2. In this Act, unless there is something repugnant in the subject or context,—

"Municipal Commissioners."

(1) the expression "Municipal Commissioners" means a body of Municipal Commissioners or a Municipal Committee constituted under the provisions of any enactment for the time being in force :

"Parent."

(2) "parent" means the father of a legitimate child and the mother of an illegitimate child :

"guardian."

(3) "guardian" includes any person who has accepted or assumed the care or custody of any child :

"unprotected child.

(4) "unprotected child" means a child who has not been protected from small-pox by having had that disease either naturally or by inoculation, or by having been successfully vaccinated, and who has not been certified under this Act to be insusceptible to vaccination :

"inoculation."

(5) "inoculation" means any operation performed with the object of producing the disease of small-pox in any person by means of variolous matter :

"vaccination-circle"

(6 "vaccination-circle" means one of the parts into which a municipality [or] cantonment [or notified area] has been divided under this Act for the performance of vaccination :

"vaccinator."

(7) "vaccinator" means any vaccinator appointed under this Act to perform the operation of vaccination, or any private person authorized by the Local Government in manner hereinafter provided to perform the same operation ; and includes a "Superintendent of vaccination" :

"vaccination-season :"

(8) "vaccination-season" means the period from time to time fixed by the Local Government for any local area under its administration by notification in the official Gazette, during which alone vaccination may be performed under this Act.

Extension of Act to municipalities.

3. A majority in number of the persons present at a meeting of the Municipal Commissioners specially convened in this behalf may apply to the Local Government to extend this Act to the whole or any part of a municipality, and thereupon the Local Government may, if it thinks fit, by notification published in the official Gazette, declare its intention to extend this Act in the manner proposed.

Any inhabitant of such municipality or part thereof who objects to such extension may, within six weeks from the date of such publication, send his objection in writing to the Secretary to the Local Government, and the Local Government shall take such objection into consideration. When six weeks from the said publication have expired, the Local Government, if no such objections have been sent as aforesaid, or (when such objections have been so sent) if in its opinion they are insufficient, may by like notification effect the proposed extension.

[3A. The Local Government may, by notification in the official Gazette, declare its intention to extend this Act to the whole or any part of a notified area.

Any inhabitant of such notified area or part thereof who objects to such extension may, within six weeks from the date of such publication send his objection in writing to the Secretary to the Local Government, and the Local Government shall take such objection into consideration. When six weeks from the said publication have expired, the Local Government, if no such objections have been sent as aforesaid, or (when such objections have been so sent) if in its opinion they are insufficient, may by like notification effect the proposed extension].

Extension to cantonments.

4. The Local Government may, with the previous sanction of the Governor-General in Council, by notification in the local official Gazette, extend this Act to the whole or any part of a military cantonment.

Power to withdraw local area from operation of Act.

5. The Local Government may, by notification in the official Gazette, withdraw any local area in a municipality [or notified area], or with the previous sanction of the Governor-General in Council, any local area in a cantonment, from the operation of this Act.

Prohibition of inoculation.

6. In any local area to which the provisions of this Act apply, inoculation shall be prohibited ; and

no person who has undergone inoculation shall enter such area before the lapse of forty days from the date of the operation, without a certificate from a medical practitioner, of such class as the Local Government may from time to time by written order authorize to grant such certificates, stating that such person is no longer likely to produce small-pox by contact or near approach.

Inoculated persons not to enter, without certificate, local area subject to Act.

7. Every local area to which this Act applies shall be a vaccination-circle, or shall, in manner hereinafter provided, be divided into a number of such circles ;

Vaccination-circles.

one or more vaccinators shall be appointed in manner hereinafter provided for each such circle ; and

Vaccinators ;

one or more Superintendents of vaccination shall be appointed in manner hereinafter provided for each such local area.

Superintendent of vaccination.

8. The Local Government may by written license authorize private vaccinators to perform vaccination in any vaccination circle, and may suspend or cancel any such license.

Private vaccinators.

9. When any unprotected child, having attained the age of 6 months, has resided for a period of one month during the vaccination-season in any local area to which the provisions of this Act apply, and has not at the expiration of such period attained the age, if a boy, of fourteen years, and if a girl, of eight years, the parent or guardian of such child shall take it, or cause it to be taken, to a vaccinator to be vaccinated, or send for a vaccinator to vaccinate it.

Unprotected children to be vaccinated.

Such vaccinator shall vaccinate the child and deliver to its parent or guardian a memorandum stating the date on which the vaccination has been performed and the date on which the child is to be inspected in order to ascertain the result of the operation, or shall, if he finds such child in a state unfit for vaccination, deliver to its parent or guardian a certificate under his hand to the effect that the child is in a state unfit for vaccination for the whole or part of the current vaccination season.

Vaccinator to vaccinate children, or deliver certificates of postponement.

Inspection after vaccination.

10. The parent or guardian of every child which has been vaccinated under section nine shall, on the date of inspection stated in the memorandum, take the child, or cause it to be taken, to a vaccinator for inspection, or get it inspected at his own house by a vaccinator; and such vaccinator shall then append to the memorandum a certificate stating that the child has been inspected and the result of such inspection.

Procedure when vaccination is successful.

11. When it is ascertained at the time of inspecting a child under section ten that the vaccination has been successful, a certificate shall be delivered by the vaccinator to the parent or guardian of such child to that effect, and such child shall thereafter be deemed to be protected.

Procedure when vaccination is unsuccessful.

12. When it is ascertained as aforesaid that the vaccination has been unsuccessful, the parent or guardian shall, if the vaccinator so direct, cause the child to be forthwith again vaccinated and subsequently inspected in manner hereinbefore provided.

Procedure when child is unfit for vaccination.

13. A certificate granted under section nine showing the unfitness of a child for vaccination shall remain in force for the period stated therein, and on the termination of that period, or if that period terminates after the vaccination-season is over, when the next vaccination-season begins, the parent or guardian of such child shall take the child, or cause it to be taken, to a vaccinator to be vaccinated, or procure its vaccination at his own house by a vaccinator:

Renewal of postponement certificates.

Provided that, if the child is still found to be in a state unfit for vaccination, the certificate granted under section nine shall be renewed.

Certificates of insusceptibility of successful vaccination.

14. If the Superintendent of vaccination is of opinion that a child which has been three times unsuccessfully vaccinated is insusceptible of successful vaccination, he shall deliver to the parent or guardian of such child a certificate under his hand to that effect; and the parent or guardian shall thenceforth not be required to cause the child to be vaccinated.

15. The vaccination of a child shall ordinarily be performed with such lymph as may be prescribed by the rules to be made under this Act :

What lymph to be used.

Provided that,

1st, if animal-lymph is so prescribed and the parent or guardian of any child desires that such child shall be vaccinated with human lymph, it shall be so vaccinated ; and

2nd, if in any local area in which animal-lymph is procurable human lymph is so prescribed, and the parent or guardian of any child desires that such child should be vaccinated with animal-lymph, and tenders to the vaccinator the amount of such fee, not exceeding one rupee, as may be fixed by such rules in this behalf, such child shall be so vaccinated.

16. No fee shall be charged by any vaccinator except a private vaccinator to the parent or guardian of any child for any of the duties imposed on such vaccinator by or under the provisions of this Act :

No fee to be charged except by private vaccinator.

Provided that it shall be lawful for a vaccinator to accept a fee for vaccinating a child by request of the parent or guardian elsewhere than in the circle for which such vaccinator is appointed.

Proviso.

17. The Superintendent of vaccination, in addition to the other duties imposed on him by or under the provisions of this Act, shall ascertain whether all unprotected children, under the age of fourteen years if boys, and under the age of eight years if girls, within the local area under his superintendence have been vaccinated ; and, if he has reason to believe that the parent or guardian of any such child is bound by the provisions hereinbefore contained to procure, the vaccination of such child or to present it for inspection, and has omitted so to do, he shall personally go to the house of such parent or guardian, and there make enquiry, and shall, if the fact is proved, forthwith deliver to such parent or guardian, or cause to be affixed to his house, a notice requiring that the child be vaccinated, or (as the case may be) that it be presented for inspection, at a time and place to be specified in such notice.

Duties of Superintendent of vaccination.

Order by Magistrate when notice not complied with.

18. If such notice is not complied with, the Superintendent of vaccination shall report the matter to the Magistrate of the District, or such Magistrate as the Local Government or the Magistrate of the District may from time to time appoint in this behalf; and the Magistrate receiving such report shall summon the parent or guardian of the child and demand his explanation, and shall, if such explanation is not satisfactory, make an order in writing directing such parent or guardian to comply with the notice before a date specified in the order.

Procedure when order not obeyed.

If on such date the order has not been obeyed, the Magistrate shall summon the parent or guardian before him, and unless just cause or excuse is shown, shall deal with the disobedience as an offence punishable under section twenty-two.

Magistrates to be non-official Natives.

The Magistrates appointed under this section shall, as far as is conveniently practicable, be Natives of India, and not paid servants of the Government.

Power to make rules for municipalities.

19. When this Act has been applied to any municipality or any part thereof, the Municipal Commissioners may, from time to time, make rules consistent with this Act for the proper enforcement of this Act within the limits to which it applies. Such rules shall be made in the manner in which, under the law for the time being in force, the Commissioners make rules or bye-laws for the regulation of other matters within the limits of the municipality, and shall, when confirmed by the Local Government and published in the official Gazette, have the force of law:

Provided that the Local Government may at any time rescind or modify any such rule.

[19A. When this Act has been applied to any notified area or any part thereof, the Local Government may, from time to time, make rules consistent with this Act, for the proper enforcement of this Act within the limits to which it applies. Such rules, when published in the official Gazette, shall have the force of law.]

Power to make rules for cantonments.

20. When this Act has been applied to any cantonment or any part thereof, the Local Government may, from time to time, subject to the control of the Governor General in Council, make such rules.

What rules under sections 19 and 20 may provide for.

21. The rules to be made for any local area under section nineteen [nineteen A] or twenty may, among other matters, provide for—

(*a*) the division of such local area into circles for the performance of vaccination ;

(*b*) the appointment of a place in each vaccination circle as a public vaccine station, and the posting of some distinguishing mark in a conspicuous place near such station ;

(*c*) the qualifications to be required of public vaccinators and Superintendents of vaccination ;

(*d*) the authority with which their appointment, suspension and dismissal shall rest ;

(*e*) the time of attendance of public vaccinators at the vaccine-stations, and their residence within the limits of the vaccination-circles ;

(*f*) the distinguishing mark or badge to be worn by them ;

(*g*) the amount of fee chargeable by private vaccinators, and their guidance generally in the performance of their duties ;

(*h*) the facilities to be afforded to people for procuring the vaccination of their children at their own houses ;

(*i*) the grant and form of certificates of successful vaccination, of unfitness for vaccination or of insusceptibility of vaccination ;

(*j*) the nature of the lymph to be used and the supply of a sufficient quantity of such lymph ;

(*k*) the fee to be paid for vaccination with animal lymph under section fifteen ;

(*l*) the fee to be paid to a public vaccinator for vaccinating a child beyond the vaccination-circle at the request of the parent or guardian of the said child ;

(*m*) the preparation and keeping of registers showing—

the names of children born in such local area on or after the date of application of this Act ;

the names of unprotected children born in such local area previous to the application of this Act, and who are, at the time this Act is applied, under the age of fourteen years if boys, and of eight years if girls ;

the names of unprotected boys and girls respectively under those ages brought within such local area at any time after the application of this Act and who have resided there for a month ;

the result of each vaccination or its postponement, and the delivery of certificates, if any ;

(*n*) the assistance to be given by the Municipal Commissioners and municipal servants in the preparation of these registers, and in other matters ; and

(*o*) the preparation of vaccination-reports and returns.

Punishment of offences. 22. Whoever commits any of the under-mentioned offences (that is to say) :—

(*a*) violates the provisions of section six,

(*b*) neglects without just excuse to obey an order made under section eighteen,

(*c*) breaks any of the rules made under section nineteen [nineteen A] or twenty, or

(*d*) neglects without just cause to obey an order made under section eighteen after having been previously convicted of so neglecting to obey a similar order made in respect of the same child,

shall be punished as follows (that is to say) :—

in the case of the offence mentioned in clause (*a*), with simple imprisonment for a term which may extend to three months, or with fine which may extend to two hundred rupees, or with both ;

in the case of the offences mentioned in clauses (*b*) and (*c*), with fine which may extend to fifty rupees ; and

in the case of the offence mentioned in clause (*d*), with simple imprisonment for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

Municipal funds to receive fines and meet expenditure. 23. The amount of all fees and fines realized, and the amount of all expenditure incurred, under this Act in any municipality (or notified area) shall respectively be credited to and paid from the municipal fund (or notified area fund).

DRAFT RULES UNDER SECTION 19 OF THE ACT.

The following rules made by the board under section 19, Act XIII of 1880 (the Vaccination Act), for the enforcement of the said Act within the limits of the municipality, and confirmed by the Local Government, are hereby published for general information :—

1. The area of the municipality shall be considered one circle for the purpose of these rules.

Appointment of a place in the circle as a public vaccination station.

2. The board will provide a vaccination office in a convenient situation, and a notice will be set up at this office and maintained there, bearing the words "Vaccination Station", and setting forth for public information, the names of the public vaccinators and the hours of their daily attendance at the station on vaccination duty, and also notifying that the public vaccinators will, on due request made, attend for the vaccination of children at their houses in the circle and that no charge will be made for vaccination, whether performed at the station or at the child's home.

3. The Civil Surgeon of shall *ex officio* be Superintendent of Vaccination within the limits of the municipality.

The Assistant Superintendent of Vaccination for the district shall *ex officio* be Assistant Superintendent of Vaccination within the limits of the municipality.

NOTE 1.—In the case of outlying municipalities, where it is impossible for the Civil Surgeon, who is not a resident, to discharge the duties of a superintendent, the assistant-surgeon or sub-assistant surgeon or a member or members of the board sanctioned by the Collector and approved by Government are usually appointed.

The second clause of the rule is generally omitted by boards as an assistant superintendent is usually not necessary.

NOTE 2.—In municipalities where there is a medical officer of health the rule should read "The medical officer of health shall be Superintendent of Vaccination."

4. Each of the public vaccinators shall possess a certificate of qualification under the seal and signature of the Superintendent of Vaccination in the following form :—

"I hereby certify that I have examined and find him qualified for the office of public vaccinator."

Dated at

The of 19 *Superintendent of Vaccination.*

Before granting such certificate the Superintendent of Vaccination shall be assured of the soundness of the candidate's knowledge in regard to—

(1) The vaccination operation.
(2) The characteristics of a good vesicle and cicatrix.
(3) The chief symptoms of small-pox disease.
(4) The collection and preservation of lymph.
(5) The Vaccination Act and Rules.
(6) The forms and certificates required under the rules.

The authority with which the appointment, suspension and dismissal of public vaccinators shall rest.

5. The public vaccinators shall be appointed, rewarded and promoted and may, for recorded misconduct or bad work, be punished, suspended or dismissed on the recommendation of the Superintendent.

The time of attendance of a public vaccinator at the vaccination station and the public vaccinator's place of residence.

6. The hours of daily attendance of a public vaccinator at the vaccine station shall be fixed by the board.

7. A public vaccinator shall be a permanent resident of the circle, and shall be absent therefrom only for such periods of leave as may be granted with the approval of the Superintendent.

The distinguishing mark or badge to be worn by the vaccinators.

8. Public vaccinators shall at all times, when engaged in the duties of their office, wear a badge in the form of a brass plate with the words "Public Vaccinator" engraved on it.

The facilities to be afforded to people for procuring the vaccination of children at their own houses.

9. Public vaccinators shall vaccinate children of the circle at their houses, at the request of the parent or guardian, or at any other place within the circle by direction of the Superintendent.

The grant and form of certificates of successful vaccination, of unfitness for vaccination, or of insusceptibility to vaccination.

10. Certificates of vaccination shall be in form (A) hereto annexed.

11. Certificates of unfitness for vaccination shall be in form (B) hereto annexed.

12. The public vaccinator shall issue to the parent or guardian a certificate of vaccination in form (A) on account of every child vaccinated on the day of vaccination, and shall complete the certificate on the day of examination, and he shall also issue to the parent or guardian a certificate in form (B) of unfitness for vaccination on account of every child found unfit on the day of its examination. All cases of reported unfitness for vaccination shall be referred by the vaccinator to the Superintendent, whose countersignature to every certificate issued in form (B) will be necessary.

Before final delivery to the parent or guardian of any certificate the public vaccinator shall complete and sign the entries on its fly-leaf, which shall remain bound in the book of such certificates. Every public vaccinator shall be provided with books of the above forms (A) and (B).

The nature of the lymph to be used and the supply of a sufficient quantity of such lymph.

13. The lymph to be used by the public vaccinator shall be bovine lymph supplied on payment to the Superintendent by the Medical Officer in charge Government Bovine Lymph Depôt, Patwa Dangar, Jeolikote (district Naini Tal) during the season.

Weir's Scarifiers will be supplied for the use of the public vaccinators, on payment, from the Government Bovine Lymph Depôt, Patwa Dangar, on indents submitted through the Director of Public Health, but vaccine needles, where they are used, and ivory points will be supplied, as formerly, free of charge.

Fee to be levied for vaccination with animal lymph.

14. No fee shall be charged for vaccination with animal-lymph within municipal limits ; for the successful vaccination with animal-

lymph of a child residing beyond the circle limits, the operation and inspection being performed at the child's home, the public vaccinator shall demand a fee of four annas.

The preparation and keeping of certain registers.

15. Registers in the forms appended to these rules shall be maintained :—

(1) Register of infants born within the circle on or after the* with record of vaccination or reason for non-vaccination, in every muhalla of the municipality.

(2) Register of the names of children brought into municipal limits after the* who have not been vaccinated or have not had small-pox, such children having resided in the municipality for a month, and being, if boys, under the age of 14 years ; if girls, under the age of 8 years.

16. The general register of vaccinations performed in the circle and forms of monthly returns will be supplied by the Superintendent, Government Press, Allahabad, on indents submitted through the Civil Surgeon.

17. At the commencement of every vaccination season the executive officer or secretary shall cause notices to be affixed for public information in conspicuous places throughout the circle both in Hindi and Urdu in form (C) appended to these rules.

The preparation of vaccination reports and returns.

18. A monthly statement of results shall be submitted by the Superintendent to the District Superintendent of Vaccination during the six months of the vaccination season in the prescribed departmental form. At the same time a copy should be sent to the board.

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*Here insert the date of the commencement of the first vaccination season during which the Act is enforced. Under present orders the vaccination season commences on 1st October in municipalities in the plains and terminates on the 31st March.

The Superintendent shall submit to the District Superintendent of Vaccination and the board a statement of results for the season after its termination, together with a concise report upon the working of the Act during the season.

Miscellaneous.

19. If at any time of the vaccination season the Superintendent shall have proof that a parent or guardian has failed to procure the vaccination of a child liable to vaccination under the Act he shall cause to be delivered to such parent or guardian, or to be attached to his house, a notice in the accompanying form (D).

FORM (A) Municipality (*see rule* 10).

FLY-LEAF.

Register no.

Date of presentation.

Result.

Record of instruction.

Public Vaccinator.

Certificate of vaccination issued on ______ of ______ 192 .

Register no.	*Vaccinated child.*			*Parent or guardian.*			Result of operation.
	Name.	Sex.	Age.	Name.	Caste.	Place of abode.	
							Case examined on the—and found——.

NOTE.—The child herein mentioned is to be presented with this certificate for examination on ______.

______, *Public Vaccinator.*

Certified that the above is a true account of the vaccination it records.

This certificate was given to ______ with instructions to ______.

______, *Superintendent of Vaccination.* ______, *Public Vaccinator.*

N.B.—The entry in the column of results should be (1) "successful" or (2) "unsuccessful" or (3) "unsuccessful for the third time"

The instructions should be (1) "to preserve the certificate" or (2) "to present the child for re-vaccination," or (3) "to consider further vaccination of the child unnecessary." In the last case (3) the instruction entry shall be countersigned by the Superintendent.

FORM (B) Municipality (*see rule* 11).

No. ——

Date——

Name of child.——

Name of parent and place of abode —

Cause of unfitness.

Instructions.

Public Vaccinator.

No.——

Certificate of unfitness for vaccination——issued on the——of——19 .

Child.			Parent or guardian.			Instruction.
Name.	Sex.	Age.	Name.	Caste.	Place of abode	Child to be presented for reinspection on—.

I hereby certify that the abovenamed child was presented to me for vaccination this day and found unfit for vaccination for a period of——by reason of——.

——,
Public Vaccinator.

Countersigned.

——,
Superintendent of Vaccination

N.B.—The instruction entry should denote (1) a fixed date of the current vaccination season, or (2) a period of the next vaccination season.

FORM (C) (*see rule* 17).

Public Notice, dated——

The public are hereby informed that the vaccination season of 19 commenced on the ——, and this is to give notice that, in obedience to the law, every unvaccinated child of more than six months of age, resident within the municipality, should be presented, by its parent or guardian, to the public vaccinator for inspection with a view to its vaccination, if found in good health.

——,
Executive Officer, / *Secretary*, *Municipal Board.*

FORM (D) (*see rule* 19).

Notice issued under section 17 *of the Vaccination Act on*——
the——*of*——19 .

To

(name) of (address).

The abovenamed (name) is required to present to the public vaccinator the under-mentioned child (or children) between the hours of and on the day of at for examination with a view to the vaccination of such child (or children).

Name or description of child (or children).

——,
Superintendent of Vaccination.

THE U. P. PREVENTION OF ADULTERATION ACT, VI OF 1912.

(AS AMENDED BY ACT I OF 1916).

The medical officers of health of municipalities undoubtedly have a great deal to do with the administration of this Act and are in most cases the "authorised persons" under section 8 of the Act.

A copy of this Act is appended below. The whole of its provisions should be noted by medical officers of health.

THE UNITED PROVINCES PREVENTION OF ADULTERATION ACT.

(ACT VI OF 1912, AS AMENDED BY ACT I OF 1916).

An Act to make provision in the United Provinces for Preventing the Adulteration of food and drugs.

WHEREAS it is expedient to make provision in the United Provinces for preventing the adulteration of food and drugs; It is hereby enacted as follows :—

Short title and extent.

1. (1) This Act may be called the United Provinces Prevention of Adulteration Act, 1912.

(2) This section extends to the whole of the United Provinces; the rest of this Act extends only to such local areas as the local Government may, by notification in the Gazette, direct.

(3) The Local Government in extending the rest of this Act as provided by sub-section (2) of this section may so extend it in respect of any specified article of food or of any specified drug or generally in respect of all articles of food or of all drugs.

Definitions.

2. In this Act, unless there is something repugnant in the subject or context,—

"food" includes every article used for food or drink by man other than drugs or water.

"drug" includes medicine for internal or external use and every substance which the Local Government may declare to be a drug for the purposes of this Act, together with every preparation and admixture of the same.

"public analyst" means evey person appointed by the Local Government to perform the duties and to exercise the powers of a publio analyst as prescribed by this Act.

"local area' includes a municipality, cantonment, notified area, town area, and any area in which a fair or market is held.

"local authority" in the case of a municipality means the municipal board, in the case of a cantonment the cantonment authority, and in the case of any other local area the District or sub-divisional Magistrate.

Power of the Local Government to appoint public analyst.

3. The Local Government may, by notification as aforesaid, appoint any person whom it may think fit to be public analyst in respect of any area prescribed thereby.

Penalty for sale or manufacture of food or drugs not of the proper nature, substance or quality.

4. (1) Whoever sells to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance or quality of the article of food or drug demanded by such purchaser, or sells or offers or exposes for sale or manufactures for sale any article of food or any drug which is not of the nature, substance or quality which it purports to be, shall be punished for the first offence with fine which may extend to one hundred rupees and for a second or any subsequent offence with fine which may extend to five hundred rupees :

Provided that no offence shall be deemed to have been committed under this section in the following cases, that is to say —

(a) where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight or measure of the food or drug or conceal the inferior quality thereof ;

(b) where in the process of production, preparation or conveyance of such article of food or drug some extraneous substance has unavoidably become intermixed therewith ;

(c) where any matter or ingredient not injurious to health has been added to or mixed with such article of food or drug and before the sale thereof the seller has brought to the notice of the purchaser, either by means of a label distinctly and legibly written or printed on or with the article or drug or otherwise, the fact that such matter or ingredient has been so added or mixed ;

(a) where the article of food or drug is a proprietary food or medicine.

(2) In a prosecution under this section the Court may presume that any article of food or any drug found in the possession of a person who is in the habit of manufacturing like articles or drugs has been manufactured for sale.

Presumption arising on sale of ghi containing substance not exclusively derived from milk.

(5) If in compliance with a demand for *ghi* or butter any article is supplied which contains any substance not exclusively derived from milk, such article shall be deemed to have been sold to the prejudice of the purchaser within the meaning of section 4.

Bar of certain pleas in defence in prosecutions under section 4.

6. In any prosecution under section 4, it shall be no defence to allege that the vendor was ignorant of the nature, substance or quality of the article or drug sold by him, or that the purchaser having brought only for analysis was not prejudiced by the sale :

Provided that the vendor shall not be deemed to have committed an offence under section 4, if he proves to the satisfaction of the Court.—

(*a*) that the article or drug sold was purchased by him as the same in the nature, substance, and quality as that demanded by the purchaser and with a written warranty to the effect that it was of such nature, substance and quality :

(*b*) that he had no reason to believe at the time when he sold it that the article or drug was not of such nature, substance and quality as aforesaid, and

(*c*) that he sold it in the same state in which he purchased it.

Power of purchaser to have article of food or drug analysed.

7. Any purchaser of an article of food or of a drug shall be entitled, on payment of such fees as the Local Government may prescribe, to have such article or drug analysed by the public analyst appointed for the area within which such article or drug is purchased, and to recieve from him a certificate of the result of his analysis.

Powers to procure samples of food or drugs for analysis.

8 Subject to any rules made by the Local Government under section 14 of this Act, any person duly authorized either generally or specially in this behalf by a local authority may procure any sample of food or drugs and may submit the same to be analysed by the public analyst appointed for the area within which such sample has been procured.

Procedure when sample of food or drugs is purchased for analysis.

9. (1) Any person purchasing any article of food or any drug with the intention of submitting the same to be analysed by a public analyst shall after the purchase has been completed, forthwith notify to the seller or his agent selling the article or drug his intention to have the same analysed as aforesaid, and shall offer to divide the article or drug into three parts to be then and there separated and each part to be marked and sealed or fastened up in such manner as its nature premits, and shall, if required to do so proceed accordingly, and shall deliver one of the parts to the seller or his agent.

He shall afterwards retain one of the said parts for future comparison and submit the third part if he deems it right to have the article analysed, to the public analyst.

(2) If the seller or his agent do not accept the offer of the purchaser as aforesaid to divide the article or drug purchased in his presence, the public analyst receiving the article or drug for analysis shall divide the same into two parts, and shall seal or fasten up one of those parts and shall cause it, either upon receipt of the sample or when he supplies his certificate, to be delivered to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter.

Penalty for refusing to sell sample of food or drugs for analysis.

10. If any person duly authorized as provided by section 8 or by a rule framed under section 14, as the case may be, applies to purchase any article of food or any drug exposed for sale and tenders the price for a quantity not more than is reasonably requisite for the purpose of analysis, and the person exposing the same for sale refuses to sell the same, the person so refusing shall be punished with fine which may extend to fifty rupees.

Duty of public analyst to supply certificate of analysis.

11. (1) Every public analyst to whom any article of food or any drug has been submitted for analysis under section 7 or under section 8 or a rule framed under section 14, as the case may be, shall deliver to the person so submitting it a certificate, in the form prescribed in the schedule attached to this Act specifying the result of his analysis and shall send a copy of the same to the local authority concerned.

(2) Any document purporting to be such certificate under the hand of a public analyst may be used as evidence of the facts therein stated in any inquiry, trial or other proceeding under this Act :

Certificate to be evidence of facts therein stated.

Provided that any Court before which a case under this Act may be pending, whether exercising original, appellate or revisional jurisdiction, may in its discretion, at the request either of the accused or the complainant, cause any article of food or any drug to be sent for analysis to the Chemical Examiner to Government, who shall thereupon analyse the same and report the result of such analysis to the said Court : the expense of such analysis shall be paid by the accused or the complainant, as the Court may by order direct.

Power to call report from Chemical Examiner.

12. No prosecution under section 4 or section 10 shall be instituted without the order or consent in writing of the local authority, or, in the case of a municipal board or a cantonment authority, of the person or persons authorised in this behalf by the said municipal board or cantonment authority.

Cognizance of offences.

13. No Magistrate whose powers are less than those of a Magistrate of the second class shall try any offence under this Act.

Jurisdiction.

Power of Local Government to make rules.

14. The Local Government may, after previous publication, make rules consistent with this Act—

(*a*) providing for the appointment of persons to be called official inspectors, to carry out the provisions of section 8 and of the Act generally,

(*b*) prescribing the qualifications of such official inspectors and the powers to be exercised by them,

(*c*) regulating the areas within which such official inspectors shall respectively exercise their powers.

15. (1) No summons shall issue for the attendance of any person accused of an offence under section 4 or section 10, unless the same is applied for within thirty days from the date upon which the order or consent referred to in section 12 shall have been made or given.

Limitation for prosecutions.

(2) Every summons issued in a prosecution under section 4 or section 10 shall specify the particulars of the offence charged and the name of the prosecutor ; and the day fixed for the hearing of the case shall not be less than seven days from the day on which the summons is served upon such person.

SCHEDULE.

Form of Certificate.

To*

I, the undersigned, public analyst for the , do hereby certify that I received on the day of 19 from† a sample of for analysis (which then weighed‡) and have analysed the same and declare the result of my analysis to be as follows :—

I am of opinion that the same is a sample of genuine

or

(1) I am of opinion that the said sample contained a $\frac{\text{large}}{\text{small}}$ proportion of $\frac{\text{an ingredient}}{\text{ingredients}}$ foreign to pure . . (*a*)

[(*a*) milk, *ghi* or any particular edible oil, as the case may be].

Observations. §

Signed this day of 19 .

A. B.

at

In the case of a certificate regarding milk, butter or any article liable to decomposition, the analyst shall specially report whether any change had taken place in the constitution of the article that would interfere with the analysis.

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* Here insert the name of the person submitting the article for analysis.

† Here insert the name of the person delivering the sample. If the sample is received by post or by railway entry should be made accordingly.

‡ When the article cannot be conveniently weighed this passage may be erased or the blank may be left unfilled.

§ Here the analyst may insert at his discretion his opinion as to whether the mixture (if any) was for the purpose of rendering the article potable or palatable, or of preserving it or of improving the appearance, or was unavoidable, and may state whether in excess of what is ordinary or otherwise, and whether the ingredients or materials mixed are or are not injurious to health.

FEES FOR ANALYSIS.

In exercise of the powers conferred by section 7 of the United Provinces Prevention of Adulteration Act, VI of 1912, the local Government is pleased to prescribe the following fees for analysis by the public analyst of articles of food submitted by private purchasers under section 11 of the said Act.

	Rs.
(*a*) for chemical examination of milk	16
(*b*) for analysis of food	20
(*c*) for analysis of butter, *ghi*, oil and fats ...	30

2. The fees must be paid in advance into the local treasury, and the Treasury Officer's receipt for the prescribed fee must be forwarded with the letter asking for analysis to the public analyst.

In continuation of Government notification No. 106-XVI—80 dated the 18th March, 1914, and in exercise of the powers conferred by section 7 of the United Provinces Prevention of Adulteration Act, VI of 1912, the local Government is pleased to prescribe a minimum fee of Rs. 32 and a maximum fee of Rs. 64 for analysis by the public analyst of a drug submitted by private purchasers under section 11 of the said Act.

RULES AS TO THE APPOINTMENT AND POWERS OF OFFICIAL INSPECTORS.

[*Under section* 14 *of the Act.*]

1. In any municipal area to which the provisions of the United Provinces Adulteration of Food Act (VI of 1912) have been applied, the medical officer of health of the municipality shall be the official inspector.

2. In the exercise of his powers as hereinafter prescribed the official inspector for any municipal area shall be subject to the general control of the municipal board.

3. The official inspector for any municipal area shall enter into and inspect from time to time every, and forthwith on complaint any, particular market, building, shop, stall or place within such area in which articles of food or drugs are sold or stored, offered, exposed,

manufactured or brought for sale ; and shall inspect and examine any articles of food or drugs which may be therein, and in respect of which the provisions of the Act have been made applicable.

4. The official inspector may procure any sample of food or drugs in respect of which the provisions of the Act have been made applicable and submit the same for analysis by the public analyst.

5. In any area for which an official inspector has been appointed a local authority may not authorise any other person under section 8 of the Act to procure samples of food or drugs for the purpose of analysis by the public analyst.

Instructions regarding collection and despatch of samples of milk, butter, *ghi*, edible oils and drugs.

(1) *Milk.*

(*a*) The medical officer of health or any officer authorized for the collection of samples of milk must be provided with 8 oz. bottles with well fitting corks together with all appurtenances for affixing the seal of the department.

(*b*) He must divide the suspected sample into three parts, one to be sent to the public analyst by registered post, one to be kept, and one to be given to the vendor, should he so desire it. He should also, in cases in which milk is to be kept for any length of time, place in each bottle a standard tabloid of corrosive sublimate before sealing.

(*c*) The bottle should be provided with blank labels and the number and nature of the sample entered then and there after the bottle has been sealed.

(2) *Butter or ghi.*

Three samples of about 3 oz. each to be sealed up in wide-mouthed bottles. The same procedure as with submission of milk samples should be followed, but no preservatives need be added.

(3) *Oils.*

Three samples of about 3 oz. each to be sealed up in bottles. The ame procedure as in the case of butter samples should be followed.

EPIDEMIC DISEASES ACT, 1897.

(Act No. III of 1897).

AN ACT TO PROVIDE FOR THE BETTER PREVENTION OF THE SPREAD OF DANGEROUS EPIDEMIC DISEASE.

Whereas it is expedient to provide for the better prevention of the spread of dangerous epidemic disease ;

It is hereby enacted as follows :—

Short title, extent and commencement.

1. (1) This Act may be called the Epidemic Diseases Act, 1897.

(2) It extends to the whole of British India (inclusive of Upper Burma, British Baluchistan, the Sonthal Parganas and the Pargana of Spiti) ; and

(3) It shall come into force at once.

Power to take special measures and prescribe regulation as to dangerous epidemic disease.

2. (1) When at any time the Governor-General in Council is satisfied that India or any part thereof is visited by or threatened with, an outbreak of any dangerous epidemic disease, the Governor-General in Council, if he thinks that the ordinary provisions of the law for the time being in force are insufficient for the purpose, may take or require or empower any person to take such measures and, by public notice, prescribe such temporary regulations to be observed by the public or by any person or class of persons as he shall deem necessary to prevent the outbreak of such disease or the spread thereof, and may determine in what manner and by whom any expenses incurred (including compensation, if any) shall be defrayed.

(2) In particular and without prejudice to the generality of the foregoing provisions, the Governor-General in Council may take measures and prescribe the regulations for—

(*a*) the inspection of any ship or vessel leaving, or arriving at, any port in British India and such detention thereof, or of any person intending to sail therein, or arriving thereby, as may be necessary ; and

(*b*) the inspection of persons travelling by railway or otherwise and the segregation, in hospital, temporary accommodation or otherwise, of persons suspected by the inspecting officer of being infected with any such disease.

(3) The Governor-General in Council may, by general or special order, direct that all or any of the powers conferred by this Act may also be exercised by any Local Government with respect to the territories administered by it.

Penalty.

3. Any person disobeying any regulation or order made under this Act shall be deemed to have committed an offence punishable under section 188 of the Indian Penal Code.

Protection to persons acting under Act.

4. No suit or other legal proceeding shall lie against any person for anything done or in good faith intended to be done under this Act.

THE INDIAN FACTORIES ACT.

(Act No. XII of 1911).

AN ACT TO CONSOLIDATE AND AMEND THE LAW REGULATING LABOUR IN FACTORIES.

Whereas it is expedient to consolidate and amend the law regulating labour in factories; It is hereby enacted as follows:—

CHAPTER I.

PRELIMINARY.

Short title, commencement and extent.

1. (*1*) This Act may be called the Indian Factories Act, 1911.

(*2*) It shall come into force on the first day of July 1912; and

(*3*) It extends to the whole of British India, including British Baluchistan and the Sonthal Parganas.

Definition.

2. In this Act, unless there is anything repugnant in the subject or context,

"Child."

1) "child" means a person who is under the age of fourteen years:

"Employed."

(*2*) a person who works in a factory, whether for wages or not,—

(*a*) in a manufacturing process or handicraft, or

(*b*) in cleaning any part of the factory used for any manufacturing process or handicraft, or

(*c*) in cleaning or oiling any part of the machinery, or (*d*) in any other kind of work whatsoever, incidental to, or connected with, the manufacturing process or handicraft, or connected with the article made or otherwise the subject of the manufacturing process or handicraft therein :

shall be deemed to be employed the rein :

Explanation.—The term "manufacturing process" shall be deemed to include the baling of any material for transport :

"Factory."

(3) "factory" means any premises wherein, or within the precincts of which, steam, water or other mechanical power or electrical power is used in aid of any process for, or incidental to, making, altering, repairing, ornamenting, finishing or otherwise adapting for use, for transport or for sale any article or part of an article :

'Inspector."

(4) "inspector" includes an additional inspector :

"Mill gearing."

(5) "mill-gearing" includes every shaft, whether upright, oblique or horizontal, and every wheel, drum, pulley, rope, chain, wire, driving strap or band by which the motion of the first moving power is communicated to any machine appertaining to any manufacturing process :

"Occupier."

(6) "occupier" includes a managing agent or other person authorised to represent the occupier:

"Prescribed."

(7) "prescribed" means prescribed by this Act or by rules made thereunder :

"System of shifts."

(8) "system of shifts" means a system of relays in which the time of the beginning and ending of the period or periods of the employment of each person is fixed for each relay :

"Textile factory."

(9) "textile factory" means a factory wherein is carried on any process for, or incidental to, making, altering, repairing, ornamenting, finishing or otherwise adapting for use, for transport or for sale cotton, wool, hair, silk, flax, hemp, jute, tow, china-grass, cocoanut fibre or other like material, either separately or mixed together or mixed with any other material, or any fabric made thereof :

Provided that the term "textile factory' shall not be deemed to include the following factories, namely : - cloth-printing works, bleaching and dyeing works, lace warehouses, paper mills, flax scutch mills, silk filatures, factories for ginning cotton, decorticating fibre, pressing cotton, jute or othe fibre, rope works and hat works.

Application of Act.

3. (*1*) Nothing in the following chapters shall apply to—

(*a*) any mine subject to the operation of the Indian Mines Act, 1901, or

(*b*) any electrical generating or transforming station, or

(*c*) any indigo factory, or

(*d*) any factory situated on and used solely for the purpose of a tea or coffee plantation, or

(*e*) any factory wherein on no day in the year are more than forty-nine persons simultaneously employed :

Provided that the Local Government may, subject to the control of the Governor-General in Council, by notification in the local official Gazette, apply to any factory or class of factories, wherein any specified number of persons, not being less than twenty, are on any day simultaneously employed, all or any of the provisions of this Act which would, save for clause (*e*) of this sub-section, have applied.

(*2*) The provisions of Chapter IV and V and sections 35 and 36 shall not, unless the Local Government by order in writing otherwise directs, apply to any person employed solely in any place within the precincts of a factory, not being a cotton reeling-room or winding-room in which place no steam, water or other mechanical power or electrical power is used in aid of the manufacturing process carried on in such factory, or in which such power is used solely for the purpose of moving or working any appliances in connection with the bringing or taking of any goods into or out of the factory.

CHAPTER II.

INSPECTORS AND CERTIFYING SURGEONS.

Inspectors.

4. (1) The Local Government may, by notification in the local official Gazette, appoint such persons as it thinks fit to be inspectors of factories within such local limits as it may assign to them respectively.

(2) No person shall be appointed to be an inspector under sub-section (1), or having been so appointed, shall continue to hold the office of inspector, who is or becomes directly or indirectly interested in a factory or in any process or business carried on therein or any patent or machinery connected therewith.

(3) The District Magistrate shall be an inspector under this Act.

(4) The Local Government may also, by notification as aforesaid, and subject to the control of the Governor-General in Council, appoint such public officers as it thinks fit to be additional inspectors for all or any of the purposes of this Act within such local limits as it may assign to them respectively.

(5) In any area where there are more inspectors than one, the Local Government may, by notification as aforesaid, declare the powers which such inspectors shall respectively exercise, and the inspector to whom the prescribed notices are to be sent.

(6) Every inspector shall be deemed to be a public servant within the meaning of the Indian Penal Code and shall be officially subordinate to such authority as the Local Government may indicate in this behalf.

Powers of inspector.

5. Subject to any rules in this behalf, an inspector may, within the local limits for which he is appointed,—

(*a*) enter, with such assistants (if any) as he thinks fit, any place which is, or which he has reason to believe to be, used as a factory ;

(*b*) make such examination of the premises and machinery and of any prescribed registers, and take on the spot or otherwise such evidence of any persons as he may deem necessary for carrying out the purposes of this Act ; and

(*c*) exercise such other powers as may be necessary for carrying out the purposes of this Act :

Provided that no one shall be required under this section to answer any question or give any evidence tending to criminate himself.

Certifying surgeons.

6. The Local Government may appoint such qualified medical practitioners as it thinks fit to be certifying surgeons for the purposes of this Act within such local limits as it may assign to them respectively.

Grant of certificate.

7. (1) A certifying surgeon shall, at the request of any person desirous of being employed in a factory situated within the local limits for which he is appointed, or of the parent or guardian of such person, or of the manager of the factory in which such person desires to be employed, examine such person and grant him a certificate in the prescribed form, stating his age, as nearly as it can be ascertained from such examination, and whether he is fit for employment in a factory.

(2) Where a certifying surgeon refuses to certify that a person is fit for employment in a factory, he shall, if required by such person, or his

parent or guardian, or the manager of the factory in which such person desires to be employed, state in writing his reasons for such refusal.

Delegation of certifying surgeon's functions.

8. A certifying surgeon may authorize any person practising medicine or surgery to exercise the functions assigned to him by section 7, and may revoke such authority :

Provided that no certificate granted under this section shall, unless confirmed, on personal examination of the person named therein, by the certifying surgeon who conferred the authority, be valid after the first date subsequent to the grant thereof on which such certifying surgeon visits the factory in which the person named therein is employed.

CHAPTER III.

HEALTH AND SAFETY.

Sanitary provisions.

9. The following provisions shall apply to every factory :—

(*a*) it shall be kept clean, and free from effluvia arising from any drain, privy or other nuisance ;

(*b*) it shall not be so overcrowded while work is carried on therein as to be dangerous or injurious to the health of the persons employed therein ;

(*c*) it shall be ventilated in such a manner as to render harmless, as far as practicable, any gases, vapours, dust or other impurities generated in the course of the work carried on therein that may be injurious to health.

Provision as to ventilation by fans in certain factories.

10. If in a factory, in which any process is carried on by which dust or other impurity is generated and inhaled by the workers to an injurious extent, it appears to the inspector that such inhalation could be to a great extent prevented by the use of a fan or other mechanical means, the inspector may serve on the manager of the factory an order in writing, directing that a fan or other mechanical means of a proper construction for preventing such inhalation be provided, maintained and used before a specified date.

Lighting.

11. (1) Every factory shall be sufficiently lighted.

(2) In the case of any factory which is not in the opinion of the inspector so lighted, the inspector may serve on the manager of the

factory an order in writing, specifying the measures which he considers necessary for the attainment of a sufficient standard of lighting, and requiring him to carry them out before a specified date.

Purity of water used for humidifying.

12. (1) In any factory in which humidity of the atmosphere is produced by artificial means, the water used for the purpose of producing humidity shall be taken either from a public supply of drinking water or from some other source of water ordinarily used for drinking, or shall be effectively purified before being used for the purpose of producing humidity.

(2) In the case of any factory in which any water required under sub-section (1) to be effectively purified is not in the opinion of the inspector so purified, the inspector may serve on the manager of the factory an order in writing specifying the measures which he considers necessary for effectively purifying the water and requiring him to carry them out before a specified date.

Provision of latrines and urinal accommodation.

13. Every factory shall be provided with sufficient and suitable latrine accommodation, and if the Local Government so requires, with separate urinal accommodation for the persons employed in the factory :

Provided that the inspector may, subject to such conditions as the Local Government may lay down in this behalf, by an order in writing exempt any factory from the provisions of this section.

Water-supply.

14. In every factory there shall be maintained a sufficient and suitable supply of water fit for drinking for the use of the persons employed in the factory.

Doors of factory to open outwards.

15. In every factory, the construction of which is commenced after the commencement of this Act, the doors of each room in which more than thirty persons are employed shall, except in the case of sliding doors, be constructed so as to open outwards.

Provision of means for escape in case of fire.

16. (1) Every factory shall be provided with such means of escape in case of fire for the persons employed therein as can reasonably be required in the circumstances of each case.

(2) In the case of any factory which is not in the opinion of the inspector so provided, the inspector may serve on the manager of the factory an order in writing, specifying the measures which he considers necessary for providing such means of escape, and requiring him to carry them out before a specified date.

Precautions against fire.

17. No person shall smoke, or use a naked light or cause or permit any such light to be used, in the immediate vicinity of any inflammable material in any factory.

Fencing.

18. (1) (*a*) Every fly-wheel directly connected with a steam-engine, water-wheel or other mechanical power or electrical power in any part of the factory and every part of any waterwheel or engine worked by any such power,

(*b*) every hoist or teagle and every hoist-well, trap-door or other similar opening near which any person is liable to pass or be employed, and

(*c*) every part of the machinery which the Local Government may by rule require to be kept fenced,

shall be securely fenced.

(2) If in any factory there is any other part of the machinery or mill-gearing which may in the opinion of the inspector be dangerous if left unfenced the inspector may serve on the manager of the factory an order in writing, specifying the measures which he considers necessary for fencing such part in order to remove the danger, and requiring him to carry them out before a specified date.

(3) All fencing must be constantly maintained in an efficient state while the parts required to be fenced are in motion or use, except where they are under repair or are under examination in connection with repair or are necessarily exposed for the purpose of cleaning or lubricating or for altering the gearing arrangements of the machinery.

(4) Such provision as may be prescribed shall be made for the protection from danger of persons employed in attending to the machinery or boilers of any factory.

Prohibition of employment of women and children in certain dangerous work.

19. No woman or child shall be allowed to clean any part of the mill-gearing or machinery of a factory while the same is in motion by the action of steam, water or other mechanical power or electrical power, as the case may be, or to work between the fixed and traversing parts of any self-acting machine while such machine is in motion by the action of any power above described.

Prohibition of employment of women and children where cotton-openers are at work.

20. No woman or child shall be employed in the part of a factory for pressing cotton in which a cotton-opener is at work :

Provided that, if the feed-end of a cotton-opener is in a room separated from the delivery-end by a partition extending from the floor to the roof, women and children may be employed in the room in which the feed-end is situated.

CHAPTER IV.

HOURS OF EMPLOYMENT AND HOLIDAYS.

Periodical stoppage of work.

21. (1) In every factory there shall be fixed for each working day, at intervals not exceeding six hours, periods of not less than half an hour, during which all work shall be discontinued.

(2) Nothing in sub-section (1) shall apply to—

(*a*) any work performed by any person while employed in accordance with a system of shifts approved by the inspector, or

(*b*) the work of sizing, calendering, finishing, sewing or tailoring in textile factories, or in cloth-printing works, or in bleaching or dyeing works, or

(*c*) work on urgent repairs executed in railway or tramway workshops or running sheds, or in engineering works or ship-repairing works, or

(*d*) any work mentioned in Part A or in Part B of Schedule I, or

(*e*) the factories mentioned in Part C of the said Schedule.

(3) Where it is proved to the satisfaction of the Local Government—

(*a*) that any class of work not specified in Part A of Schedule I is of an urgent nature or is such as in the interests of efficiency is commonly performed while the main manufacturing process of the factory is discontinued, or

(*b*) that there is in any class of factories not specified in Part B of the said Schedule any work which necessitates continuous production for technical reasons, or

(*c*) that any class of factories not specified in Part C of the said Schedule requires, by reason of the exigencies or special circumstances of the trade carried on therein, an uninterrupted working day

the Local Government may, subject to the control of the Governor General in Council, by notification in the local official Gazette, exempt,—

in case (*a*), such class of work,

in case (*b*), work of the nature described in such class of factories,
in case (*c*), such class of factories,

from the provisions of sub-section (1) on such conditions, if any, as it may impose.

Weekly holiday. 22. (1) No person shall be employed in any factory on a Sunday, unless—

(*a*) he has had, or will have, a holiday for a whole day on one of the three days immediately preceding or succeeding the Sunday, and

(*b*) the manager of the factory has previous to the Sunday or the substituted day, whichever is earlier, given notice to the inspector of his intention so to employ the said person and of the day which is to be substituted and has at the same time affixed a notice to the same effect in the place mentioned in section 36.

(2) Nothing in sub-section (1) shall apply to work on urgent repairs executed in railway or tramway workshops or running sheds or in engineering works or ship-repairing works.

(3) Nothing in sub-section (1) shall apply to any person employed on any work specified in Part A of Schedule I or in Part A of Schedule II or to any factory specified in Part B of Schedule II.

(4) Where it is proved to the satisfaction of the Local Government—

(*a*) that any class of work not specified in Part A of Schedule I is of an urgent nature or is such as in the interests of efficiency is commonly performed while the main manufacturing process of the factory is discontinued, or

(*b*) that there is in any class of factories not specified in Part A of Schedule II any work which necessitates continuous production for technical reasons, or

(*c*) that any class of factories not specified in Part B of Schedule II supplies the public with articles of prime necessity which must be made or supplied every day, or

(*d*) that in any class of factories the work performed, by the exigencies of the trade or by its nature, cannot be carried on except at stated seasons, or at times dependent on the irregular action of natural forces,

the Local Government may, subject to the control of the Governor General in Council, by notification in the local official Gazette, exempt,—

in case (*a*), such class of work

case (*b*), work of the nature described in such class of factories and

in cases (*c*) and (*d*), such class of factories,
from the provisions of sub-section (1), on such conditions, if any, as it may impose.

Employment of children.

23. With respect to the employment of children in factories the following provisions shall apply :—

(*a*) no child shall be employed in any factory unless he is in possession of a certificate granted under section 7 or section 8 showing that he is not less than nine years of age and is fit for employment in a factory and while at work carries either the certificate itself or a token giving reference to such certificate;

(*b*) no child shall be employed in any factory before half-past five o'clock in the morning or after seven o'clock in the evening;

(*c*) no child shall be employed in any factory for more than seven hours in any one day.

Employment of women.

24. With respect to the employment of women in factories the following provisions shall apply :—

(*a*) no woman shall be employed in any factory before half-past five o'clock in the morning or after seven o'clock in the evening;

(*b*) no woman shall be employed in any factory for more than eleven hours in any one day.

Prohibition of employment of woman or child in two factories on same day.

25. No person shall employ, or permit to be employed, in any factory any woman or child whom he knows, or has reason to believe to have already been employed on the same day in any other factory.

Hours of employment of women and children to be fixed.

26. The manager of a factory shall fix specified hours for the employment of each woman and child employed in such factory, and no woman or child shall be employed except during such hours.

Exception to provisions relating to employment of women.

27. Nothing in section 24 or section 26 shall apply to any woman in any factory for ginning or pressing cotton, in which such number of women are employed as are in the opinion of the inspector sufficient to make the hours of employment of each woman not more than eleven in any one day.

CHAPTER V.

SPECIAL PROVISIONS FOR TEXTILE FACTORIES.

Limitation of hours of work.

28. No person shall be employed in any textile factory for more than twelve hours in any one day.

Limits between which a person may be employed.

29. (*1*) No person shall be employed in any textile factory before half-past five o'clock in the morning or after seven o'clock in the evening.

(*2*) Nothing in sub-section (*1*) shall apply to any person while employed in accordance with a system of shifts approved by the inspector.

Exceptions from sections 28 and 29.

30. (*1*) Nothing in section 28 or section 29 shall apply to—

(*a*) the work of calendering, finishing, sewing or tailoring, or

(*b*) the work of cloth-printing, bleaching or dyeing, or

(*c*) any work specified in part A of Schedule I.

(*2*) Where it is proved to the satisfaction of the Local Government that any work not specified in Part A of Schedule I is of an urgent nature, or is such as in the interests of efficiency is commonly performed while the main manufacturing process of the factory is discontinued, the Local Government may, subject to the control of the Governor-General in Council by notification in the local official Gazette, exempt any person employed on such work from the operation of section 28 or section 29 on such conditions, if any, as it may impose.

Limit of use of machinery.

31. (*1*) The period for which mechanical power or electrical power is used in any textile factory shall not in any one day exceed twelve hours.

(*2*) Nothing in sub-section (*1*) shall apply to any mechanical power or electrical power while being solely used in aid of the work performed by any person employed in accordance with a system of shifts approved by the inspector.

(*3*) Nothing in sub-section (*1*) shall apply to any mechanical power or electrical power required in connection with any work specified in sub-section (*1*) of section 30 or in connection with any work which is exempted by the Local Government under sub-section (*2*) of the same section.

Limitation of hours of children.

32. No child shall be employed in any textile factory for more than six hours in any one day.

CHAPTER VI.

NOTICES AND REGISTERS.

Person occupying factroy to give notice.

33. (*1*) Every person occupying a factory shall,—

(*a*) in the case of existing factories, within one month after the commencement of this Act, or

(*b*) in the case of a factory which starts work after the commencement of this Act, within one month after he begins to occupy the factory,

send to the inspector a written notice containing—

(i) the name of the factory and place where it is situate,

(ii) the address to which he desires his letters to be directed,

(iii) the nature of the work performed in such factory,

(iv) the nature and amount of the moving power therein, and

(v) the name of the person who shall be deemed to be the manager of the factory for the purposes of this Act :

Provided that in the case of a seasonal factory such notice shall be sent on or before the date of starting work for each season.

(2) If the manager of the factory is changed, the occupier shall send to the inspector, within seven days from the date on which the change is made, written notice of the change.

(3) During any period for which no person has been designated as manager of a factory under this section, the occupier shall himself be deemed to be the manager of the factory for the purposes of this Act.

Notice to be given of accident.

34. When any accident occurs in a factory causing death or bodily injury, whereby the person injured is prevented from returning to his work in the factory during the forty eight hours next after the occurrence of the accident, the manager shall send notice of the accident to such authorities in such form and within such time as may be prescribed.

Register of children.

35. In every factory there shall be kept, in the prescribed form, a register of the children (if any) employed in such factory, and of the nature of their respective employment.

Affixing of abstract and notices.

36. (*1*) There shall be affixed in some conspicuous place near the main entrance of every factory, in English and in the language of the majority of the operatives in such factory, the prescribed abstracts of this

Act and of the. rules made thereunder, and also a notice containing the standing orders of the factory upon the following matters, namely :—

(*a*) the time of beginning and ending work on each day ;

(*b*) the periods during which all work is discontinued under section 21 ;

(*c*) the hours of beginning and ending work for each shift (if any) ; and

(*d*) the hours of employment of women and children, respectively, if not employed in shifts.

(*2*) A copy of the said notice shall be sent to the inspector within one month of the commencement of this Act, or, in the case of a factory which starts work after the commencement of this Act, within one month of commencing work.

(*3*) The said notice shall be correctly maintained and kept up to date, and intimation of any change therein shall be sent by the manager to the inspector within seven days.

(*4*) Nothing in this section, except in so far as it relates to affixing the prescribed abstracts of this Act and the rules made thereunder, shall apply to any seasonal factory.

CHAPTER VII.

RULES.

Power to make rules.

37. (*1*) Subject to the control of the Governor General in Council, the Local Gevernment may make rules for the purpose of carrying into effect the provisions of this Act.

(*2*) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for—

(*a*) the inspection of factories ;

(*b*) the manner in which inspectors are to exercise the powers conferred on them by this Act ;

(*c*) the duties to be performed by certifying surgeons ;

(*d*) the form of the certificate prescribed by section 7, the grant of a duplicate in the event of loss of the original certificate, and the fee, if any, to be charged for such duplicate ;

(*e*) the methods, including lime-washing, painting, varnishing and washing, to be adopted in order to secure cleanliness and freedom from effluvia ;

(*f*) the proportion which the number of cubic feet of space in any room shall bear to the number of persons employed at one time therein ;

(*g*) standards of ventilation, and the methods to be adopted in order to secure their observance ;

(*h*) standards of latrine and urinal accommodation ;

(*i*) standards of water-supply ;

(*j*) the parts of the machinery to be kept fenced in accordance with section 18, sub-section (*1*), clause (*c*), and the provisions to be made for the protection from danger of persons employed in attending to the machinery or boilers ;

(*k*) the form of the notice prescribed by section 34, and the time within which and the authorities to whom it shall be sent ;

(*l*) the form of the register prescribed by section 35 ;

(*m*) the abstracts of the Act and of the rules required by section 36 ;

(*n*) the procedure to be followed in presenting and hearing appeals under this Act, including the appointment and remuneration of assessors ; and

(*o*) the manner of service of notices and orders upon occupiers or managers of factories.

Returns.

38. The Governor General in Council may from time to time make rules requiring occupiers or managers of factories to furnish such returns, occasional or periodical, as may in his opinion be necessary for the effectual carrying out of this Act.

Prior publication of rules.

39. (*1*) The power to make rules conferred by section 37, except clauses (*k*), (*l*) and (*m*) of sub-section (*2*) thereof, and by section 38 is subject to the condition of the rules being made after previous publication.

(*2*) The date to be specified in accordance with clause (*3*) of section 23 of the General Clauses Act, X of 1897, as that after which a draft of rules proposed to be made under sections 37 and 38 will be taken into consideration, shall not be less than three months from the date on which the draft of the proposed rules was published for general information.

Commencement of rules.

40. Rules made under this Chapter shall be published in the local official Gazette or the Gazette of India, as the case may be, and shall thereupon have effect as if enacted in this Act.

CHAPTER VIII.

PENALTIES AND PROCEDURE

Penalties. 41. If in any factory—

(*a*) any person is employed or allowed to work contrary to any of the provisions of this Act ;

(*b*) any of the provisions of section 9 are not complied with ;

(*c*) latrine or urinal accommodation in accordance with the provisions of section 13 is not provided ;

(*d*) a supply of water for the persons employed is not maintained in accordance with the provisions of section 14 ;

(*e*) any door is constructed in contravention of section 15 ;

(*f*) any of the provisions of section 18 sub-sections (*1*), (*3*) and (*4*), regarding fencing and the protection from danger of persons employed in attending to the machinery or boilers are not complied with ;

(*g*) any order of an inspector under section 10, section 11, section 12, section 16 or section 18 is not complied with ;

(*h*) the register prescribed by section 35 is not kept up to date ;

(*i*) any of the provisions of section 36 are not complied with ;

(*j*) any notice or return required by this Act or by rules made thereunder to be furnished is not furnished ;

the occupier and manager shall be jointly and severally liable to a fine which may extend to two hundred rupees :

Provided that in cases where an appeal is allowed by section 50 no prosecution under clause (*g*) of this section shall be instituted until either the time prescribed by section 50 for the presentation of an appeal has expired or such appeal, if made, has been determined.

Exemption of occupier or manager from liability in certain cases.

42. (*1*) Where the occupier or manager of a factory is charged with an offence against this Act, he shall be entitled upon complaint duly made by him to have any other person whom he charges as the actual offender brought before the Court at the time appointed for hearing the charge ; and if, after the commission of the offence has been proved, the occupier or manager of the factory proves to the satisfaction of the Court—

(*a*) that he has used due diligence to enforce the execution of this Act, and (*b*) that the said other person committed the offence in question without his knowledge, consent or connivance,

that other person shall be convicted of the offence and shall be liable to the like fine as if he were the occupier or manager, and the occupier or manager shall be discharged from any liability under this Act.

(*2*) When it is made to appear to the satisfaction of the inspector at any time prior to the institution of the proceedings—

(*a*) that the occupier or manager of the factory has used all due diligence to enforce the execution of this Act, and

(*b*) by what person the offence has been committed, and

(*c*) that it has been committed without the knowledge, consent or connivance of the occupier or manager, and in contravention of his orders,

the inspector shall proceed against the person whom he believes to be the actual offender without first proceeding against the occupier or manager of the factory, and such person shall be liable to the like fine as if he were the occupier or manager.

Penalties for certain offences.

43. Any person who—

(*a*) wilfully obstructs an inspector in the exercise of any power under section 5, or fails to produce on demand by an inspector any registers or other documents kept in persuance of this Act or the rules made thereunder, or conceals or prevents or attempts to prevent any person employed in a factory from appearing before or being examined by an inspector ;

(*b*) smokes, or uses a naked light, or causes or permits any such light to be used, in the immediate vicinity of any inflammable material in contravention of section 17 ; or

(*c*) does or omits to do any other act prohibited or prescribed by this Act or any order or rule made thereunder ;

shall be punishable with fine which may extend to two hundred rupees.

Using false certificate.

44. Any person who knowingly uses or attempts to use, as a certificate granted to himself under section 7 or section 8, a certificate granted to another person under either of those sections, or who, having procured such a certificate, knowingly allows it to be used, or an attempt to use it to be made, by another person, shall be punishable with fine which may extend to twenty rupees.

Limit to penalty in case of repetition of offence.

45. A person shall not be liable in respect of a repetition of the same kind of offence from day to day to any larger amount of fines than the highest fine fixed by this Act for the offence, except—

(*a*) where the repetition of the offence occurs after a prosecution has been instituted in respect of the original offence, or

(*b*) where the offence is one of employing or allowing to be employed two or more persons contrary to the provisions of this Act.

Presumption as to employment.

46. If a child over the age of six years is found inside any room or part of a factory in which room or part children are employed and in which any manufacturing process or work incidental to any manufacturing process is being carried on, he shall, until the contrary is proved, be deemed to be employed in the factory.

Evidence as to age.

47. (*1*) When an act or omission would, if a person were under or over a certain age, be an offence punishable under this Act, and such person is in the opinion of the Court apparently under or over such age, it shall be on the accused to prove that such person is not under or over such age.

(2) A declaration in writing by a certifying surgeon that he has personally examined a person employed in a factory and believes him to be under or over the age set forth in such declaration shall, for the purposes of this Act, be admissible as evidence of the age of that person.

Cognizance of offences.

48. (*1*) No prosecution under this Act, except a prosecution under section 43, clause (*b*), shall be instituted except by or with the previous sanction of the inspector.

(2) No Court inferior to that of a Presidency Magistrate or of a Magistrate of the first class shall try any offence against this Act or any rule or order thereunder, other than an offence against section 43, clause (*b*).

Limitation of prosecutions.

49. No Court shall take cognizance of any offence against this Act or any rule or order thereunder, unless complaint thereof is made within six months of the date on which the offence is alleged to have been committed.

CHAPTER IX.

SUPPLEMENTAL PROVISIONS.

Appeals.

50. (*1*) Any person on whom an order under section 10, section 11, section 12, section 16 or section 18 has been served may, within fourteen days from the date of service of the order, appeal against such order to the Local Government or to such authority as it may appoint in this behalf, who may confirm, modify or reverse any such order.

(*2*) Where an inspector refuses to approve a system of shifts, he shall, if required by the manager of the factory, record his order of refusal with the reasons therefor, and the manager of the factory may, within fourteen days from the date of such order, appeal against it to the Local Government or to such authority as it may appoint in this behalf, who may confirm, modify or reverse any such order.

(*3*) In the case of any appeal under sub-section (*1*) the appellate authority may, and if so requested by the appellant in the petition of appeal shall, hear the appeal with the aid of two assessors, one of whom shall be appointed by the said authority and the other by such body representing the interest of the industry concerned as the Local Government may in this behalf prescribe :

Provided that if no assessor is appointed by such body within the prescribed period, or if the assessor so appointed fails to attend at the time and place fixed for the hearing of the appeal, the said authority may proceed to hear the appeal without the aid of such assessor, or, if it thinks fit, without the aid of any assessor.

Special provision regarding computation of time.

51. (1) In respect of any area in which the hours of the day are not ordinarily reckoned according to local mean time, the times and hours, referred to in section 2, sub-section (8), section 26 and section 36 shall be reckoned according to the standard of time ordinarily observed in such area.

(2) The Local Government may, by notification in the local official Gazette, direct that, for any specified area and during any specified months, for the morning and evening hours mentioned in section 23, clause (b), section 24, clause (a), and section 29, such one of the following sets of morning and evening hours, as it deems suitable, reckoned according to the standard of time ordinarily observed in such area, shall be substituted, namely :

five o'clock in the morning and half past six o'clock in the evening;
six o'clock in the morning and half past seven o'clock in the evening;
half past six o'clock in the morning and eight o'clock in the evening;
seven o'clock in the morning and half past eight o'clock in the evening.

Computation of hours of employment.

52. In computing the hours referred to in section 23, clause (c) section 24, clause (b), section 28 and section 32, any interval by which work is interrupted for half an hour or more shall be excluded.

Power to declare parts of a factory to be separate factories.

53. The Local Government may, subject to the control of the Governor General in Council, by special order in writing, direct, with respect to any factory or class of factories, that different branches or departments of work carried on in the same factory shall for all or any of the purposes of this Act be treated as if they were separate factories.

Application to Crown factories.

54. This Act shall apply to factories belonging to the Crown.

Special provision for Burma for employment on Sunday.

55. Notwithstanding anything in section 22, sub-section (1), any person may in the province of Burma be employed on Sunday for any time not exceeding four hours in cleaning the machinery and apparatus in a factory, provided that he has not worked in the factory later than two o'clock in the afternoon on the previous day.

Power to exempt from Act.

56. In case of any public emergency, the Local Government may, by an order in writing, exempt any factory from this Act to such extent and during such period as it thinks fit.

Exercise of power by Governor General in Council.

57. The Governor General in Council may, if he thinks fit, exercise any power which is by this Act conferred upon the Local Government.

Protection to persons acting under Act.

58. No suit, prosecution or other legal proceeding shall lie against any person for anything which is in good faith done or intended to be done under this Act.

Repeal and savings. 59. The Indian Factories Act, XV of 1881, and the Indian Factories Act, XI of 1891, are hereby repealed:

Provided that all appointments made and all certificates given under the said Acts shall be deemed to have been made or given under this Act.

SCHEDULE I.

(*See Sections 21, 22, 30*).

PART A.

[*See Sections 21 (2), (3) ; 22 (3) ; 30*].

WORK OF AN URGENT NATURE OR SUCH AS IN THE INTERESTS OF EFFICIENCY IS COMMONLY PERFORMED WHILE THE MAIN MANUFACTURING PROCESS OF THE FACTORY IS DISCONTINUED.

(*a*) Work by the supervising staff, clerks, watchmen or messengers ;

(*b*) work in the machanic shop, the smithy or foundry, the boiler-house, the engine-room or power-house, or in connection with the mill-gearing, the electric driving or lighting apparatus, mechanical or electrical lifts, or the steam or water pipes or pumps ;

(*c*) work on the cleaning of walls, ceilings or other portions of factory buildings, tanks, wells, humidifying or ventilating apparatus, tunnels, blow-room flues or line-shaft alleys or of galleries in ginning factories ;

(*d*) work by persons engaged in oiling, examining or repairing or in supervising or aiding in the oiling, examination or repair of any machinery or other thing whatsoever which is necessary for the carrying on of the work in a factory.

Explanation.—Periodical cleaning is not included in the terms "examining" or "repairing" ;

(*e*) work on the processes of packing, bundling or baling of finished articles or the receiving or despatching of goods.

PART B.

[*See section 21* (*2*), (*3*)].

WORK NECESSITATING CONTINUOUS PRODUCTION FOR TECHNICAL REASONS IN THE FOLLOWING FACTORIES, NAMELY :—

Tanneries.
Sugar refineries.
Breweries.
Distilleries.
Oil refineries.
Oil mills.
Cement works.
Cloth printing works.
Bleaching and dyeing works.
Carbonic acid gas works.
Chemical works.
Glass works.
Paper mills.
Shellac factories.
Potteries.
Blast furnaces, ore smelting works, or works for the manufacture of iron or steel or other metals.

PART C.

[*See section 21*; (*2*), (*3*)].

FACTORIES WHICH BY REASON OF THE EXIGENCIES OR THE SPECIAL CIRCUMSTANCES OF THE TRADE CARRIED ON THEREIN REQUIRE AN UNINTERRUPTED WORKING DAY, NAMELY :—

Flour mills.
Rice mills.
Letter-press printing works.
Dairies.
Bakeries.
Ice factories.
The mints.
Gas works.
Air-compressor stations.
Water works or water-supply pumping stations.

SCHEDULE II.

(*See section 22*).

PART A.

[*See section 22* (*3*), (*4*)].

WORK NECESSITATING CONTINUOUS PRODUCTION FOR TECHNICAL REASONS IN THE FOLLOWING FACTORIES, NAMELY :—

Tanneries.
Sugar refineries.
Breweries.
Distilleries.
Oil refineries.
Cement works.
Carbonic acid gas works.
Chemical works.
Glass works.
Shellac factories.
Potteries.
Blast furnaces, ore smelting works or works for the manufacture of iron or steel or other metals.

PART B.

[*See section 22* (*3*), (*4*)].

FACTORIES WHICH SUPPLY THE PUBLIC WITH ARTICLES OF PRIME NECESSITY WHICH MUST BE MADE OR SUPPLIED EVERY DAY, NAMELY :—

Ice factories.
Dairies.
Bakeries.
Gas works.
Air-compressor stations.
Water works or water-supply pumping stations.

EXTRACTS FROM THE INDIAN PENAL CODE RELATING TO OFFENCES AFFECTING THE PUBLIC HEALTH AND SAFETY.

268. A person is guilty of a public nuisance who does any act or is guilty of an illegal omission which causes any common injury, danger or annoyance to the public or to the people in general who dwell or occupy

property in the vicinity, or which must necessarily cause injury, obstruction, danger or annoyance to persons who may have occasion to use any public right.

A common nuisance is not excused on the ground that it causes some convenience or advantage.

269. Whoever unlawfully or negligently does any act which is, and which he knows or has reason to believe to be, likely to spread the infection of any disease dangerous to life, shall be punished with imprisonment of either description for a term which may extend to six months, or with fine, or with both.

270. Whoever malignantly does any act which is, and which he knows or has reason to believe to be, likely to spread the infection of any disease dangerous to life, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both.

271. Whoever knowingly disobeys any rule made and promulgated by the Government of India, or by any Government, for putting any vessel into a state of quarantine, or for regulating the intercourse of vessels in a state of quarantine with the shore or with other vessels, or for regulating the intercourse between places where an infectious disease prevails and other places, shall be punished with imprisonment of either description for a term which may extend to six months, or with fine, or with both.

272. Whoever adulterates any article of food or drink, so as to make such article noxious as food or drink, intending to sell such articles as food or drink, or knowing it to be likely that the same will be sold as food or drink, shall be punished with imprisonment of either description for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

'*Noxious*'.—That is, harmful or injurious to health or unwholesome. It must be shewn that the accused sold or exposed for sale an article which was to *his* knowledge noxious as food or drink. The accused was convicted for exposing for sale some *Ghi* which was bad. The *Ghi* was not adulterated, but somewhat rancid. The High Court quashed the conviction on the ground that it was not shewn that the *Ghi* was noxious as food or drink to the knowledge or belief of the accused. Milk is not rendered noxious by being mixed with water. Nor is *Ghi*, when adulterated with vegetable oil. It is not an offence to sell inferior food cheap, if it is not shown to be noxious. Where a person sold an inferior quality of flour after reducing its price and the purchaser was aware of the fact, it was held that he was not guilty under this section. Similarly selling wheat containing a large admixture of extraneous matter, e.g., dirt, wood, matches, charcoal, black-seeds, etc., is held to be no offence.

274. Whoever adulterates any drug or medical preparation in such a manner as to lessen the efficacy or change the operation of such drug or medical preparation, or to make it noxious, intending that it shall be sold or used for, or knowing it to be likely that it will be sold or used for, any medicinal purpose, as if it had not undergone such adulteration, shall be punished with imprisonment of either description for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

275. Whoever knowing any drug or medical preparation to have been adulterated in such a manner as to lessen its efficacy, to change its operation, or to render it noxious, sells the same, or offers or exposes it for sale, or issues it from any dispensary for medicinal purposes as unadulterated, or causes it to be used for medicinal purposes by any person not knowing of the adulteration, shall be punished with imprisonment of either description for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

276. Whoever knowingly sells, or offers or exposes for sale, or issues from a dispensary for medicinal purposes, any drug or medical preparation, as a different drug or medical preparation, shall be punished with imprisonment of either description for a term which may extend to six months or with fine which may extend to one thousand rupees, or with both.

277. Whoever voluntarily corrupts or fouls the water of any public spring or reservoir, so as to render it less fit for the purposes for which it is ordinarily used, shall be punished with imprisonment of either description for a term which may extend to three months, or with fine which may extend to five hundred rupees, or with both.

278. Whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the neighbourhood or passing along a public way, shall be punished with fine which may extend to five hundred rupees.

Comment.—Prosecutions against offensive trades which give out bad smells will come under this section.

SECTIONS OF THE CRIMINAL PROCEDURE CODE RELATING TO PUBLIC NUISANCES.

133. (1) Whenever a District Magistrate, a Sub-divisional Magistrate or a Magistrate of the first class considers, on receiving a police-report or other information and on taking such evidence (if any) as he thinks fit,

that any unlawful obstruction or nuisance should be removed from any way, river or channel which is or may be lawfully used by the public, or from any public place, or that the conduct of any trade or occupation, or the keeping of any goods or merchandise, is injurious to the health or physical comfort of the community, and that in consequence such trade or occupation should be prohibited or regulated or such goods or merchandise should be removed or the keeping thereof regulated, or that the construction of any building, or the disposal of any substance, as likely to occasion conflagration or explosion, should be prevented or stopped, or

that any building, tent or structure, or any tree is in such a condition that it is likely to fall and thereby cause injury to persons living or carrying on business in the neighbourhood or passing by, and that in consequence the removal, repair or support of such building, tent or structure, or the removal or support of such tree, is necessary, or

that any tank, well or excavation adjacent to any such way or public place should be fenced in such manner as to prevent danger arising to the public, or

that any dangerous animal should be destroyed, confined or otherwise disposed of,

such Magistrate may make a conditional order requiring the person causing such obstruction or nuisance, or carrying on such trade or occupation, or keeping any such goods or merchandise, or owning, possessing or controlling such building, tent, structure, substance, tank, well or excavation, or owning or possessing such animal or tree, within a time to be fixed in the order,

to remove such obstruction or nuisance ; or

to desist from carrying on, or to remove or regulate in such manner as may be directed, such trade or occupation ; or

to remove such goods or merchandise, or to regulate the keeping thereof in such manner as may be directed ; or

to prevent or stop the erection of, or to remove, repair or support, such building, tent or structure ; or

to remove or support such tree ; or
to alter the disposal of such substance ; or
to fence such tank, well or excavation, as the case may be ; or

to destroy, confine or dispose of such dangerous animal in the manner provided in the said order ; or, if he objects so to do,

to appear before himself or some other Magistrate of the first or second class, at a time and place to be fixed by the order, and move to have the order set aside or modified in the manner hereinafter provided.

(2) No order duly made by a Magistrate under this section shall be called in question in any Civil Court.

Explanation.—A "public place" includes also property belonging to the State, camping grounds and grounds left unoccupied for sanitary and recreative purposes.

134. (1) The order shall, if practicable, be served on the person against whom it is made, in manner herein provided for service of a summons.

(2) If such order cannot be so served, it shall be notified by proclamation, published in such manner as the Local Government may by rule direct, and a copy thereof shall be stuck up at such place or places as may be fittest for conveying the information to such person.

135. The person against whom such order is made shall

(*a*) perform, within the time and in the manner specified in the order, the act directed thereby ; or

(*b*) appear in accordance with such order and either show cause against the same, or apply to the Magistrate by whom it was made to appoint a jury to try whether the same is reasonable and proper.

136. If such person does not perform such act or appear and show cause or apply for the appointment of a jury as required by section 135 he shall be liable to the penalty prescribed in that behalf in section 188 of the Indian Penal Code, and the order shall be made absolute.

137. (1) If he appears and shows cause against the order, the Magistrate shall take evidence in the matter as in a summons case.

(2) If the Magistrate is satisfied that the order is not reasonable and proper, no further proceedings shall be taken in the case.

(2) If the Magistrate is not so satisfied, the order shall be made absolute.

138. (1) On receiving an application under section 135 to appoint a jury, the Magistrate shall—

(*a*) forthwith appoint a jury consisting of an uneven number of persons not less than five, of whom the foreman and one half of the remaining members shall be nominated by such Magistrate, and the other members by the applicant ;

(*b*) summon such foreman, and members to attend at such place and time as the Magistrate thinks fit ; and

(*c*) fix a time within which they are to return their verdict.

(2) The time so fixed may, for good cause shown, be extended by the Magistrate.

139. (1) If the jury or a majority of the jurors find that the order of the Magistrate is reasonable and proper as originally made, or subject to a modification which the Magistrate accepts the Magistrate shall make the order absolute, subject to such modification (if any).

(2) In other cases no further proceedings shall be taken under this Chapter of the Criminal Procedure Code.

139A. (1) Where an order is made under section 133 for the purpose of preventing obstruction, nuisance or danger to the public in the use of any way, river, channel or place, the Magistrate shall, on the appearance before him of the person against whom the order was made, question him as to whether he denies the existence of any public right in respect of the way, river, channel or place, and, if he does so, the Magistrate shall, before proceeding under section 137 or section 138, inquire into the matter.

(2) If in such inquiry the Magistrate finds that there is any reliable evidence in support of such denial, he shall stay the proceedings until the matter of the existence of such right has been decided by a competent Civil Court ; and, if he finds that there is no such evidence, he shall proceed as laid down in section 137 or section 138, as the case may require.

(3) A person who has, on being questioned by the Magistrate under sub-section (1) failed to deny the existence of a public right of the nature therein referred to, or who, having made such denial, has failed to adduce reliable evidence in support thereof, shall not in the subsequent proceedings be permitted to make any such denial, nor shall any question in respect of the existence of any such public right be inquired into by any jury appointed under section 138.

140. (1) When an order has been made absolute under section 136, section 137 or section 139, the Magistrate shall give notice of the same to the person against whom the order was made, and shall further require him to perform the act directed by the order within a time to be fixed in the notice, and inform him that in case of disobedience he will be liable to the penalty provided by section 188 of the Indian Penal Code.

(2) If such act is not performed within the time fixed, the Magistrate may cause it to be performed, and may recover the cost of performing it, either by the sale of any building, goods or other property removed by his order or by the distress and sale of any other moveable property of such person within or without the local limits of such Magistrate's jurisdiction. If such other property is without such limits, the order shall authorise its attachment and sale when endorsed by the Magistrate within the local limits of whose jurisdiction the property to be attached is found.

(3) No suit shall lie in respect of anything done in good faith under this section.

141. If the applicant, by neglect or otherwise, prevents the appointment of the jury, or if from any cause the jury appointed do not return their verdict within the time fixed or within such further time as the Magistrate may in his jurisdiction allow, the Magistrate may pass such order as he thinks fit, and such order shall be executed in the manner provided by section 140.

142. (1) If a Magistrate making an order under section 133 considers that immediate measures should be taken to prevent imminent danger or injury of a serious kind to the public, he may, whether a jury is to be, or has been appointed or not, issue such an injunction to the person against whom the order was made, as is required to obviate or prevent such danger or injury pending the determination of the matter.

(2) In default of such person forthwith obeying such injunction, the Magistrate may himself use, or cause to be used, such means as he thinks fit to obviate such danger or to prevent such injury.

(3) No suit shall lie in respect of anything done in good faith by a Magistrate under this section.

143. A District Magistrate or Sub-divisional Magistrate or any other Magistrate empowered by the Local Government or the District

Magistrate in this behalf may order any person not to repeat or continue a public nuisance, as defined in the Indian Penal Code, or any special or local law.

TEMPORARY ORDERS IN URGENT CASES OF NUISANCE OR APPREHENDED DANGER.

144. (1) In cases where, in the opinion of a District Magistrate, a Chief Presidency Magistrate, a sub-divisional Magistrate, or of any other Magistrate (not being a Magistrate of the third class) specially empowered by the Local Government or the Chief Presidency Magistrate or the District Magistrate to act under this section, there is sufficient ground for proceeding under this section and immediate prevention or speedy remedy is desirable,

such Magistrate may, by a written order stating the material facts of the case and served in manner provided by section 134, direct any person to abstain from a certain act or to take certain order with certain property in his possession or under his management, if such Magistrate considers that such direction is likely to prevent, or tends to prevent, obstruction, annoyance or injury or risk of obstruction, annoyance or injury to any person lawfully employed, or danger to human life, health or safety, or a disturbance of the public tranquillity, or a riot, or an affray.

(2) An order under this section may, in cases of emergency or in cases where the circumstances do not admit of the serving in due time of a notice upon the person against whom the order is directed, be passed *ex parte*.

(3) An order under this section may be directed to a particular individual or to the public generally when frequenting or visiting a particular place.

(4) Any Magistrate may either on his own motion or on the application of any person aggrieved rescind or alter any order made under this section by himself or any Magistrate subordinate to him or by his predecessor in office.

(5) Where such an application is received, the Magistrate shall afford to the applicant an early opportunity of appearing before him either in person or by pleader and showing cause against the order ; and, if the Magistrate rejects the application wholly or in part, he shall record in writing his reasons for so doing.

(6) No order under this section shall remain in force for more than two months from the making thereof, unless, in cases of danger to human life, health or safety, or a likelihood of a riot or an affray, the Local Government, by notification in the official Gazettee, otherwise directs.

THE UNITED PROVINCES DISTRICT BOARDS ACT, 1922.

[SECTIONS RELATING TO PUBLIC HEALTH.]

An Act to make better provision for Local Self-Government in rural areas of the United Provinces.

Whereas it is expedient to make better provision for local self-government in rural areas of the United Provinces ; and whereas the previous sanction of the Governor-General has been obtained, under sub-section (3) of section 80A of the Government of India Act, to the passing of this Act ; it is hereby enacted as follows :—

PRELIMINARY.

Short title, extent, and commencement. 1. (1) This Act may be called the United Provinces District Boards Act, 1922.

(2) It extends to the territories for the time being administered by the Local Government of the United Provinces.

(3) It shall come into force on the first day of February, 1923.

Repeal. 2. (1) The Acts mentioned in Schedule III are hereby repealed to the extent specified in the fourth column thereof.

(2) Notwithstanding anything in sub-section (1)—

Every district board or committee established and every district fund formed, under the United Provinces District Boards Act, 1906, shall be deemed to have been established or formed, as the case may be, in like manner and with the like authority as if it had been a district board or committee established, or district fund formed, under this Act :

Provided that every person holding office as a chairman or member of such district board or committee at the commencement of this

Act shall vacate his office as such chairman or member from the date of the establishment under this Act of a district board or committee respectively.

Definitions. 3. In this Act, unless there is something repugnant in the subject or context,—

(3) "Board" means a district board established under this Act and shall include, in any case where a power is expressed as being conferred or a duty as being imposed on a board, a committee appointed by a board, and any member, officer or servant of a board authorized or required under this Act to exercise the power or perform the duty.

(2) "Division," "district," and "tashil" shall have the same meaning as they have in the United Provinces Land Revenue Act, 1901.

(3) "Government servant" does not include a Government pleader, a Government treasurer or a person holding a purely honorary office, or a person who has retired from the service of Government.

(4) "Land assessed to land revenue" includes land the land revenue of which has been wholly or in part released, compounded for, redeemed or assigned.

(5) "Notification" means a notification published in the Gazette.

(6) "Public road" means any road, street, bridge, culvert, thoroughfare, passage or place over which the public have a right of way and which is vested in or maintained by Government or a local authority.

(7) "Quarter," when referring to a period of time, means a period of three months commencing on the first day of any of the months of January, April, July, and October.

(8) "Regulation" means a regulation made in exercise of a power conferred by this Act.

(9) "Rule" means a rule made by the Local Government in the exercise of a power conferred by this Act.

(10) "Rural area" means the area of a district excluding every municipality as defined in the United Provinces Municipalities Act, 1916, and every cantonment as defined in the Cantonments Act, 1910.

(11) "Servant of the board" means a person in the pay and service of the board.

(12) All references to anything done, required, prescribed, authorized, permitted, forbidden or punishable, or to any power vested, under this Act, shall include anything done, required, prescribed, authorized, permitted, forbidden or punishable, or any power vested by any provision of this Act or by any rule lawfully made thereunder.

Power of Local Government to prescribe minimum scale of board's staff.

72. Every board shall, by special resolution, appoint in addition to the secretary, such officers and servants as it is required to appoint by rule.

Delegation of power by secretary.

76. (1) The secretary of a board with the sanction of the chairman, may empower, by general or special order, any servant of the board to exercise, under his control, any power conferred on him under this Act.

(2) An order by the secretary under sub-section (1) may prescribe any condition and impose any restriction in respect of the exercise of any power.

(3) Any order passed by a servant of the board in the exercise of a power conferred on him under sub-section (1) shall be liable to rescission or revision by the officer who conferred the power.

Power of board to require reports, etc, from officers.

77. (1) A board or any committee of a board may require from the secretary and from any of its officers—

(*a*) any return, statement, estimate, statistics or other information regarding any matter appertaining to the administration of the district ;

(*b*) a report or explanation on any such matter, and

(*c*) a copy of any record, correspondence or plan or other document which is in his possession or under his control in his official capacity or which is recorded or filed in his office or in the office of any servant subordinate to him.

(2) Every officer from whom any requisition is made under sub section (1) shall comply with it without any unreasonable delay.

Right of officers to take part in discussions.

78. The secretary and any officer prescribed by regulation in this behalf may, with the permission of the chairman, or in virtue of a resolution passed in this behalf at a meeting of the board, or of a committee thereof, make an explanation in regard to a subject under discussion, but shall not vote upon or propose a resolution at such meeting.

Power of Local Government to effect appointment of officers to whom section 70 or section 72 applies.

79. (1) The Local Government may by order require a board to exercise the power conferred on it by sections 70 and 72 to appoint any of the officers or servants referred to therein, or the power conferred by sub-section (1) of section 73 to appoint a person to act in the place of any such officer or servant.

(2) An order under sub-section (1) shall prescribe the period within which the board shall comply therewith.

(3) If the board fails to comply with any such order within the prescribed period, or appoints a person whose appointment contravenes a rule made under section 84 and fails within a further period to be fixed by the Local Government to appoint an approved person, the Local Government may, if it thinks fit, appoint a person to fill the vacancy and may also, at its discretion, fix the salary, contribution, provident fund or pension and conditions of service of the officer or servant so appointed.

Power of board to determine staff in addition to obligatory minimum.

80. A board may by resolution determine what officer or servants are required for the discharge of the duties of the board, and the salaries to be paid to them respectively. Provided that the appointment of a health officer shall be made by special resolution.

Appointment and dismissal of servants of board.

82. Subject to the provisions of sections 70 and 71, the power to appoint, grant leave of absence to, punish, dismiss, transfer and control all servants of the board shall vest in the board.

Temporary servants required for emergency.

83. The chairman of a board shall have power to authorize the appointment and fix the salaries of temporary servants in case of an emergency subject to the following conditions, namely,—

(*a*) the chairman in the exercise of such power shall not act in contravention of an order of the board prohibiting the employment of temporary servants for any particular work, and

(*b*) each appointment under this section shall be reported at the next meeting of the board following the appointment.

All officers and servants of a board to be public servants.

89. Every officer or servant of a board shall be deemed to be a public servant within the meaning of the Indian Penal Code; and in the definition of "legal remuneration" in section 161 of that Code, the word "Government" shall, for the purposes of this section, be deemed to include a board.

Duties of board.

91. Every board shall make reasonable provision within the district for the following matters :—

(*e*) the construction and repair of public wells, tanks, water works, canals, embankments and drainage works and the supply of water from them and from other sources ;

(*k*) the institution, holding and management of fairs,

(*m*) public vaccination, sanitation and the prevention of disease ;

(*n*) providing a sufficient supply of pure and wholesome water where the health of the inhabitants is endangered by the insufficiency or unwholesomeness of the existing supply, guarding from pollution water used for human consumption and preventing polluted water from being so used ;

(*p*) preparing such returns, statements and reports as the Local Government requires the board to submit ;

(*q*) regulating offensive, dangerous or obnoxious trades, callings or practices ;

(*r*) the dissemination of knowledge regarding such matters as disease, hygiene, sanitation, agriculture, industries, and cattle-breeding ;

Discretionary functions of board.

92. A board may make provision within the district for—

(*b*) registering births and deaths ;

(*c*) reclaiming unhealthy localities ;

(*e*) taking a census, and granting rewards for information which may tend to secure the correct registration of vital statistics ;

(*h*) securing or assisting to secure suitable places for the carrying on of any trade, calling or practice referred to in clause (*q*) of section 91 ;

(*i*) conserving and preventing injury or contamination to, or pollution of, rivers and other sources of water supply within its jurisdiction ;

Power to require private water-course, etc., to be cleansed or closed.

99. (1) The board may, by notice, require the owner of, or the person having control over, a private water-course, spring, tank, well or other place, the water of which is used by the public for drinking, to keep and maintain the same in good repair and to clean the same, from time to time, of silt, refuse or decaying vegetation, and may also require him to protect the same from pollution in such manner as the board may think fit.

(2) When the water of any such water-course, spring, tank, well or other place is proved to the satisfaction of the board to be unfit for drinking, the board may, by notice, require the owner or person having control to desist from so using such water or permitting others to so use it, and if, after such notice, such water, is used by any person for drinking, the board may, by notice, require the owner or person having control thereof to close such well either temporarily or permanently, or to enclose or fence such water-course, spring, tank, well or other place in such manner as it may direct, so that the water thereof may not be so used.

Emergent powers on outbreak of epidemic.

100. In the event of a district or any part thereof being visited with an outbreak of cholera or other infectious disease notified in this behalf by the Local Government, the chairman of the board, or any person authorized by him in this behalf, may, during the continuance of the epidemic, without notice and at any time, inspect and disinfect any well, tank or other place from which water is, or is likely to be, taken for the purpose of drinking, and may, further, take such steps as he deems fit to prevent the removal of water therefrom.

Ordinary inspection.

101. (1) The chairman of a board, and, if authorized in this behalf by resolution, any other member, officer or servant of the board, may enter into or upon a building or land, with or without assistants or workmen, in order to make an inspection or survey or to execute a work which a board is

authorized by this Act, or by rules or bye-laws, to make or execute, or which it is necessary for a board, for any of the purposes or in pursuance of any of the provisions of this Act or of rules or bye-laws, to make or execute.

(2) Provided that—

(*a*) except when it is in this Act or in rules or bye-laws otherwise expressly provided, no such entry shall be made between sunset and sunrise, and

(*b*) except when it is in this Act or in rules or bye-laws otherwise expressly provided, no building which is used as a human dwelling shall be so entered, except with the consent of the occupier thereof, without giving the said occupier not less than four hours' previous written notice of the intention to make such entry ; and

(*c*) sufficient notice shall in every instance be given even when any premises may otherwise be entered without notice, to enable the inmates of an apartment appropriated for females to remove to some part of the premises where their privacy need not be disturbed ; and

(*d*) due regard shall always be had to the social and religious usages of the occupants of the premises entered.

Powers for effecting entry.

102. It shall be lawful for a person authorized under the provisions of the preceding section to make an entry for the purpose of inspection or of search, to open or cause to be opened a door, gate or other barrier—

(*a*) if he considers the opening thereof necessary for the purpose of such entry, inspection or search, and

(*b*) if the owner or occupier is absent, or, being present, refuses to open such door, gate or barrier.

Penalty for obstructing persons employed by board.

107. Whoever obstructs or molests a person employed by, or under contract with, the board under this Act in the performance of his duty or in the fulfilment of his contract, or removes a mark set up for the purpose of indicating any levels or direction necessary to the execution of works authorized by this Act, shall be liable on conviction to a fine which may extend to fifty rupees.

147. All tanks and wells and all adjacent land, buildings, materials, and things connected therewith or appertaining thereto within the rural area of the district, not being private property and not being maintained or controlled by the Government or by a local authority other than the board, shall vest in and belong to the board.

Public tanks and wells, etc.

165. A work, or institution, constructed or maintained, in whole or part, at the expense of a board, and all registers, books, accounts or documents relating thereto shall at all times be open to inspection by such officers as the Local Government appoints in this behalf.

Inspection of works and institutions by Government officers.

166. (1) The Commissioner, or the District Magistrate, may, within the limits of his division or district, as the case may be, by order in writing, prohibit the execution or further execution of a resolution or order passed or made under this or any other enactment by a board or committee of a board, or a joint committee, or any officer or servant of a board or joint committee, if in his opinion such resolution or order is of a nature to cause or tend to cause obstruction, annoyance or injury to the public or to any class or body of persons lawfully employed, or danger to human life, health or safety, or a riot or affray, and may prohibit the doing or continuance by any person of any act, in pursuance of or under cover of such resolution or order.

Power of Commissioner or Magistrate to suspend action under Act.

174. (1) A board by special resolution may, and where required by the Local Government shall, make byelaws applicable to the whole or any part of the rural area of the district, consistent with this Act, and with any rule, for the purpose of promoting or maintaining the health, safety, and convenience of the inhabitants of such area and for the furtherance of the administration of the district under this Act.

Power of board to make byelaws.

(2) In particular, and without prejudice to the generality of the power conferred by sub-section (1), a board may, in the exercise of the said power, make any byelaw described in the list below—

(*c*) regulating sanitation, conservancy, and drainage ;

(*d*) protecting from pollution and purifying all sources of water used for drinking or bathing purposes ;

(*e*) prohibiting the removal or use for drinking purposes of any water from any stream, well, tank, or other source where such removal or use causes or is likely to cause, disease or injury to health, and preventing such removal or use by the filling in of any well, tank or other receptacle or by any other method that may be considered advisable ;

(*f*) prohibiting the deposit or storage of manure, refuse, carcasses of animals, or other offensive matter in a manner prejudicial to the public health, comfort or convenience ;

(*g*) regulating the disposal of corpses by burning or burial ;

(*h*) regulating the excavation of earth and the filling up of excavations and depressions injurious to health or offensive to the neighbourhood ;

(*i*) regulating the removal of noxious vegetation ;

(*j*) regulating the disposal or destruction of materials likely to convey infection ;

(*k*) regulating slaughter-houses and offensive, dangerous or obnoxious trades, callings or practices, and prescribing fees to defray the expenditure incurred by a board for this purpose ;

(*m*) regulating fairs ;

(*p*) providing for the destruction of unclaimed, diseased or rabid dogs and noxious animals ;

(*r*) prohibiting or regulating any act which occasions, or is likely to occasion, a public nuisance for the prohibition or regulation of which no provision is made elsewhere by or under this Act ;

(*s*) providing for the registration of births and deaths and the taking of a census and for the compulsory supply of such information as may be necessary to make such registration or census effective ;

(*v*) prohibiting the discharge of the water of any sink, drain, steam engine or boiler, or of any filthy, offensive or injurious matter into any river, tank or other source of water-supply or into any specified portion thereof ordinarily used for drinking or bathing purposes.

Infringement of rules and byelaws.

175. In making a rule the Local Government, and in making a byelaw the board with the sanction of the Local Government may direct that a breach of it shall be punishable with fine which may extend to Rs. 100, and, when the breach is a continuing breach, with a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

Previous publication of rules, etc., made by Government.

176. (1) The power of the Local Government to make rules or regulations under this chapter is subject to the condition of the rules or regulations being made after previous publication and of their not taking effect until they have been published in the gazette.

(2) Any rule or regulation made by the Local Government may be general for all divisions or districts or for all divisions or districts not expressly excepted from its operation, or may be special for the whole or any part of any one or more than one division or district as the Local Government directs.

Confirmation, etc., of regulations and byelaws made by board.

177. (1) The power of a board to make regulations under clauses (*e*) to (*l*) of sub-section (1) of section 173 shall be subject to the condition of the regulations not taking effect until they have been confirmed by the Local Government.

(2) The power of a board to make byelaws shall be subject to the condition of the byelaws being made after previous publication and of their not taking effect until they have been confirmed by the Local Government and published in the gazette.

(3) The Local Government in confirming a byelaw or regulation may make any change in its form that appears necessary.

(4) No alteration or rescission of a regulation made under clauses (*e*) to (*l*) of sub-section (1) of section 173 or of any byelaw by a board shall have effect unless and until it has been confirmed by the Local Government.

(5) The Local Government may, after previous publication of its intention, rescind any regulation or byelaw which it has confirmed, and thereupon the regulation or byelaw shall cease to have effect.

PROCEDURE

Fixation of reasonable time for compliance.

178. Where any notice issued under any section of this Act or under any rule or byelaw requires an act to be done for which no time is fixed by such section or rule or byelaw, the notice shall specify a reasonable time for doing the same ; and it shall rest with the court to determine whether the time so specified was a reasonable time within the meaning of this section.

Service of notice.

179. (1) Every notice or bill issued or prepared under any section of this Act or under any rule or byelaw shall, unless it is in such section or rule or bye-law otherwise expressly provided, be served or presented—

(*a*) by giving or tendering the notice or bill, or sending it by post, to the person to whom it is addressed, or

(*b*) if such person is not found, then by leaving the notice or bill at his last known place of abode if within the jurisdiction of the board, or by giving or tendering the notice or bill to some adult male member or servant of his family, or by causing the notice or bill to be fixed on some conspicuous part of the building or land (if any) to which the notice or bill relates.

(2) When a notice under this Act or under a rule or a byelaw is required or permitted by or under this Act, or under a rule or a byelaw to be served upon an owner or occupier of a building or land, the service thereof, in cases not otherwise specially provided for in this Act, shall be effected either—

(*a*) by giving or tendering the notice, or sending it by post, to the owner or occupier, or if there be more owners or occupiers than one, to any one of them, or

(*b*) if no such owner or occupier is found, then by giving or tendering the notice to an adult male member or servant of his family, or causing the notice to be fixed on some conspicuous part of the building or land to which the same relates.

(3) Whenever the person on whom a notice or bill is to be served

is a minor, service upon his guardian or upon an adult male member or servant of his family shall be deemed to be service upon the minor.

Defective form.

180. No notice or bill shall be invalid for defect of form.

Disobedience to notice issued to individual.

181. If a notice has been given under the provisions of this Act or under a rule or byelaw to a person requiring him to execute a work in respect of any property, moveable or immoveable, public or private, or to provide or do or refrain from doing anything within a time specified in the notice, and if such a person fails to comply with such a notice, then—

(*a*) the board may cause such work to be executed or such thing to be provided or done, and may recover all expenses incurred by it on such account from the said person in the manner provided in Chapter VII ; and further

(*b*) the said person shall be liable, on conviction before a magistrate, to a fine which may extend to one hundred rupees, and, in case of a continuing breach, to a further fine which may extend to five rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

Authority for prosecution.

182. Unless otherwise expressly provided, no court shall take cognizance of any of the offences punishable under this Act or under any rule or byelaw, except on the complaint of, or upon information received from, the board or some person authorized by the board by general or special order in this behalf.

Power to compound offences.

183. (1) The chairman of a board may, either before or after the institution of proceedings, compound an offence against this Act or a rule or byelaw, except the offences against any rules made under section 172 with reference to the matters specified in section 26, provided that no offence shall be compoundable which is constituted by failure to comply with a written notice issued by the board, or on behalf of the board, unless and until the notice has been complied with, in so far as compliance is possible.

(2) When an offence has been compounded the offender, if in custody, shall be discharged and no further proceedings shall be taken against him in respect of the offence so compounded.

(3) Sums paid by way of composition under this section shall be credited to the district fund.

Powers and duties of police in respect of offences and assistance to authorities of board.

185. Every police officer shall give immediate information to the board of an offence coming to his knowledge which has been committed against this Act or any Act wherein or whereunder provision is made for the fine being credited to the district fund, or against any rule made under any of the said Acts; and shall be bound to assist all members, officers and servants of the board in the exercise of their lawful authority.

Suits against boards or its officers.

192. (1) No suit shall be instituted against a board or against a member, officer or servant of a board, in respect of an act done or purporting to have been done in its or his official capacity, until the expiration of two months next after notice in writing has been, in the case of a board, left at its office, and, in the case of a member, officer or servant, delivered to him or left at his office or place of abode, explicitly stating the cause of action, the nature of the relief sought, the amount of compensation claimed, and the name and place of abode of the intending plaintiff, and the plaint shall contain a statement that such notice has been so delivered or left.

(2) If the board, member, officer or servant, has before action is commenced, tendered sufficient amends to the plaintiff, he shall not recover any sum in excess of the amount so tendered and shall also pay all costs incurred by the defendant after such tender.

(3) No action such as is described in sub-section (1) shall, unless it is an action for the recovery of immoveable property or for a declaration of title thereto, be commenced otherwise than within six months next after the accrual of the cause of action.

(4) Provided that nothing in sub-section (1) shall be construed to apply to a suit wherein the only relief claimed is an injunction of which the object would be defeated by the giving of the notice or the postponement of the commencement of the suit or proceeding.

Provision for publicity of rules, regulations, and bye-laws.

195. Books containing every rule, regulation, and byelaw shall be kept in the offices of the board and shall be open, during the ordinary hours of business, to inspection free of charge by any person and shall be for sale to the public at such offices at a reasonable price to be specified by bye-law in this behalf.

SCHEDULE I.—(Extracts).

The Powers and Functions of a Board.

[*Sections* 67(1) *and* 68(1) (*a*)].

Section.	Power or duty.	Remarks.
57	To appoint persons other than members of the board to committees.	
58	To fill up vacancies in committees.	
59(1)	To appoint the chairman of a committee.	
61	To call for returns, etc., from a committee.	
62(1)	To delegate powers and duties to tahsil committees.	
62(2)	To allot funds to tahsil committees.	
63	To appoint joint committees and to vary or rescind any written instrument by virtue of which a joint committee has been appointed.	
64(1)	To sanction contracts for which budget provision does not exist, or involving a value exceeding such amount as may be fixed by rule.	
64(2) & (3)	To empower a committee or officer or servant of the board to sanction other contracts.	
65(2)(*b*)	To empower a person to execute a contract.	May be delegated.
68	To delegate powers and duties conferred or imposed on a board.	
72	To appoint officers whose appointment is obligatory.	May be delegated.
77	To require the secretary, etc., to furnish returns, etc.	May be delegated.

Section.	Power or duty.	Remarks.
80	To determine the number and salaries of staff in addition to obligatory minimum.	May be delegated.
82	To appoint, punish or dismiss, etc., any servant of the board.	
83(*a*)	To prohibit the employment of temporary servants for any particular work.	
174	To make byelaws.	
175	To direct that breach of byelaw shall be punishable with fines.	
General	Any power, duty or function which any rule requires to be exercised, performed or discharged by the board itself by means of a resolution.	

SCHEDULE II.—(Extracts).

SCHEDULED POWERS OF SECRETARY.

[*Sections* 74(*b*) *and* 75(1) (*a*)].

Section.	Power or duty.	Remarks.
99(1)	To require private wells, etc., to be cleansed.	

RULES FROM THE DISTRICT BOARD MANUAL RELATING TO PUBLIC HEALTH, MADE UNDER THE U. P. DISTRICT BOARDS ACT OF 1906.

24. The Civil Surgeon of the district.........shall be entitled to attend any meeting of a board and to address the board on any matter affecting medical relief, sanitation and vaccination..........

Certain Officers entitled to attend and speak.

The object of this provision is not in any way to relax or sever the connection that has hitherto existed between the Civil Surgeons on the one hand and district boards on the other, but rather to place the chief medical officer of the district in a position where he will be better able than he was before (when he was only one of many members) to draw authoritative attention to the needs, sanitary and otherwise, of the various localities. The position the Civil Surgeon occupies is practically that of an inspecting officer, representing the general administration of the district in the medical and sanitation departments. The functions that now devolve upon them should be brought prominently to the notice of all Civil Surgeons and their co-operation should be invited in all questions connected with the medical and sanitary improvement of the district. When a Civil Surgeon has any suggestion or advice to offer, to a board, otherwise than at a public meeting, or when correspondence follows discussion at a meeting, he should place himself demi-officially or officially in communication with the chairman.

Duties of the Civil Surgeon.—1. It shall be the duty of the Civil Surgeon or other principal medical officer of each district

(*a*) to attend the meetings of the board as often as may be and whenever he is directed by the district magistrate to do so,

(*b*) of his own motion, or whenever directed by the district magistrate to do so, to inspect any place over which the board has authority, and report to the board as to the sanitary condition of the place, and as to the measures, if any, that should in his opinion, be taken to render the place less noxious to the public health, and

(*c*) generally to advise the board in all matters relating to sanitation, and to bring to the notice of the board any thing defective in its sanitary arrangements.

27. (1) Subject to such conditions as may be prescribed by rule, a board may appoint from among its members, committees to assist it in the discharge of any specified duties or class of duties within the whole or any portion of the district and may delegate to any such committee all or any power of the board which may be necessary for the purpose of rendering such assistance.

Appointment of committees.

Rule 1. A board may appoint general committees for finance, public works, public instruction and public health, and may entrust to them the administration of the board's duties in these directions: but not so as to divest itself of the powers of punishment of servants and of fixing salaries, or so as to allow the committee to bind the board to large recurring expenditure.

RULES CONCERNING PUBLIC HEALTH STAFF EMPLOYED BY DISTRICT BOARDS MADE UNDER SECTIONS 72, 84(D) AND 182 OF THE U. P. DISTRICT BOARDS ACT, 1922.

Rule 1.—This prescribes the vaccination staff of Assistant Superintendents of Vaccination, Vaccinators and apprentice vaccinators to be maintained by each district board.

Rule 2.—For the purpose of these rules "enrolled Assistant Superintendent of Vaccination" means a member of the Government service of Assistant Superintendents of Vaccination.

Rule 3.—(1) A board shall not appoint as an Assistant Superintendent of Vaccination any person who is not either already an Assistant Superintendent of Vaccination or a vaccinator whose name is borne on the Director of Public Health's list of candidates approved for appointment as Assistant Superintendent of Vaccination.

(2) When a vacancy occurs or is about to occur, the board shall apply to the Director of Public Health either for the nomination of an enrolled Assistant Superintendent of Vaccination or for permission to appoint a person who is not an enrolled Assistant Superintendent of Vaccination. In such case, on receipt of such application or of his own motion, the Director of Public Health may nominate an enrolled Assistant Superintendent of Vaccination for appointment by the board, and

the board shall then appoint the Assistant Superintendent of Vaccination so nominated. If the Director of Public Health does not desire to nominate an enrolled Assistant Superintendent of Vaccination he shall authorise the board to appoint a person who is not an enrolled Assistant Superintendent of Vaccination, and the board may then, subject to the provisions of the following rule, fill the vacancy without further reference to the Director of Public Health, but shall report to him the name of the person appointed. .

Rule 4.—(1) The transfer of an enrolled Assistant Superintendent of Vaccination from one district to another shall rest with the Director of Public Health, but no such transfer shall be made except with the consent of the boards concerned :

Provided that the Director of Public Health may, without obtaining such consent, transfer an enrolled Assistant Superintendent of Vaccination to a district to which he has been nominated under the preceding rule.

(2) The transfer of an Assistant Superintendent of Vaccination who is not an enrolled Assistant Superintendent of Vaccination from one district to another shall rest with the boards concerned.

NOTE.—**An exchange of Assistant Superintendents of Vaccination between two districts shall not be deemed to create a vacancy in either district. In every other case the transfer of an Assistant Superintendent of Vaccination from a district shall be deemed to create in that district a vacancy to which the provisions of the preceding rule shall be applicable.**

Rule 5.—An enrolled Assistant Superintendent of Vaccination shall receive pay according to the scale prescribed by Government, and shall also when on tour receive a horse allowance of Rs. 20 per mensem subject to the conditions governing the grant of a similar allowance to Government servants of the same class.

The promotion of an enrolled Assistant Superintendent of Vaccination to a higher rate of pay shall rest with the Director of Public Health, who shall before passing orders obtain and consider the reports of the board and the District Superintendent of Vaccination.

Rule 6.—A board shall not reward, punish, suspend, remove or dismiss an Assistant Superintendent of Vaccination except after obtaining and considering the recommendation of the District Superintendent of Vaccination. An order suspending, removing or dismissing an enrolled Assistant Superintendent of Vaccination shall be subject to confirmation by the Director of Public Health who may, after obtaining the board's explanation, cancel or vary the order.

Rule 7.—For the purpose of these rules "enrolled vaccinator", means a Government servant appointed as vaccinator before the 27th November, 1906, whose services have been lent to the board.

Rule 8.—(1) The board shall not appoint any person to be a vaccinator unless (*a*) he is an enrolled vaccinator, or (*b*) he has resided in the United Provinces for at least three years, has passed either the annual promotion examination of class VII of an English school or the Vernacular Final Examination, has undergone a course of training in vaccination, elementary sanitation, etc., for six months, under the District Superintendent of Vaccination and possesses a certificate of qualification granted by him in the following form :—

I hereby certify that I have examined * * * and find him qualified for the office of public vaccinator.

Dated at

The *of* 19 . *District Superintendent of Vaccination.*

NOTE.—Before granting such certificate, the District Superintendent of Vaccination shall be assured of the soundness of the candidate's knowledge in regard to—

(1) the vaccination operation ;
(2) the characteristics of a good vesicle and cicatrix ;
(3) the chief systems of small-pox ;
(4) elementary sanitation and prevention of epidemic disease.

(2) The board may select the candidates for the course of training prescribed in the preceding sub-rule.

Rule 9.—An enrolled vaccinator shall receive a pay of Rs. 30 per mensem until he has completed 20 years' service and thereafter shall receive a pay of Rs. 35 per mensem.

Rule 10.—The board shall not reward, promote, punish, suspend, remove or dismiss a vaccinator except after considering the recommendations of the District Superintendent of Vaccination. An appeal against the removal or dismissal of an enrolled vaccinator shall lie to the Director of Public Health, whose decision shall be final.

Rule 11.—Transfer of district board vaccinators from one district to another may be arranged between the boards concerned, but the previous sanction of the Director of Public Health shall be obtained to the transfer of an enrolled vaccinator.

Rule 12.—The Assistant Superintendent of Vaccination or vaccinator shall obey all rules and orders made by the Government in the Provincial Manual of Vaccination or otherwise and shall prepare all returns and forms so prescribed.

Rule 13.—Every vaccinator shall be attached for two months for duty with the Civil Hospital at headquarters in some year early in his service. Such duty should ordinarily be for the months of August and September. The A. S. V. shall maintain a register showing those vaccinators who have been attached and those who have still to be attached for duty. During his two months of hospital duty a vaccinator shall attend the hospital daily during the hours fixed by the Civil Surgeon and shall conform to the orders of the Civil Surgeon in regard to the performance of hospital duties.

Rule 14.—A vaccinator shall perform vaccination work from the 1st October to the 31st March and at no other period except in the hill districts or on receipt of special instructions in consequence of an epidemic of small-pox. During the vaccination season he shall not ordinarily perform other duties except such attesting of registration of births and deaths as is necessary for vaccination work and can be done without hindrance to that work. From the beginning of the vaccination season he shall proceed systematically in one onward direction from village to village in his circle and shall vaccinate all the unprotected in these villages. He shall send a copy of his tour programme to the board's office every fortnight. He shall ascertain from the village register the names of all children born since the previous season and shall vaccinate them all.

Rule 15.—At the time of vaccination a vaccinator shall enter the necessary details as to the persons vaccinated in his diary and also in the village register in vaccination form no. 5. When a vaccinator visits a village where there is a school he shall first vaccinate all unprotected boys at the school and shall have his diary attested by the schoolmaster. He shall keep his own copy of the village register always with him. He shall make the entry in the register as to the result of the operation on revisiting the village after seven days.

Village vaccination register.

(Vaccination form no. 5).

*List of persons vaccinated in village*____________

*district*________

Serial number.	Date of vaccination.	Name of the child vaccinated.	Father's name.	Caste.	Sex.	Age.	Result of vaccination.	Number of vaccination as entered in register.	Seal or signature of the vaccinator.

NOTE—When a second operation is performed on an individual on account of failure on the first occasion, the column showing "serial number" in form no. 5 and that showing "number" in form no. 5A should be left blank.

Rule 16.—Except in the vaccination seasons the board may employ the Assistant Superintendent of Vaccination and vaccinators upon sanitary and registration work, on the distribution of medicine, on relief in times of scarcity, on the checking of vital statistics or on minor sanitary improvements in the villages or on other suitable district board work. The chairman shall ordinarily employ a vaccinator on such work in or near the vaccinator's circle.

Rule 17.—An enrolled Assistant Superintendent of Vaccination and an enrolled vaccinator employed on sanitary work in connection with cholera or other dangerous epidemic diseases, or on famine relief work, or on duty at fairs outside the district shall receive an allowance in addition to his pay at the rate of Rs. 10 and Rs. 5 a month respectively and may receive travelling allowance for journey, made by rail while on such duty.

Rule 18.—A vaccinator shall test the entries in the village registers of births and deaths and shall enter therein under his own signature any omissions discovered and shall send the returns of the number of entries checked and omissions discovered through the A. S. V. to the District Magistrate.

Rule 19.—The board shall provide the A. S. V. and the vaccinators with such uniform as may be from time to time prescribed by the D. P. H.

Rule 20.—No leave shall ordinarily be granted to a member of the vaccination staff during the working season. If it is necessary to grant leave during the working season the leave shall be either leave without pay, leave on medical certificate, or casual leave.

GENERAL POWERS AND DUTIES OF BOARDS IN MATTERS AFFECTING SANITATION UNDER THE U. P. DISTRICT BOARDS ACT, 1906.

Famine relief works.—The liability of a board for the relief of scarcity is confined under the existing orders contained in the Famine Code to the earlier stages of distress. It is its business to open test works and to bear the cost of them when famine appears to be imminent and to maintain poor-houses in districts in which famine has not been officially declared to exist.

Fair, Shows, and exhibitions.—Separate orders have been issued by Government regarding fairs in each district that have been placed under the control of boards.

Vaccination and sanitation, and works of public utility.—Vaccination, so far as it is not carried on by the servants of municipalities, notified areas, and cantonments, is entirely under the control and at the expense of boards, the Civil Surgeon being at once the executive agent of the board and district superintendent on behalf of the Government. Towards the improvement of sanitation boards are in possession of funds for small sanitary works in villages, and they are the only authority which can carry out large works of the kind outside urban areas.

Sanitary reform in rural areas.—Sanitary improvements fall into two classes :—The first class are those which concern the construction or repair of wells and tanks for drinking water and the drainage of the village site, and which require some expenditure of money. The second are those which merely involve the observance of simple sanitary rules or the exercise of a little energy on the part of owners and occupiers of the village. The funds for the first class of improvements will be provided by the district board; by grants-in-aid from the Board of Public Health within the limits of the sum which Government may be able annually to assign to that body; by moneys levied under the Village Sanitation Act, and by local contributions. The amount which a district board can spare from its funds for rural sanitation may not, to begin with, be large, but some provision, however small, should in future be made for this purpose in every district board budget.

As regards the second class of improvements, which may generally be described as connected with the preservation of the village water-supply from pollution and the village site from being befouled, these require nothing more than the observance of simple sanitary rules by the village community. Again, the filling up of pits and stagnant pools within the village site, the clearance of jungle from it, and the execution of simple repairs to wells and tanks by the persons owning or using them, require only the contribution of a little assistance in materials and labour or the expenditure of a little labour. The appointment of places for the deposit of manure and household refuse, the regulation of burials and of the practice of offensive trades – these and similar matters will in due time, when village opinion is ripe, be brought to the notice of the village panchayat. At present the law does not empower the district magistrate, except in the comparatively few villages to which the Village Sanitation Act has been extended, to enforce rules on these points. But much has been and is being done in many districts by persuasive executive action to introduce and render sanitary rules effective; and what the Government desires is that pending the amendment of the law in this respect the district magistrate and the district board will co-operate with the chief sanitary officer of the district in extending the observance in villages of simple sanitary rules of proved utility.

· *Protection of village wells.* (fig. 77)—The *pakka* brickwork (of the cylinder wall) should be so sloped off at the top that people drawing water from the well cannot stand upon the top or place *gharas* there. This wall may be about 14 inches thick and 2½ feet high above the platform. Two or more pulley blocks, according to requirements, should be fixed on this wall as shown on the plan, and may be of either wood or iron. The object of the raised wall is to prevent the splashings from dirty or disease-infected clothes or hands and feet from going into the well. The sloping top is to keep them from putting their feet or *gharas*, which may have come in contact with the vomit, etc., of cholera patients, on the coping of the edge of the well, and thus greatly increasing the danger of infecting the water of the well.

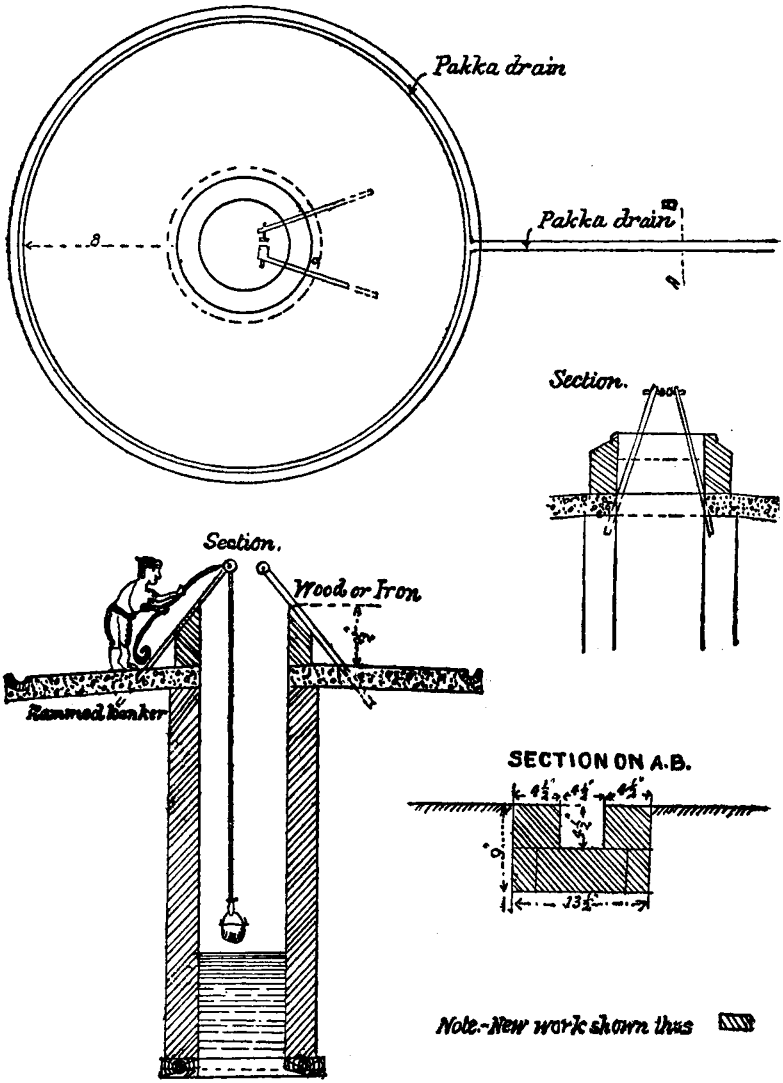


Fig. 77.—Plan of a village well.

Where there is an already existing *pakka* platform, the rammed *kankar* will not be required. In the event of a new platform being required, it should be made of rammed *kankar*, at least eight feet broad. The platform should be well drained, and the length of the *pakka* drain carrying off the water should be 1½ times the depth of the well.

NOTE.—The proper method of protecting village wells is described in Chapter I.

MANUAL OF GOVERNMENT ORDERS, U. P.

RULES FOR THE MANAGEMENT OF FAIRS.

Control.

Officer in charge of the fair.

2049. The Magistrate of the district in which the fair is held should ordinarily be the officer in charge of the fair; but when he is unable to take immediate charge he should depute one of his covenanted staff for the duty. No one but a covenanted officer should, under any circumstances, be placed in charge of any fair without the previous sanction of the Commissioner.*

2050. In the case of every important fair the Magistrate, or officer charged by him with the conduct of the fair, should communicate freely and confidentially with the Director of Public Health on matters relating to the sanitation of the fair and to the health of the people attending it and should endeavour, by the utmost weight of his authority, to enforce the observance by the people assembled of measures deemed essential to their protection from disease.

2051. The Director of Public Health exercises administrative medical and sanitary control over all fairs and large gatherings and additional medical officers placed at his disposal will be under his entire control during the time of the fair or gathering.

The Director of Public Health or an Assistant Director of Public Health will be in charge of the medical and sanitary arrangements at

*NOTE.—The responsibility for the general management, for the measures adopted for the protection of life and property, and for the enforcement of the sanitary regulations laid down must rest with a magisterial officer, and orders with regard to them can only be properly issued by him. It is the part of the police—as subordinate to the district staff—to see that these orders are obeyed, and it is clear that the Superintendent of Police, who has no magisterial powers, must either be wanting in the necessary authority or exercise authority which does not properly belong to him. It is further essential that a Magistrate should be present to dispose promptly of all cases that may arise and of all offences committed, and if present, he, and not the Superintendent of Police is undoubtedly the officer to have the general control.

all large fairs in the province : the district Medical Officer of Health of the smaller district fairs.

In the absence of the Director of Public Health or an Assistant Director of Public Health or a district Medical Officer of Health the Civil Surgeon will be responsible for advising the Magistrate on any points of sanitation in connection with the fair.

The Civil Surgeon (whose services are indispensable on the outbreak of cholera) should ordinarily have charge of the hospitals of the fair and visit them twice a day, affording all necessary professional aid both to those in hospital and to any who may be unable to be carried thither.

At very important stations, as at Allahabad, Agra or Benares, the Civil Surgeon may, at his discretion, depute a medical officer of the rank at least of an Assistant Surgeon to act for him and under his orders.

2052. The Civil Surgeon should keep a register of admissions at every hospital and furnish two returns in forms A and B to the Director of Public Health after the termination of the fair and one return daily in form C to the Sanitary Officer present at the fair. Samples of the three forms are printed below.

A

Abstract of admission register of the hospitals established at the——————fair from (date)———to (date)———.

No. of hospital.	Description of hospital.	No. admitted.			Total deaths.	Cause of death.	Total number discharged.	No. of cases of most common diseases.	
		Male.	Female.	Total.					
1	2	3	4	5	6	7	8	9	10
No. I	General ...								
No. II	Contagious ...								

B

Abstract of outdoor cases treated at the dispensaries established at the——fair from (date)——to (date)——.

No. of hospital.	Description of hospital and location.	Total cases treated.			No. of cases of most common diseases.	No. of cases of diarrhœa or dysentery.	Remarks.
		Male.	Female.	Total.			

C

Daily report of cholera / small-pox / plague cases treated in the——hospital established at the——fair from (date)——to (date)——.

Name.	Age.	Sex.	Caste.	Where came from.	When arrived.	Where put up.	Where attacked.	When attacked.	When removed to hospital.	Name of hospital to which removed.	Date of recovery or death.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13

Dated *Signature of reporting officer.*

2053. About a month or two before the occurrence of a large fair the Magistrate of the district should inform the Director of Public Health of the date of the fair and the probable number of persons likely to be present, with an estimate of the strength of the conservancy staff and police in his opinion required for the enforcement of sanitary regulations. The Director of Public Health will either visit the site or see the plans before the actual lay-out, and will reply, either agreeing to the proposals or suggesting modifications, and at the same time telling the Magistrate whether he or the Assistant Director of Public Health will be present, and, if so, on what date they propose to arrive. It will then be for the Magistrate to arrange to have the staff collected as far as possible. The staff will be under the orders of the officer in charge and will be available for laying out the site or for such other purposes as he thinks fit, until the arrival of the sanitary authority. On the arrival of the sanitary authority he should consult the officer in charge and they will arrange with each other as to what proportion of the staff, both police and sweepers, can be placed at the disposal of the sanitary authority. The latter will then be in immediate charge of the conservancy and sanitary arrangements, and, as far as possible, the staff put under his control will not be removed at all, and will never be removed without previous intimation.

Preliminary arrangements for fairs.

2054. (1) Some time before the fair the officer in charge should prepare a ground plan of the site of the fair correctly drawn to scale. Upon this plan the site should be divided by roads of communication 100 to 200 feet in width as may be most convenient for the purposes of the fair, the area being separated into divisions, each possessing its own complement of banias' and sweetmeat sellers' shops, supervising and conservancy staff.

(2) The land between main roads should be divided by cross-roads, and the space between any two cross-roads should be considered as a section of the fair. Prominently placed on the main road will be the enclosure for the tahsil and the police. The frontages of both sides of the main roads are generally taken by shops, and as the shops are usually erected on plinths the depths of these frontages should be sufficient to allow for the excavations necessary to form these plinths. Behind the shops will be blocks reserved for the residence of pilgrims. A strip 10 feet wide should be left along the breadth on opposite sides of each block as a sanitary area for the erection of urinals, etc. (fig. 78).

(3) The site of the fair should then be laid out in correspondence with the plan, the main roads, if possible, being permanently marked out by stones placed in line on each side of the road, or the edge should be *dagh bailed.*

(4) All covers such as jungle or high crops in or within a hundred yards of the edge of the fair should be cut down and removed, and if suitable may be used to construct latrine fences or to make roads.

Shallow depressions should, if possible, either be filled up or fenced. Special care is required wherever there is water. All pools, back-waters, etc., should be fenced or filled in. If thorns are easily procurable they will suffice, elsewhere barbed wire or even ordinary rope is most useful, especially when under a police patrol.

(5) Whenever at any fair a very great assemblage of people may be expected, strong barricades should be erected across the roads of communication at such places as the police authorities may determine.

2057. *Hospital Staff.* For an ordinary hospital at a fair the staff required varies with the number of pilgrims attending the fair, the duration of the fair and the size of the area. For all the smaller fairs, the officer in medical charge will have at his disposal the staff of the local travelling dispensaries who for the period of the fair will be directly under his orders. This will ordinarily suffice with the addition of one or two vaccinators who should be employed for the detection of infectious diseases. A menial staff of one bhisti and four kahars for doolies should also be employed. For larger fairs the staff must be correspondingly increased so that the hospitals may be properly looked after and the whole fair area adequately patrolled to discover cases of sickness.

2058. *Duties.* The medical officer should visit without delay any part of the fair where the outbreak of sickness or death arising from any cause has been reported to him. The sick should be removed, if possible, with their families, to the nearest hospital, and if the disease is cholera, to the segregation hospital.

Police at fairs. 2059. The duties of all the police on duty at fairs are—

(1) to maintain a careful watch that the sanitary arrangements are fully carried out ;

(2) to forbid the performance of the offices of nature in or near the fair at any place not set aside for such purpose ;

(3) to report to the medical officer of the fair the appearance of sickness in any part of the fair ;

(4) to cause all persons sick of cholera or small-pox or any other serious disease to be carried at once to the hospital set apart for such case, and, if possible, prevent the approach to the fair of any person affected by these diseases.

Drugs and equipment.

2060. The travelling dispensaries or dispensaries attached to a division should be present throughout every fair held in the district. The Civil Surgeon will furnish a supply of medicines and surgical instruments for hospital use at the fairs, which will ordinarily be the equipment supplied to a travelling dispensary.

This supply will as a rule suffice. In addition the main hospital should be provided with blankets, a reserve stock of permanganate of potash and a drum or two of cyllin or hycol.

Conservancy arrangements. Staff.

2061. The employment of an adequate staff of sweepers is the first essential. The local supply of sweepers should, where necessary, be supplemented by sweepers from outside, preferably professional sweepers from a municipality in the neighbourhood. Sweepers should be provided, if possible, with shelters near their work, and all sweepers should be numbered and provided with badges to provide a check on the number employed, to prevent salaries being paid twice over to the same men and to ascertain their presence or absence from their allotted work.

The sweepers should be divided into gangs, the arrangement of the members of each gang being left as far as possible to the sweepers themselves. Each gang should be numbered and placed under the charge of a mate. Female sweepers should be placed in charge of latrines for females. The medical officer in charge will allot to each superviser of a section of the fair—a sanitary inspector, a sub-assistant surgeon or a vaccinator, as the case may be—the number of gangs necessary for the efficient working of each sub-section.

Reserve gangs of peripatetic sweepers should be held in readiness for emergencies.

At fairs, lasting only a day or two, the employment of peripatetic sweeper gangs on yellow flag areas will save the expense of erecting extensive latrines.

The dual control of sweepers should be avoided. They should be all under the medical officer in charge, who should be responsible for their control, inspection and payment. The Tahsildar in charge of the fair should not be made responsible for seeing that they do their work, as he has little time to go round the outlying area of a fair, which is the most important area from a sanitary point of view.

Cholera.

Detection.

2067. The most important duty of the officer in medical charge of a fair is the early detection of any case of infectious disease occurring in or near the fair or in the lodging houses of the town near the fair. The following precautions should be taken to guard against an outbreak of an epidemic.

The whole of the fair area should be divided into conveniently sized blocks and each block should be placed under the direct supervision of a sanitary inspector, a sub-assistant surgeon or a vaccinator whose duty it will be to go over this area and to report at once to the officer in medical charge of the fair the occurrence of any case of infectious disease or any other suspicious illness. Volunteers of the Friends of India, etc., may also with advantage be employed for this purpose. Sweepers in charge of latrines should be required to make daily reports, so that the occurrence of an unusual amount of diarrhoea or any other similar disease may be brought to the notice of the medical officer in charge without delay. Arrangements should also be made for the constant inspection of latrines and patrolling of fair areas in order to discover cases of sickness as pilgrims at a fair suffering from diarrhoea or dysentery will not resort to hospitals for treatment of their own accord.

For the removal of the sick doolies should be provided at the fair hospitals and at police outposts in the fairs, and gangs of kahars should be employed to carry these doolies.

Inspection of lodging houses.

The duty of inspecting lodging houses in fair times should be given to an officer who has been authorized by the municipal authority to inspect lodging houses.

The inspection of the lodging houses in the town must be regularly undertaken for the detection of infectious disease.

Prevention of cholera and disinfection.

2068. (1) The provision of a piped water supply is the best insurance policy against epidemic cholera.

(2) When this is impossible the water of wells should be protected from infection with polluted vessels. Wells not largely used should be closed. The wells in the fair area and along the roads of approach should be disinfected a week before the fair commences and twice a week during the fair period, but daily on the outbreak of epidemic cholera. The first few cases of cholera may point to food infection from flies. It is in these cases that early reporting and disinfection of the discharges is very important, as these measures may suffice to check a general epidemic. Kahars protected by chaukidars or police may be placed on wells. They should be provided with several *matkas* and should serve the people through *piaos*. For large fairs Kahar water drawers are seldom satisfactory as they are overpowered by large crowds. In those fairs the mouth of the well should be closed, and when the water is not over 25 feet from the surface it should be pumped by Kahars into cisterns provided with water-taps. Tube wells with pump attachment sunk into the soil where the sub-soil water is 20 feet below the surface are often very satisfactory.

(3) The Chief Medical Officer at a fair should himself and through his assistants make a point of inspecting all food supplies offered for sale. Efforts should be made to induce shopkeepers and hawkers to cover or protect in some way their goods from infection of flies. This is particularly important where there is a danger of cholera. Gauze-covered trays or even ordinary clean cloth should be used for this purpose. Food that is stale, indigestible, badly cooked or likely to have been exposed to infection with cholera germs by means of flies should be destroyed. The executive order of the officer in charge will generally suffice to carry out the recommendations of the inspecting officers and to ensure that only good food, safe to eat, is sold, but if necessary vendors of bad food can be prosecuted under section 273, Indian Penal Code. As a general rule it is better that shops where food is sold should be let out at fixed rates and not put up to auction. This tends to keep prices down. But where the area is so confined that the number of shops of one kind that can be let out is insufficient to ensure genuine competition the shops should be auctioned.

2069. Disinfecting gangs or their nuclei must be maintained in readiness. These gangs must be provided with bottles of disinfectant, pails for mixing the disinfectant and syringes for spraying ; also with lime or bleaching powder. As soon as a case of cholera is discovered the disinfecting gang under a reliable official should proceed to the place and disinfect it by sprinkling the whole surface with solution of 1 to 150 of hycol or cyllin, by removing 2 inches of soil and covering the area with a layer of lime or bleaching powder.

All gumlas should be destroyed and metal vessels should be disinfected. The contacts of the first few cases and as far as possible of all cases should be isolated and their clothes disinfected. The clothes of the sick or deceased person should be destroyed or very thoroughly disinfected. Compensation should, where this is desired, be given for all clothing destroyed. The patient should be removed to the hospital where his excreta should be passed into a solution 1 to 150 of hycol or cyllin. To provide against carelessness on the part of the menial staff it is safest also to boil the excreta in a kerosine oil can and to bury them 3 feet under ground.

Further measures as laid down in the instructions for the prevention of the spread of cholera in urban areas should be generally observed as far as they are applicable to fairs.

Disinfection for infectious diseases other than cholera should be carried out on the usual lines by burning the huts and boiling or otherwise disinfecting clothes. At fairs infectious hospital arrangements should be made for the disinfection of the clothing of contacts by boiling. A large karahi or iron vessel should be provided and the clothes placed in boiling water for a few minutes, wrung out and returned to the wearers.

Notification of cholera.

2070. If cholera should appear in an epidemic form at any fair the officer in charge of the fair should immediately send a notice of the fact by telegraph, if possible, to the Director of Public Health, to the Magistrates of all surrounding districts and to the Government, while the Magistrate of the district should give intimation by demi-official letter or telegram to all Magistrates and political agents of localities where disease-stricken people are likely soon to arrive. The Director of Public Health should inform the Directors of Public Health of neighbouring provinces.

2071. In the event of such notice being received the Magistrates in charge of surrounding districts will put in force such measures as may be necessary to prevent the passage of a numerous body of pilgrims through any large towns or cantonment in their respective districts.

2072. If the usual road of such pilgrims lies through any large town the Magistrate should establish a commodious halting-place with a good well near to the most convenient way or road by which the pilgrims may pass on their route outside the town, as directed by the police force detached for that duty. A plentiful supply of the ordinary articles of food will be sent out to the camping ground. Such of the pilgrims as belong to the town should be required to encamp there for one week before they can be permitted to enter the town, and then only in case of no appearance of the disease in the camp.

2073. In the case of cholera appearing amongst the pilgrims so encamped, a hospital similar to a fair hospital should be established. Provided the water supply and the food supply is protected from contamination it will be rarely necessary for the general body of pilgrims to be removed to another distant camping place, there to pass a second week in quarantine, paupers being supplied with a daily ration of food at the public expense.

Outbreaks of cholera after dispersion of fairs.

2074. (1) Prompt investigation should be made into cases of cholera occurring amongst pilgrims returning from bathing fairs and other great gatherings in order that the local origin of the disease may be ascertained as accurately as possible.

(2) The various railway authorities in these provinces will report cases occurring on railway premises, and the District Magistrate should send immediate intimation by telegram to the Director of Public Health of any such cases occurring outside railway premises which may come to his knowledge, and also inform the Civil Surgeon, who should make prompt inquiries into cases occurring near district headquarters, or at such other places as he can visit without detriment to his other duties.

(3) With regard to the investigations to be carried out in the interior of districts, the district vaccinators will be employed by the Civil Surgeon to make inquiries into cases with a view to ascertaining the origin of the epidemic. Information collected by the vaccinators shall be recorded on the form called "Abstract report on cholera" which should embody facts not only as to the occurrence of cholera in the village or villages visited, but also regarding any connection between the occurrence and the return or arrival of a villager or pilgrim from an affected locality. Facts recorded by vaccinators shall be fully verified before entry in the abstract report, all doubtful information being

rejected. The abstract report when completed shall be submitted in duplicate direct to the Civil Surgeon, who will transmit one copy duly endorsed to the Director of Public Health.

Booking of railway passengers to fairs closed on account of the out-break of an epidemic.

2075. With reference to the position of a railway administration to passengers who are desirous of proceeding by railway to a fair or other public gathering after it has been notified by the civil authorities that such fair or gathering has been closed in consequence of the prevalence of an infectious or contagious disease in epidemic form, or has been prohibited for any other reason, a railway administration should—

(i) discontinue the running of all special trains and withdraw all other facilities which are usually provided for the convenience of the traffic incidental to the occasion ; and

(ii) post up conspicuously at its stations a notice to the effect that the fair has been stopped, and require the booking clerks to warn intending passengers of this fact.

An intending passenger cannot, except for the reasons specified in section 71 of the Indian Railways Act, 1890, be prevented from proceeding on his journey if he persists in demanding a ticket after having been warned as directed above.

N. B.—The above orders empower a railway administration to stop special trains actually en route at any intermediate station, and to withdraw all special facilities from the passengers for proceeding thence to the fair, giving them at the same time special facilities for returning to their homes.

The position is altered when the Government has prohibited booking under the Epidemic Diseases Act.

Pilgrim routes and camping-grounds.

2076. (1) A camping-ground with a good well should, if possible, be provided at the railway stations nearest to the fair.

(2) From this camping-ground to the site of the fair a pilgrim route should be laid down so as to avoid large towns, and camping-grounds should be provided at proper distances of a day's march apart on the line of road.

(3) The camping-ground should be laid out so as to accommodate with orderly arrangement as many men as possible. A plentiful supply of food should be provided, and fenced trenches for conservancy purposes should also be provided, and a party of police be appointed to have charge of each camping-ground.

(4) A hospital space should be set aside at each camping-ground, and no pilgrim sick of cholera, small-pox or contagious fever should be allowed to proceed with the pilgrims, but should be removed to the hospital space for medical treatment, and the pilgrim route should be immediately diverted from that camp into some other road, a new camping-ground being provided to which the camping pilgrims should be directed.

(5) Two sweepers should be attached to each considerable camping-ground to cover in the trenches after they have been used, to provide new trenches, and to bury carefully the excretions of patients encamped in the hospital space.

Similar arrangements should be enforced on all main lines frequented by travellers to the fair.

2077. If cholera is known to be present as an epidemic in any place at the time of the fair, pilgrims from that place should not be permitted to go to the fair.

MEASURES TO BE TAKEN FOR THE PREVENTION OF THE SPREAD OF CHOLERA IN THE RURAL AREAS OF THE UNITED PROVINCES.

1. The *mukhia* and the *chaukidar* are both equally responsible for at once reporting to the *patwari* the occurrence of any case of cholera or suspected cholera in their village or villages. If the *patwari* be absent from his circle the *chaukidar* shall proceed at once to the thana to report. It is part of the *mukhia's* duties to see he does so.

2. The *patwari* on receiving this information or coming to know in any other manner of the suspected outbreak of cholera shall at once give a written report of the circumstances to the *chaukidar*, who shall immediately take it to the thana. The officer for the time being in charge of thana shall at once send messages in green envelopes to the District Magistrate, the Civil Surgeon and the Tahsildar.

3. The District Magistrate shall on receipt of the news give immediate notice to the Civil Surgeon as well as to the military authorities, the Magistrates of surrounding districts and to the Political Agents for neighbouring Indian States. The district board shall be liable to meet from its allotments for district epidemic charges any expenditure incurred in consequence of such action from the deputation of assistant or sub-assistant-surgeons to the district or other emergent measures.

4. On receipt of the information of a cholera case the Civil Surgeon shall take immediate steps to depute vaccinators to proceed to the seat of the outbreak.

5. The Civil Surgeon shall send with them a supply of cholera pills, permanganate of potash and other necessary medicines.

6. The Civil Surgeon shall when possible visit the cholera infected village and advise the District Magistrate as to the staff required in the event of an epidemic occurring. He should inspect the work of the staff placed on cholera duty.

7. The distribution of 32 one-ounce packets of permanganate of potash or of 32 two-ounce bottles of bleaching powder shall be made through the *tahsildar* to each *patwari*.

8. Every *tahsildar* shall in addition be supplied with a reserve stock of 10 lb. of permanganate of potash or 20 lb. of bleach made up in 10 separate packages each containing either 16 one-ounce packages of permanganate of potash or 16 two-ounce bottles of bleaching powder for issue to *patwaris* or vaccinators and sub-assistant-surgeons on special cholera duty.

9. Headquarter dispensaries will also maintain a reserve stock of 10 lb. of potassium permanganate or 20 lb. of bleach packed in bottles on which the *tahsildar* may indent in case of emergency and on which the sub-assistant surgeons or vaccinators placed on special cholera duty shall also draw.

10. On the issue of any of these reserve stocks the *tahsildar* shall indent on the Secretary, district board, and the Medical Officer in charge of a dispensary on the Civil Surgeon for the replacement of the amount expended.

11. *Patwaris* must be made to understand clearly that after sending information to the thana as laid down in the first part of these rules they must proceed at once to the infected area and disinfect the wells with permanganate of potash or bleaching powder and re-disinfect them every third day till the epidemic has ceased or till relieved by the vaccinators.

12. (1) The District Magistrate should arrange for the distribution of pamphlets to all *patwaris*, containing information as to the method of avoiding infection from cholera.

The *patwari* should be ordered to acquaint the villagers with the contents of the pamphlet. Leaflets explaining the method of disinfecting wells should also be distributed to *patwaris*.

(2) If the epidemic threatens to become serious in a defined area the Magistrate should at his discretion apply to the Inspector General of Civil Hospitals for the services of a sub-assistant surgeon.

(3) In case of a severe epidemic within a fairly defined area application should be made by the Magistrate to the Commissioner for sanction to depute a *tahsildar* or *naib tahsildar* on special cholera duty.

13. If the epidemic does not rapidly subside, the Civil Surgeon should, when necessary, direct the nearest travelling dispensary in his own district, to move at once to the infected area, reporting the fact that he has done so as a temporary measure to the supervising medical officer of travelling dispensaries. If further assistance is required, the Director of Public Health may be consulted with regard to the transfer of travelling dispensaries from adjoining districts.

THE UNITED PROVINCES TOWN AREAS ACT, 1914.

AN ACT TO MAKE BETTER PROVISION FOR THE SANITATION, LIGHTING AND IMPROVEMENT OF TOWN AREAS IN THE UNITED PROVINCES OF AGRA AND OUDH.

WHEREAS is it expedient to make better provision for the sanitation, lighting and improvement of town areas in the United Provinces of Agra and Oudh ; it is hereby enacted as follows :—

CHAPTER I.

PRELIMINARY.

Short title, commencement and extent. 1. (1) This Act may be called the United Provinces Town Areas Act, 1914.

(2) It shall come into force at once ; and

(3) It extends to the territories for the time being administered by the Lieutenant-Governor of the United Provinces.

Definitions. 2. In this Act, unless there is anything repugnant in the subject or context,—

(1) an act shall be deemed to be the act of a panchayat when it is done with the previous consent of, or of a majority of, all such members for the time being serving on the panchayat as are not incapacitated by illness or absence from the town area from signifying their consent thereto :

Provided that it is done with the previous consent of at least two members of the panchayat ;

(2) "annual value" means the gross annual rent at which any house or land may be reasonably expected to let from year to year ;

(3) "house" includes any shop, warehouse, shed or enclosure used for keeping carts or cattle ;

(4) "land" does not include land used for agricultural purpose or pastoral purposes ;

(5) "occupier" means, in the case of a house let out to several tenants or to lodgers or travellers, the person who lets the house or receives or is entitled to receive, the rents or payments from the tenants or the lodgers or travellers ;

(6) "prescribed" means prescribed by this Act or by any rule or order made thereunder ;

(7) "public road" means any road, street, thoroughfare, passage or place over which the public have a right of way ;

(8) "town area" means any local area which the Local Government has declared or defined under section 3 to be a town area ; and

(9) "town magistrate" means, in respect of any town area, the sub-divisional magistrate in charge of the sub-division within which such town area is situated, unless and until some other magistrate has been appointed under section 4, in which case the expression means such other magistrate.

CHAPTER II.

Town Areas, Magistrate, Panchayat and Servants.

Town areas.

3. (1) The Local Government may, by notification in the gazette,—

Declaration and definition of town areas.

(*a*) declare any town, village, suburb, bazar or inhabited place to be a town area for the purposes of this Act, and may unite, for the purpose of declaring the area constituted by such union to be a town area, the whole or a portion of any town, village, suburb, bazar or inhabited place with the whole or a portion of any other town, village, suburb, bazar or inhabited place, (*b*) define the limits of any town area for the like purposes,

(*c*) include or exclude any area in or from any town area so declared or defined, and

(*d*) at any time cancel any notification under this section :

Provided that an agricultural village shall not be declared, or included within the limits of, a town area.

(2) The decision of the Local Government that any inhabited area is not an agricultural village within the meaning of the proviso to sub-section (1) of this section shall be final and conclusive, and the publication in the gazette of a notification declaring such area to be a town area or within the limits of a town area shall be conclusive proof of such decision.

Town magistrate.

Appointment of town magistrate.

4. The district magistrate may appoint any magistrate, other than the sub-divisional magistrate, to exercise the powers and perform the duties of the town magistrate under this Act in respect of any town area.

Town panchayat.

Constitution of town panchayat.

5. (1) A panchayat shall be established for each town area.

(2) The panchayat shall consist of three or more members to be appointed by the district magistrate or elected in the prescribed manner or partly so appointed and partly so elected as the Local Government may by general or special order prescribe :

PROVISO.—At least one-third of the members of the panchayat shall be elected.

(3) The Local Government may by order exclude any town area from the operation of the proviso to sub-section (2) of this section.

Term of office of member of panchayat.

6. (1) Subject to any rule made by the Local Government in this behalf, the term of office of a member of a town panchayat shall be three years.

(2) An outgoing member shall, if otherwise qualified, be again eligible for appointment or election.

Removal of member of panchayat.

7. The Commissioner may remove any member of a panchayat who is in his opinion unfit to act or persistently remiss in the discharge of his duties as such member.

Duties of the panchayat.

8. The duties of the panchayat shall be—

(*a*) to perform any duty specifically assigned to it by this Act or by any rule or order made under this Act.

(*b*) to advise the district magistrate or the town magistrate in respect of the matters prescribed in section 26, and

(*c*) generally to render such assistance to the district magistrate or the town magistrate in the discharge of their functions under this Act as may reasonably be required of it by these officers.

Town servants.

Establishment list.

9. (1) The panchayat shall as soon as may be practicable prepare an establishment list of the permanent staff of tax collectors and other servants necessary for carrying out the purposes of this Act and of the duties, salary and allowances to be attached to the respective posts entered therein.

(2) The panchayat shall, when so required by the town magistrate from time to time, revise the establishment list prepared under sub-section (1).

(3) Every establishment list prepared under sub-section (1) or revised under sub-section (2) shall be subject to confirmation by the town magistrate, and in the event of that officer refusing to confirm any establishment list, it shall be altered by the panchayat under his direction.

Appointment and control of permanent staff.

10. (1) Subject to confirmation by the town magistrate in the case of an appointment to a post of which the salary exceeds five rupees a month, the panchayat shall appoint the permanent staff prescribed in the establishment list.

(2) Subject to like confirmation, the panchayat may fine, suspend or dismiss any member of the permanent staff so appointed.

Appointment and control of temporary staff.

11. With the previous sanction, express or implied, of the town magistrate the panchayat may from time to time appoint, prescribe the remuneration and duties of, and discontinue or dismiss such servants as may temporarily be required to supplement the permanent staff.

Prohibition of unauthorized service.

12. Except in the manner prescribed by sections 9, 10 and 11 a person shall not be appointed a town servant or employed as such.

Town servants to be deemed public servants.

13. Every town tax collector or other town servant permanently or temporarily appointed under this Act shall be deemed to be a public servant within the meaning of section 21 of the XLV of 1860. Indian Penal Code.

CHAPTER III.

TAXATION AND TOWN FUND.

Taxation.

Imposition of town tax.

14. The district magistrate shall, after ascertaining the opinion thereon of the panchayat, annually determine the amount required to be raised in any town area for the purposes of this Act, and the amount so determined shall be raised by the imposition of a tax to be assessed on the occupiers of houses or lands within the limits of the town area according either to their circumstances or to the annual value of the houses and lands occupied by them, as the district magistrate may in like manner determine :

Provided that, in the case of a tax assessed according to circumstances as aforesaid, the amount assessed in respect of any one person shall not exceed seven rupees eight annas per month ; and, in the case of a tax assessed according to the annual value of houses and land, the amount assessed in respect of any house or land shall not exceed $6\frac{1}{4}$ per cent. of the annual value of the house or land :

Provided also that, whenever the district magistrate does not accept the opinion of the panchayat, he shall record his reasons in writing for not doing so.

Assessment of tax.

15. (1) Subject to any rules made in this behalf by the Local Government, the panchayat established for any town area shall, as soon as may be, prepare a

list of the persons liable to pay the tax imposed under section 14 and of the amounts to be paid respectively by such persons.

(2) The panchayat shall, when so required by the town magistrate, from time to time revise the assessment list prepared under sub-section (1).

(3) Every assessment in a list prepared under sub-section (1) or revised under sub-section (2) shall be subject to confirmation by the town magistrate, and any assessment which such magistrate refuses to confirm shall be altered by the panchayat under his direction.

(4) An assessment, when confirmed by the town magistrate, shal not be subject to alteration except upon revision of the assessment list under sub-section (2) or in pursuance of an order passed in appeal under the provisions of section 18.

Exemptions from tax.

16. Subject to any rules made in this behalf by the Local Government, the district magistrate may, by order, exempt in whole or in part from the payment of any tax imposed under this Act any person or class of persons or property or description of property.

Publication of assessment list.

17. The panchayat shall cause a copy of every assessment list prepared or revised under section 15 and confirmed by the town magistrate to be posted in a conspicuous place within the town area and shall cause a register of assessments to be maintained at such place and in such manner as the district magistrate may prescribe.

Appeals from assessment or levy of tax.

18 (1) An appeal against the assessment or levy of any tax shall lie to the district magistrate or to such magistrate other than the town magistrate as he may appoint in this behalf.

(2) A court-fee shall not be payable on an appeal presented under sub-section (1) of this section.

(3) An appeal under the said sub-section shall not be admitted after the expiry of thirty days from the date of posting under section 17, unless the appellant shows sufficient reason for failing to appeal within the said period.

(4) The decision of the appellate authority prescribed in sub-section (1) of this section shall be final and shall not be called in question in any court.

Payment of tax.

19. The tax shall be payable in such instalments, and each instalment shall become due on such date as the panchayat may, subject to any rules framed by the Local Government in this behalf, prescribe by notice posted in a conspicuous place within the town area :

Provided that any person so desirous may pay the whole year's tax in advance.

Writ of demand.

20. On failure of any person to pay any instalment of tax on or before the specified date the panchayat shall, ordinarily within fifteen days of such date, cause a writ of demand to be served on the defaulter, or delivered at or affixed to his place of residence within the town area, or addressed by post to such place of residence or any other place where he may be known to reside. Any postal charges incurred under this section may be added to the arrear claimed and recovered as such.

Recovery of arrears.

21. Arrears of any tax imposed under this Act may be recovered, on the expiry of three weeks from the date of the issue of a writ of demand, on application to a magistrate having jurisdiction within the limits of the town area or in any other place within the United Provinces where the defaulter may for the time being reside, by the attachment and sale of any moveable property belonging to such defaulter and within the limits of such magistrate's jurisdiction.

Town fund.

The town fund.

22. For each town area there shall be formed a town fund, and there shall be placed to the credit thereof—

(*a*) the proceeds of any tax imposed under the provisions of this Act ;

(*b*) all fines realized in cases in which prosecutions for offences committed within the limits of such town area are instituted under this Act or the rules made thereunder, or under section 34 of the Police Act, 1861, or under any other Act or rules under any other Act, in which provision is made for the credit of such fines to the town fund ;

(*c*) the balance (if any) standing at the credit of the chaukidari fund of any town comprised in such town area at the date when this Act comes into force ;

(*d*) all sums ordered by a court to be placed to the credit of the town fund ;

(*e*) the sale proceeds, except in so far as any private person is entitled to the whole or a portion thereof, of all dust, dirt, dung or refuse (including the dead bodies of animals) collected by the town servants ;

(*f*) such portion of the rent or other proceeds of nazul property as the Local Government may direct to be placed to the credit of the town fund ;

(*g*) sums contributed to the town fund by any district board ;

(*h*) all sums received by way of loan or gift ; and

(*i*) such other sums as may be assigned to the town fund by any general or special order of the Local Government.

Control of town fund.

23. Subject to any rules framed in this behalf by the Local Government, the town fund shall be under the control of the town magistrate and shall be applied to—

(*a*) the repayment of the principal and interest of any sum advanced as a loan by the Local Government for the purposes of this Act ;

(*b*) the payment of the salary and allowances of the establishment entertained under this Act ;

(*c*) the purchase of stationery and other contingent expenditure necessary for the purpose of this Act ;

(*d*) the payment of expenses incurred for the maintenance of public roads not being roads of which the maintenance is undertaken by the Government or by a district board ;

(*e*) the payment of expenses incurred for the repair of public wells and tanks, or for the provision of an adequate supply of pure drinking water ;

(*f*) the payment of expenses incurred generally for carrying out the sanitation, drainage, lighting and improvement of the town area ; and

(*g*) the payment of any other sums which the Local Government may by general or special order declare to be an appropriate charge on the town fund.

Custody of town fund.

24. Subject to any rules made in this behalf by the Local Government, the town magistrate shall make arrangements for the proper custody of the town fund and for the remittance to such custody of all sums collected on behalf of or received to the credit of the town fund.

Power to require panchayat to carry out certain orders.

25. The Local Government may, by order require a panchayat to carry out any scheme detailed in such order for the drainage of the town area or for the provision of an adequate supply of pure drinking water for the town area.

CHAPTER IV.

POWERS FOR SANITARY AND OTHER PURPOSES.

Sanitation orders.

26. The district magistrate, after taking into consideration any representation made in that behalf by the panchayat, may, by general or special order in writing, provide for all or any of the following matters within the town area, namely—

(*a*) the protection from pollution, purification and periodical examination of all sources of water used for drinking purposes ;

(*b*) the prohibition of the removal or use for drinking purposes of any water from any stream, well, tank or other source where such removal or use causes, or is likely to cause, disease or injury to health, and the prevention of such removal or use by the filling in of any well, tank or other receptacle or by any other method that may be considered advisable ;

(*c*) The prohibition of the deposit or storage of manure, refuse or other offensive matter in a manner prejudicial to the public health, comfort or convenience ;

(*d*) the regulation of offensive callings or trades ;

(*e*) the disposal of corpses by burning or burial ;

(*f*) the excavation of earth and the filling up of all excavations and depressions injurious to health or offensive to the neighbourhood ;

(*g*) the removal of noxious vegetation ;

(*h*) the repair or removal of dangerous or ruinous buildings ;

(*i*) the disposal or destruction of materials likely to convey infection ;

(*j*) the regulation of slaughter-houses ;

(*k*) the prohibition of the storage of more than a fixed quantity of petroleum in any building within the town area.

Delegation by district magistrate of the power to issue sanitation orders.

27. The district magistrate may by written order delegate to the town magistrate all or any of the powers conferred by the preceding section in respect of the town area.

Publication of sanitation orders.

28. A copy of every order issued under section 26 shall be posted in some conspicuous place within the town area.

Appeals against sanitation orders.

29. (1) An order of the district magistrate under section 26 shall be final and shall not be called in question in any court.

(2) An appeal shall lie to the district magistrate against any order passed by a sub-divisional magistrate under section 27.

(3) Such appeal shall be preferred within thirty days from the date when the order was posted.

(4) The decision of the district magistrate in appeal shall be final and shall not be called in question in any court.

Naming of streets and numbering of houses.

30. The panchayat may cause a name to be given to any street and affixed in such place or places as it may think fit, and may also cause a number to be affixed to every house in any street or muhalla, for the purpose of identifying such house.

CHAPTER V.

OFFENCES.

Breach of any sanitation order.

31. Any person guilty of a breach of an order under section 26 shall be liable upon conviction to a fine which may extend to ten rupees, and when the breach is a continuous breach with a further fine which

may extend to two rupees for every day after the date of the first conviction during which the offender is proved to have persisted in the offence.

Removal of names and numbers affixed to streets and houses.

32. Any person who wilfully removes, obliterates or destroys any name or number affixed by the panchayat under section 30 shall be liable upon conviction, to a fine which may extend to twenty rupees.

Jurisdiction of courts to try offences.

33. Offences under this Act shall be triable by any magistrate within whose jurisdiction any such offence may have been committed :

Provided that no magistrate other than the town magistrate shall take cognizance of any offence punishable under this Act except with the previous sanction or on the complaint of the town magistrate.

CHAPTER VI.

SUPPLEMENTAL PROVISIONS.

Application of town fund when area ceases to be a town area.

34. When by reason of the cancellation under clause (*d*) of section 3 of an order under clause (*a*) of the said section any area ceases to be a town area, the unexpended proceeds of any tax levied therein shall be applied for the benefit of the inhabitants of the said area as the Local Government may think fit.

Power of town magistrate to assume functions of panchayat.

35. If any panchayat refuses or omits to perform any prescribed duty, the town magistrate may perform such duty, and any assessment made or revised or any other thing done by the town magistrate in the exercise of the power conferred by this section may be enforced as if it had been made, revised or done by the panchayat.

Power to supersede panchayat in case of persistent default or abuse of powers.

36. (1) If, in the opinion of the Local Government, a panchayat persistently makes default in the performance of the duties imposed on it by or under this or any other Act for the time being in force, or exceeds or abuses its powers, the Local Government may, by an order published, with the reasons or making it, in the gazette, declare that panchayat to be in default, or

to have exceeded or abused its powers; and supersede it for a period not exceeding two years to be specified in the order.

(2) When a panchayat is so superseded, the following consequences shall ensue :—

(*a*) all members of the panchayat shall as from the date of the order vacate their offices as such members;

(*b*) all powers and duties of the panchayat may during the period of supersession, be exercised and performed by the town magistrate;

(*c*) on the expiration of the period of supersession specified in the order the panchayat shall be reconstituted, and the persons who vacated their offices under clause (*a*) of sub-section (2) shall not be deemed disqualified for being members.

Power of Local Government to confer on panchayats powers of town magistrate.

37. The Local Government may, by notification in the gazette, confer or impose on any panchayat established under this Act all or any of the powers conferred or duties imposed by the Act or by rules made thereunder on the town magistrate and in like manner may divest any panchayat of any power conferred or duty imposed under this section.

Extension of enactment to town areas.

38. (1) The Local Government may, by notification in the gazette, extend to all town areas or to any town area or to any part of a town area any enactment for the time being in force in any municipality in the United Provinces, and declare its extension to be subject to such restrictions and modifications, if any, as it thinks fit.

(2) Where any enactment is so extended, any provision of this Act inconsistent with such extension or declared in the aforesaid notification to be inoperative shall cease to have effect so long as the extension is in force.

(3) When any enactment has been so extended the functions of the municipal board shall so long as the extension is in force, be discharged by the district magistrate or by the panchayat if so empowered by the Local Government.

(4) When the panchayat is empowered under sub-section (3) to discharge any functions assigned to the municipal board by any enactment so extended, the Local Government may declare applicable also

to the panchayat, for such periods as the extension continues in force and subject to such restrictions and modifications, if any, as it thinks fit any enactment prescribing the status, rights or liabilities of the municipal board in respect of the exercise of such functions.

(5) The Local Government may, by notification in the gazette, direct that any enactment so extended shall cease to be extended to any town area or part of a town area.

Power of Local Government to make rules.

39. (1) The Local Government may make rules applicable to all or any town areas for carrying out the purposes of this Act.

(2) In particular and without prejudice to the generality of the powers conferred by sub-section (1) of this section, such rules may relate to all or any of the following matters or be for all or any of the following purposes :—

(*a*) to regulate and control the powers conferred by this Act or by any rule made under this section on any officer of Government or on the panchayat ;

(*b*) to prescribe for any such officer or for the panchayat any duty in addition to those prescribed by this Act ;

(*c*) to prescribe or regulate in respect of all or any town areas the number of members to compose the panchayats established therein ;

(*d*) as to the term of office of any or all of the members of any panchayat, and as to the method of filling casual vacancies ;

(*e*) as to the provision (if any) to be made for the special representation of any classes of the community ;

(*f*) as to the qualifications of electors and of candidates for election to the panchayat, as to the registration of such electors, as to the nominations of such candidates, as to the time of election and mode of recording votes, as to the method of settling disputes or questions arising from elections, and generally for regulating all elections under this Act ;

(*g*) as to the custody of the town fund ;

(*h*) as to the form in which any accounts are to be kept or any registers maintained ;

(*i*) as to the proportions in which the town fund shall be expended, and as to the preparation of estimates of income and expenditure ;

(*j*) as to the preparation of plans and estimates for works of construction involving expenditure from a town fund, and as to the authorities by whom, and the conditions subject to which such plans and estimates may be sanctioned ;

(*k*) as to the returns, statements and reports to be submitted by the town magistrate ;

(*l*) to regulate the imposition, assessment and collection of any tax imposed under this Act, and to prevent the evasion of the same ;

(*m*) as to the exemption from taxation of any person or class of persons or property or description of property.

(3) The power to make rules under this section shall be subject to the condition of the rules being made after previous publication.

Village Sanitation Act, 1892, not to apply to town areas.

40. The United Provinces Village Sanitation Act, 1892, shall so long as any area is a town area under this Act, not be operative therein.

Repeal of Bengal Chaukidari Act, 1856.

41. The Bengal Chaukidari Act, 1856, in so far as it extends to the United Provinces, is hereby repealed.

Savings.

42. Notifications published, local limits defined, taxes imposed, assessments, revisions and appointments made, lists prepared, powers conferred, duties assigned and exemptions granted under the Bengal Chaukidari Act, 1856, shall, so far as they are consistent with this Act, have the same force and effect as if they had been respectively published, defined, imposed, made, prepared, conferred and granted under this Act and by the authority empowered thereby in such behalf.

Provided that the term of office of a panchayat appointed under the former Act shall not by reason of this section be extended beyond one year from date of appointment.

References in other enactments to the Bengal Chaukidari Act, 1856.

43. In every enactment passed before this Act comes into force in which reference is made to, or to any section of, the Bengal Chaukidari Act, 1856, such reference shall, so far as may be practicable, be deemed to be made to this Act or to its corresponding section.

THE UNITED PROVINCES VILLAGE SANITATION ACT, 1892.

(As amended by Act V of 1912).

(AN ACT TO MAKE BETTER PROVISION FOR SANITATION IN VILLAGES IN THE UNITED PROVINCES).

WHEREAS it is expedient to make better provision for sanitation in villages in the United Provinces, it is hereby enacted as follows :—

Title, extent and commencements.

1. (1) This Act may be called "The United Provinces Village Sanitation Act, 1892 ;"

(2) It extends to the territories for the time being administered by the Lieutenant-Governor of the United Provinces ;

(3) It shall come into force at once.

Definitions.

2. In this Act, unless there is something repugnant in the subject or context—

(1) "Village" means an inhabited site, but does not include a municipality, cantonment, or notified area as defined in section 193 of the United Provinces Municipalities Act, 1900 ;

(2) "Village lands" mean the lands included in the revenue mauza or mauzas in which the village is situated ;

(3) "Well" means a well the water of which is habitually used for drinking purposes by all or some of the inhabitants of a village ;

(4) "Collector" means any Revenue Officer in independent charge of a district, and any officer appointed by the Local Government to discharge throughout any specified local area the functions of a Collector under this Act ;

(5) "Magistrate" means the District Magistrate and any Magistrate empowered by the Local Government, by name or virtue of his office, to exercise the powers of a Magistrate under this Act ;

(6) "Sanitary Commissioner" includes a Deputy Sanitary Commissioner ;

(7) "Proprietors of village lands" mean the proprietors of the mahâl or mahâls in which the village lands are situated ; and in sub-settled mahâls mean the persons with whom sub-settlement has been made.

Application of certain sections of the Act to notified villages.

3. Part I shall not apply to any village until, by order notified in the Gazette, the Local Government shall have declared it applicable to the district in which the village is situated.

PART I.

Power to cause local inquiry to be made into the sufficiency and purity of the water supply.

4. In any village which contains not less than 2,000 inhabitants or in such other villages as the Local Government may, from time to time by general or special order direct, the Collector may cause a local inquiry to be made, through the agency prescribed by rules made under section 20, into the sufficiency and purity of the water-supply and general sanitary condition of the village, with the view of ascertaining any or all of the following matters :—

(1) whether the water of any well is contaminated from surface drainage, or from any other cause against which effective measures of protection can be taken ;

(2) whether the water of any well is dangerous to health, and its impurity is due to causes against which effective measures of protection cannot be taken ;

(3) Whether the construction of additional wells is necessary fro the health of the inhabitants of the village ;

(4) whether it is necessary for the health of the inhabitants of the village that provision be made in respect of the matters described in section 14.

Action that may be taken by the Collector on considering the result of the local inquiry,

5. The Collector shall take into consideration the result of the above inquiry, and may—

(1) by the publication of notice in the manner prescribed, direct that any well be cleaned, improved, repaired, or otherwise protected from contamination, by, or at the expense of, those of the inhabitants of the village who are found on local inquiry to use the well ;

(2) after recording his reasons, condemn any well referred to in section 4 (2) ;

(3) by the publication or service of notice in the manner prescribed, direct that one or more additional wells be constructed by the proprietors of the village lands ;

(4) by the publication or service of notice in the manner prescribed, declare any or all of the rules framed by the Local Government under section 14 applicable to the village.

Power of Collector to close or keep open a condemned well.

6. When a well has been condemned in accordance with the provisions of section 5 (2), the Collector may either cause it to be filled up and closed, or, if it be a masonry well and is used for irrigation, allow it to remain open on the condition that the inhabitants of the village abstain from using it for drinking purposes.

Publication of order prohibiting the use of condemned well for drinking purposes.

7. When the Collector allows a condemned well to remain open under section 6, he shall cause the contents of his order to be published within the limits of the village, and shall direct—

(1) the inhabitants of the village to abstain from using the water of such well for drinking purposes ; and

(2) the proprietors of the village lands to affix and maintain upon or adjacent to such well a conspicuous notice or mark indicating that the use of the water for drinking purposes is prohibited.

Power of Collector to close a condemned well, if the prohibition issued under section 7 is disregarded.

8. If at any time it be proved to the satisfaction of the Collector that the prohibition issued under the preceding section respecting the use of a well for drinking purposes is disregarded, he may forthwith cause such well to be filled up and closed.

Contents of notice issued under section 5

9. Every notice issued under section 5 shall specify the nature and extent of the work to be executed, its estimated cost, and the period within which it is to be completed ;

Provided that no notice shall be issued under clause (3) of section 5 if the estimated cost of the work exceeds the limit prescribed by rules made under section 20.

Power of Collector to execute the work himself.

10. On the expiration of the period prescribed in any notice issued under section 5, the Collector shall ascertain whether the direction conveyed by the notice has been satisfactorily complied with ; and may in default of such compliance proceed to execute the work himself ;

Provided that he may on sufficient cause being shown extend the period specified in the notice, or modify or rescind the direction conveyed by it.

Application to Collector for a loan of public moneys.

11. Whenever notice has been issued under section 5 directing that measures be taken with regard to any existing well, or that a new well be constructed, the persons affected by the notice, or a majority of them, may apply to the Collector for a loan of public moneys for the purpose of executing the work specified in the notice ; and the Collector, on being satisfied that the applicants are competent to execute the work, may grant to them in loan a sum not exceeding the amount specified in the notice, and may direct that it be paid to such person among the applicants as they may appoint.

Preparation of list of persons from whom sums expended by Collector are recoverable.

12. Whenever the Collector has expended money under section 10, or has made a loan under section 11, he shall forthwith prepare a list of the persons from whom such expenditure or loan is declared to be recoverable under the provisions of the next section.

Manner of recovery of sums expended or advanced by Collector

13. All sums expended by the Collector under section 10, and all loans made by him under section 11, shall be recoverable in accordance with the following provisions :—

(1) In the case of a well referred to in section 5 (1), from the persons found by the local inquiry to use the well, in proportion to their respective means and circumstances, and

in accordance with any rules that may be made under section 20 ;

(2) In the case of a well referred to in section 5 (3) :—

(*a*) one-quarter from the district fund ;

(*b*) one-quarter from the proprietor or proprietors of the village lands in proportion to their respective proprietary shares in those lands ;

(*c*) one-half from persons, including proprietors of village lands, owning or occupying houses, situated within the village, or if the Collector so determine, situated in that portion of the village which will chiefly benefit from the well, with reference to their respective means and circumstances, and in accordance with any rules that may be made under section 20.

Additional power of Government to make rules regarding conservancy.

14. The Local Government may, after previous publication, frame rules regulating conservancy, providing for the protection and periodical examination of the water-supply, prohibiting or regulating the making of pits and excavations, and defining and prohibiting public nuisances in or near any village to which the Collector may, under section 5 (4) declare such rules or any of them applicable.

Penalty for breach of rules.

15. (1) In making any rule under the preceding section the Local Government may direct that a breach of it shall be punishable with fine which may extend to ten rupees.

(2) All fines recovered under this section shall be applied for the benefit of the village as the Local Government shall from time to time direct.

PART II.

Advances for the repair, construction or improvement of wells.

16. Advances may be made by the Collector for the repair, improvement or construction of wells in any village, whatever be its population, provided that the applicant furnishes sufficient securityr fo the repayment of the advance.

Power to take special measures to prevent outbreak or spread of infectious disease.

17. When the Magistrate and the Sanitary Commissioner, or the Civil Surgeon, acting in concert, have ascertained that a serious epidemic or infectious disease is present in the district, or in any part of the district, and that special preventive measures are required, they may record their reasons in writing, specifying at the same time the tract in which such preventive measures are required. The Magistrate may then, subject to the provisions of any rules made under section 20, take such measures as he may deem necessary for the following purposes in any village, which is situated in the said tract, and in which an outbreak of the disease has either taken place or is apprehended, namely :—

(1) the cleansing and conservancy of the site ;

(2) the disposal of corpses by cremation or burial ;

(3) the prohibition of the use for drinking purposes, or the closing, of any source of water-supply ; and

(4) the disposal or destruction of materials likely to convey infection.

Recovery of sums expended under the preceding section.

18. Subject to the rules made under section 20, sums expended by the Magistrate under the preceding section shall be recoverable, in whole or in part, from the proprietors of village lands, and owners and occupiers of houses in the village, with reference to their respective means and circumstances.

Compensation to be paid for destruction of materials likely to retain infection.

19. When any hut, shed, clothing, bedding, or other article which is likely to retain infection is destroyed under the provisions of section 17, clause (4), the Magistrate shall pay such compensation, if any, as he may consider reasonable, to any person sustaining substantial loss thereby ; but no person shall be entitled as of right to claim compensation for any loss or damage sustained by him by reason of such destruction.

PART III.

Power of Government to make rules.

20. (1) The Local Government shall make rules consistent with this Act :—

(*a*) prescribing the agency by which the local enquiry referred to in section 4 shall be conducted ; and

(*b*) fixing the limit referred to in the proviso to section 9.

(2) The Local Government may, after previous publication, make rules consistent with this Act :—

(*a*) defining the manner in which notices and injunctions shall be published or served ;

(*b*) determining the rate of interest (if any) to be charged on advances made under this Act, and on sums expended by the Collector under section 10 ;

(*c*) fixing the period within which and the instalments by which such advances and sums shall be repaid ;

(*d*) prescribing the manner of keeping and auditing the accounts of the expenditure of such advances and sums, and of the repayment made in respect of the same ;

(*e*) prescribing the mode of assessment of sums recoverable under section 13 and the agency by which such sums shall be assessed and recovered ;

(*f*) prescribing the measures which may be taken under section 17 ;

(*g*) limiting the sums which may be recovered under section 18 ;

(*h*) specifying the cases in which any action taken under section 17 shall be reported to the Government ; and

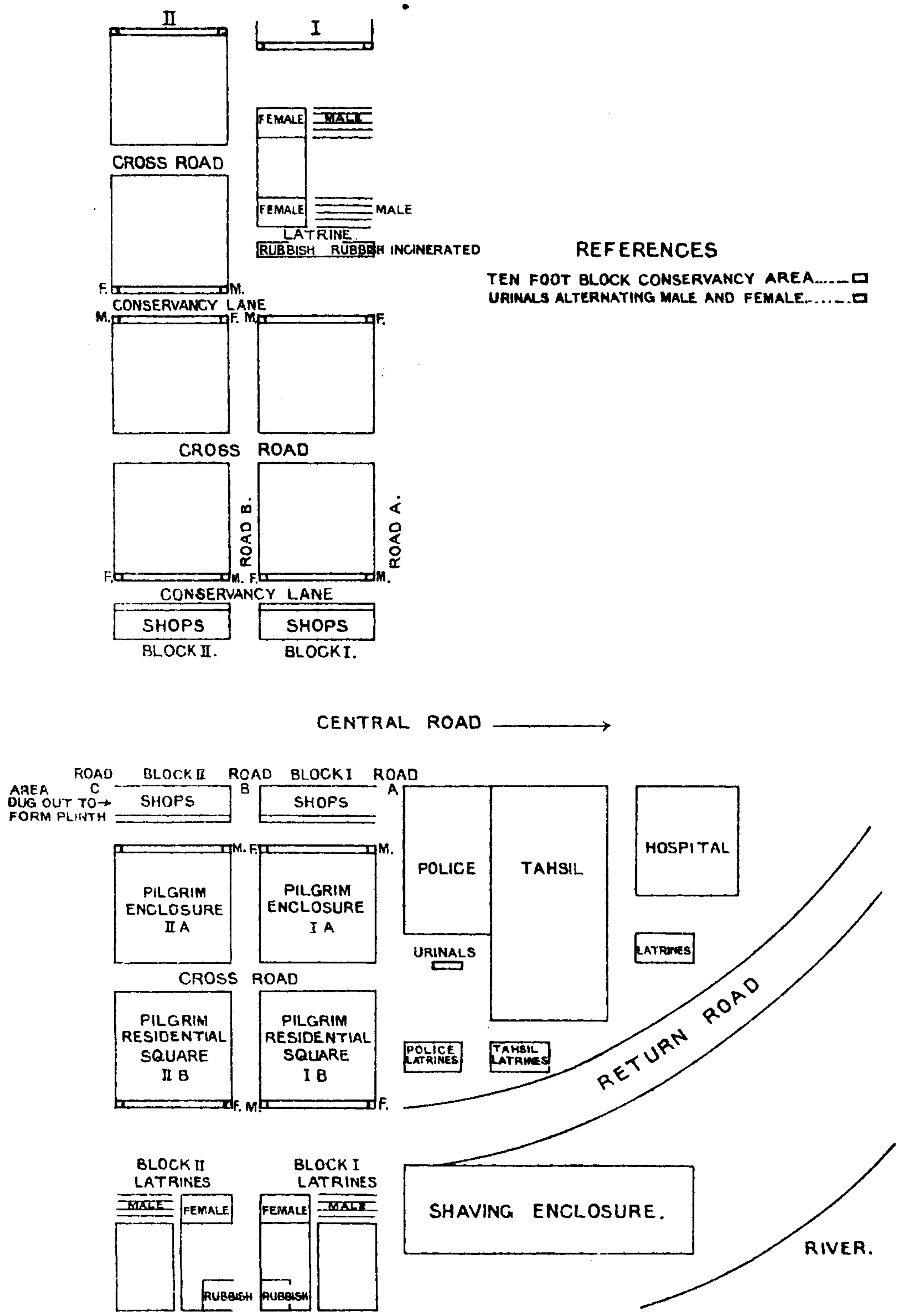
(*i*) generally for the purposes of giving effect to the provisions of of this Act.

Recovery of arrears due to Government.

21. Any sum becoming due under this Act, and not paid on or before the date fixed for payment, shall be recoverable by the Collector as if it were an arrear of land revenue.

Fig. 78.-PLAN OF LAYING OUT FAIR SITE.

SCALE 20" TO THE SMALL SQUARE.



ROMAN NUMERAL I. SHOWS DOUBLE LATRINE BETWEEN TWO PILGRIM BLOCKS.
ROMAN NUMERAL II. SHOWS FOUR PILGRIM BLOCKS AND CONSERVANCY.
LANES. THE LATRINE IS SITUATED BEYOND THE FOURTH RESIDENTIAL SQUARE.

No.1211-18. 20 ec.

APPENDIX I

USEFUL DATA

WEIGHTS AND MEASURES.

Avoirdupois Weight.

480	grains	1 ounce
16	ounces	1 pound
14	pounds	1 stone
28	pounds	1 quarter
112	pounds	1 cwt.
20	cwt.	1 ton

Measures of Length.

12	inches	1 foot
3	feet	1 yard
220	yards	1 furlong.
8	furlongs	1 mile
1,760	yards	1 mile
5,280	feet	1 mile

Fluid Measures.

20	ounces of water	1 pint
2	pints „	1 quart
4	quarts „	1 gallon
1	gallon = 70,000 grains =	10 lbs. (avoir.).
1	cubic foot of water	6·2355 gallons
1	cubic foot of water =	62·355 lbs.
224	gallons =	1 ton.

Square and Land Measures.

144	square inches	1 square foot.
9	square feet	1 square yard.
4,840	square yards	1 acre.
640	acres	1 square mile.

Cubic Measures.

1,728	cubic inches	1 cubic foot
27	cubic feet	1 cubic yard.

Metric System.

Weights.

10	milligrammes	1 centigramme
10	centigrammes	1 decigramme
10	decigrammes	1 gramme
10	grammes	1 decagramme
10	decagrammes	1 hectogramme
10	hectogrammes	1 kilogramme

Measures of Length.

10	millimetres	1 centimetre
10	centimetres	1 decimetre
10	decimetres	1 metre
10	metres	1 decametre
10	decametres	1 hectometre
10	hectometres	1 kilometre

Fluid Measures.

1,000	cubic millimetres	1 cubic centimetre
1,000	cubic centimetres	1 litre
1	litre	1 cubic decimetre
1,000	litres	1 cubic metre.

English and Metric Equivalents.

Weight.

1	gramme	= 15·432 grains
1	cubic centimetre of distilled water @ 4°C.	= 1 gramme
1	litre of water = 1,000 grammes	= 2·2 lbs.
1	ounce	= 28·349 grammes
1	pound	= 453·6 grammes
1	kilogramme	= 2·2 lbs.

Length.

1	metre	= 39·37 inches
1	inch	= 2·54 centimetres
1	yard	= ·9144 metre
1	mile	= 1·6093 kilometre

Square Measure.

1 square metre	=	10·764 square feet
1 ,, ,,	=	1,550 square inches.

Capacity.

1 litre	=	35·3 fl. ounces = 61 cubic inches = ·22 gallon
1 fl. ounce	=	28·4 cubic centimetres
1 gallon	=	4·5434 litres.

RAINWATER.

1 inch of rain = 4·673 gallons per square yard.
1 inch of rain = 22,615 gallons per acre.

Hawkesley's formula to ascertain the number of days' supply of water which require to be stored per 1,000 of the population of a district obtaining its supply from rainwater only :

Let D = number of days' supply to be stored
F = average rainfall for the three driest consecutive years

then $D = \frac{1,000}{\sqrt{F}}$

Pole's formula to ascertain the number of acres of collecting area required to supply a given number of gallons daily to a population :

Let F = mean annual rainfall in inches
E = mean annual evaporation in inches
A = acres of collecting ground
W = number of gallons required daily
then $W = 62\ A\ (F - E)$ gallons.

TABLE OF CONTENTS OF WELLS IN GALLONS.

Diameter of well	Contents in gallons per foot of depth.
2 ft. 6 in.	30·62
3 ft. 0 in.	44·10
3 ft. 6 in.	60·02
4 ft. 0 in.	78·40
4 ft. 6 in.	99·22
5 ft. 0 in.	122·50
5 ft. 6 in.	148·22
6 ft. 0 in.	176·40

DRAINAGE.

To find the inclination at which drain pipes of various sizes should be laid, multiply the inside diameter of the pipe by ten ; the result will be the number of feet in which the drain should fall one foot.

Example : 4 in. = 1 in 40.

The velocity of flow in drains should be from 3 to $4\frac{1}{2}$ feet per second.

TABLE OF FALL NECESSARY TO OBTAIN CERTAIN VELOCITIES IN FEET PER SECOND IN DRAINS RUNNING FULL OR HALF FULL.

Diameter of the drain in inches.	V-2·5	V-3	V-3·5	V-4	V-5	V-6
4	1- 89	1- 62	1- 46	1- 35	1-22	1-16
5	1-120	1- 84	1- 61	1- 47	1-30	1-21
6	1-155	1-105	1- 78	1- 60	1-38	1-27
9	1-265	1-185	1-135	1-105	1-66	1-46
12	1-385	1-270	1-195	1-150	1-97	1-67

GASES.

Weight.

1 litre of hydrogen at 0°C. and 760 mm pressure weighs ·08958 *gramme.*

This is the chemical standard or "crith".

The density of all gases is equal to their atomic weight. Therefore the weight of any gas can be found by multiplying the "crith" by the atomic weight of the gas.

From this it is easy to calculate that :

11·2	litres of	Hydrogen	weighs	1 gramme
11·2	,,	Oxygen	,,	16 grammes
11·2	,,	So_2	,,	32 ,,
11·2	,,	Co_2	,,	22 ,,
11·2	,,	Steam	,,	9 ,,

In the case of Co_2 and steam, being compounds, the sum of the atomic weights must be divided by two.

Standard in Physics.

1 cubic foot of dry air at 32°F. and 760 mm. weighs 566·85 grains.

Air is 14·47 times heavier than Hydrogen.

The weight of any gas or gaseous compound can be calculated from the above which is the standard adopted in Physics.

Relations of volume, pressure, weight, temperature of gases.

If W. V. P. and T. equal the *known* weight, volume, pressure and temperature of a gas and w. v. p. and t. equal the weight, volume, pressure and temperature of the gas to be ascertained, it can be done by the following formulæ :—

Volume and pressure	$V : v :: p : P$	(Boyle's law)
Volume and temperature	$V : v :: 273+T : 273+t$	(Charles' law)
Weight and pressure	$W : w :: P : p$	
Weight and temperature	$W : w :: 273+t : 273+T$	
Pressure and temperature	$P : p :: 273+T : 273+t$	

Diffusion of gases.

Gases diffuse inversely as the square roots of their densities.

$$\therefore H : O :: \sqrt{16} : \sqrt{1}$$

CONVERSION OF THERMOMETER SCALES.

Centigrade freezing point of water	= 0° C.
Fahrenheit freezing point of water	= 32° F.
Centigrade boiling point of water	= 100° C.
Fahrenheit boiling point of water	= 212° F.

$$\therefore C : F-32 :: 100 : 212-32$$
$$:: 100 : 180$$
$$\therefore C = \frac{5(F-32)}{9}$$
$$\text{and } F = \frac{9}{5}C + 32$$

BAROMETER SCALES.

Atmospheric pressure = 760 mm. of mercury = 29·92 inches of mercury
= 34 feet of water
= 14·73 lbs. to the square inch.

The barometer falls one inch for every 900 feet of ascent above sea level.

Atmospheric pressure and boiling point.

Number of Atmospheres	*Boiling Point*
1	100°C.
$1\frac{1}{2}$	112°C.
2	120·6°C.
3	134°C.
4	144°C.

APPENDIX II

Logarithms

Definition.—A logarithm of a number to a given base is the power to which the base must be raised to make it equal to the number.

Example : - the logarithm of 100 to the base 10 is 2, as 2 is the power to which 10 must be raised to equal 100, thus

$$10^2 = 10 \times 10 = 100$$

This is written $\log.\ 10^{100} = 2$

also $\log.\ 10^{10} = 1$

In common logarithms which are used in vital statistics the base is always 10 ; so it is omitted, thus

$\log.\ 10$ means $\log.\ 10^{10}$.

The advantage of using logarithms is that

(*a*) multiplication of numbers can be done by adding their logarithms, thus :

$$\log.\ (a \times b) = \log.\ a + \log.\ b.$$

(*b*) division of numbers can be done by subtraction of their logarithms, thus :

$$\log.\ \left(\frac{a}{b}\right) = \log.\ a - \log.\ b.$$

(*c*) the squaring, cubing, etc., of numbers can be done by the multiplication of the logarithms, thus :

$$\log.\ a^n = n \log.\ a$$

(*d*) extraction of square roots, cube roots, etc, can be done by the division of their logarithms, thus :

$$\log.\ \sqrt[n]{a} = \frac{\log.\ a}{n}$$

Use of Logarithmic Tables.—A logarithm consists of two parts : the *characteristic* and the *mantissa*. The former comes before the decimal point and the latter after it Only the mantissa is given in the tables.

The mantissa of a logarithm is always the same when the figures of the number whose logarithm is required are the same. The characteristic is always one less than the number of figures before the decimal point.

Example : log. 10145 $= 4\cdot0062521$
log. $1014\cdot5 = 3\cdot0062521$
log. $101\cdot45 = 2\cdot0062521$
log. $10\cdot145 = 1\cdot0062521$
log. $1\cdot0145 = 0\cdot0062521$

Tables of logarithms giving the logarithms of all numbers upto five figures are sufficient for the purpose of calculation in vital statistics.

Where a number contains more than five figures, such as 101455, find the log. of 101450 and 101460.

log. $101460 = 5\cdot0062949$
log. $101450 = 5\cdot0062521$
The difference $= \cdot0000428$

$\therefore$ an increase of 10 in the number produces an increase of 0000428 in the logarithm ; what will an increase of 5 produce ?

$10 : 5 :: \cdot0000428 : x$

$$\therefore x = \frac{5 \times \cdot0000428}{10} = \cdot0000214.$$

$\therefore$ log $101455 = 5\cdot0062521 + 0000214 = 5\ 0062735.$

Conversely, if the logarithm of a number is known and is not given exactly in the tables and the nnmber which corresponds to it is required, find in the tables the logarithms between which it lies and find the difference. As this difference is to the difference between the given logarithm and the one immediately below it in the table so is the difference between the two numbers corresponding to the logarithms to the answer.

Example : Find the number corresponding to the logarithm $3\cdot0062735$.

The mantissæ found in the table between which this logarithm lies are

$\cdot0062949$, its number being $1014\cdot6$
and $\cdot0062521$, its number being $1014\cdot5$
Diff. $= \cdot0000428$ Diff. $= \cdot1$

As the characteristic is 3, the number must have four figures before the decimal point, in other words the decimal point is placed after the fourth figure.

Now, the difference between

$\cdot0062735$ and $\cdot0062521$ is $\cdot0000214$,

$\cdot0000428 : \cdot0000214 :: 0\cdot1 : x$

$$\therefore x = \frac{\cdot0000214 \times 0\cdot1}{\cdot0000428}$$

$= \cdot05.$

$\therefore$ the number corresponding to the logarithm

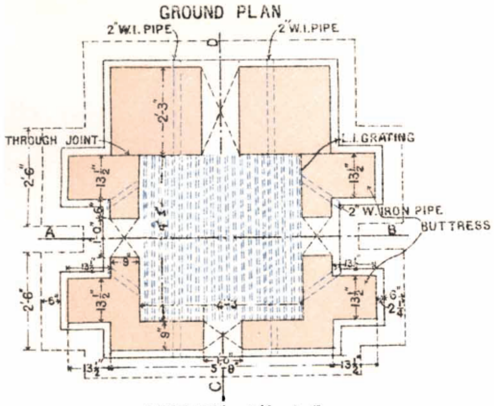
$$3{\cdot}0062735 = 1014{\cdot}5 + {\cdot}05$$
$$= 1014{\cdot}55.$$

The above short description contains sufficient information about logarithms to enable a medical officer of health to estimate the population of an area at any given time by the method employed by the Registrar-General in England.

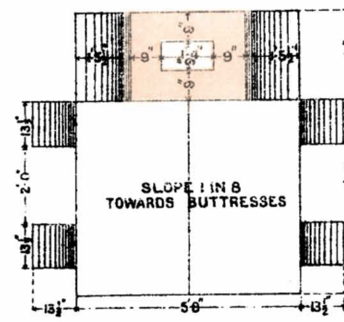
Appendix III-i.

TYPE DESIGN
OF
INCINERATOR
FOR PLAINS
(CHEAP PATTERN).

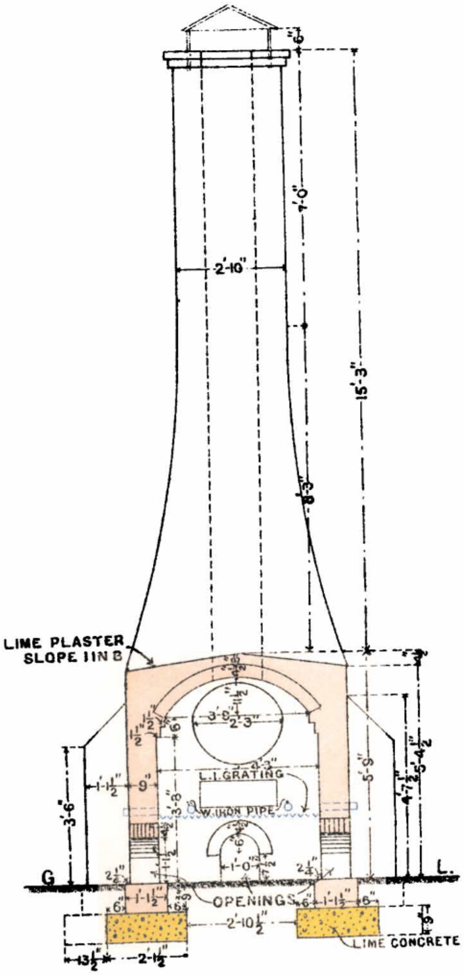
GROUND PLAN



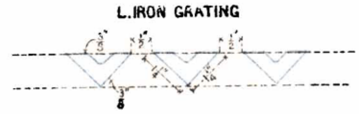
TOP PLAN



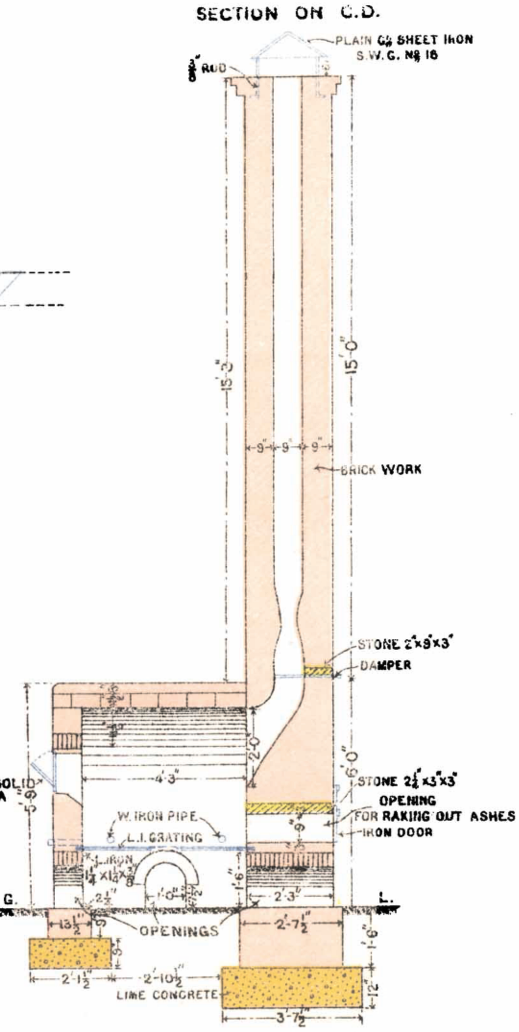
SECTION ON A.B.



L. IRON GRATING



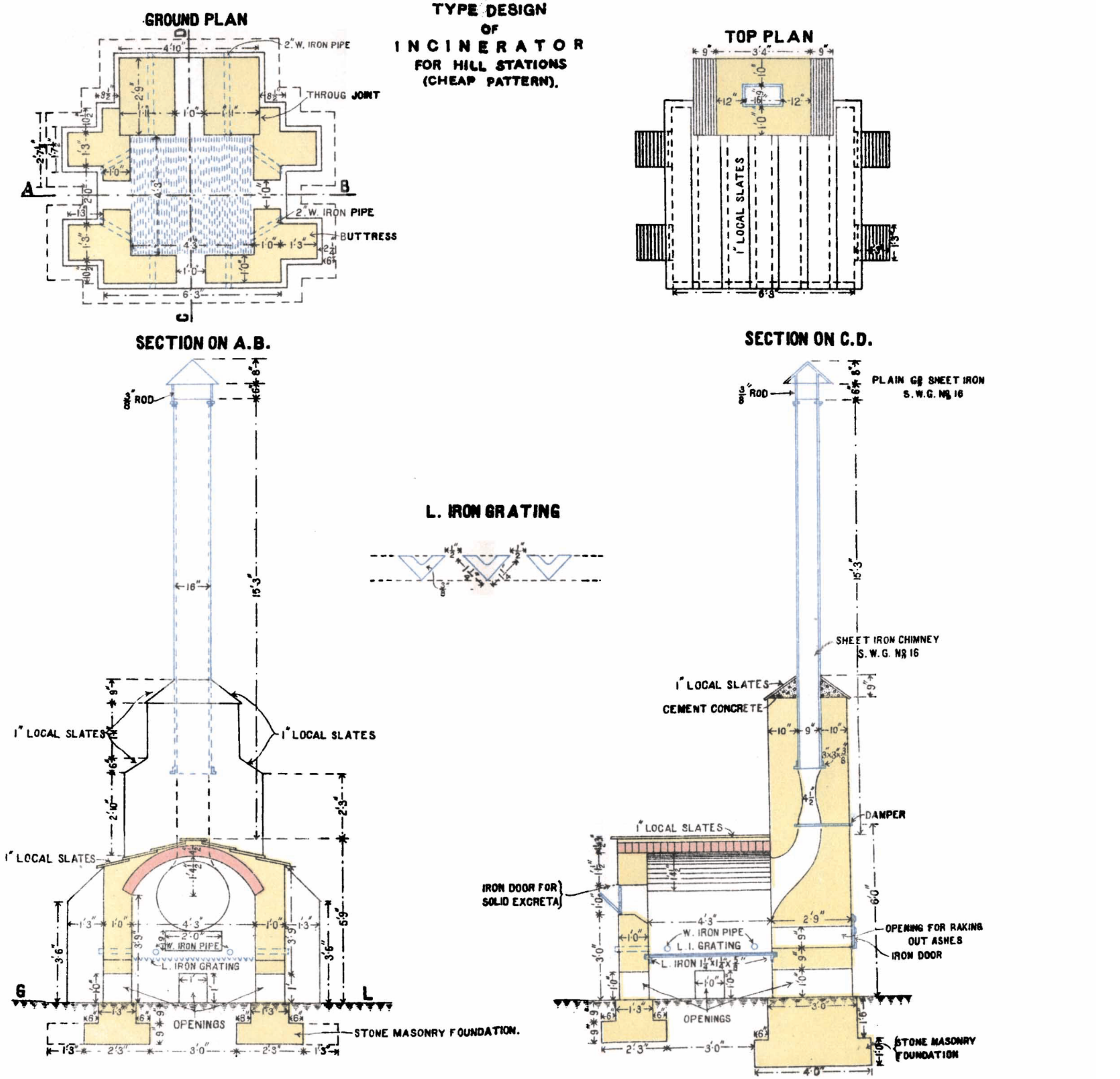
SECTION ON C.D.



G. McO. HOEY,
Superintending Engineer, Public Health Department,
United Provinces.

Photo. Zinco. January, 1925.—No. 1211. 2060.

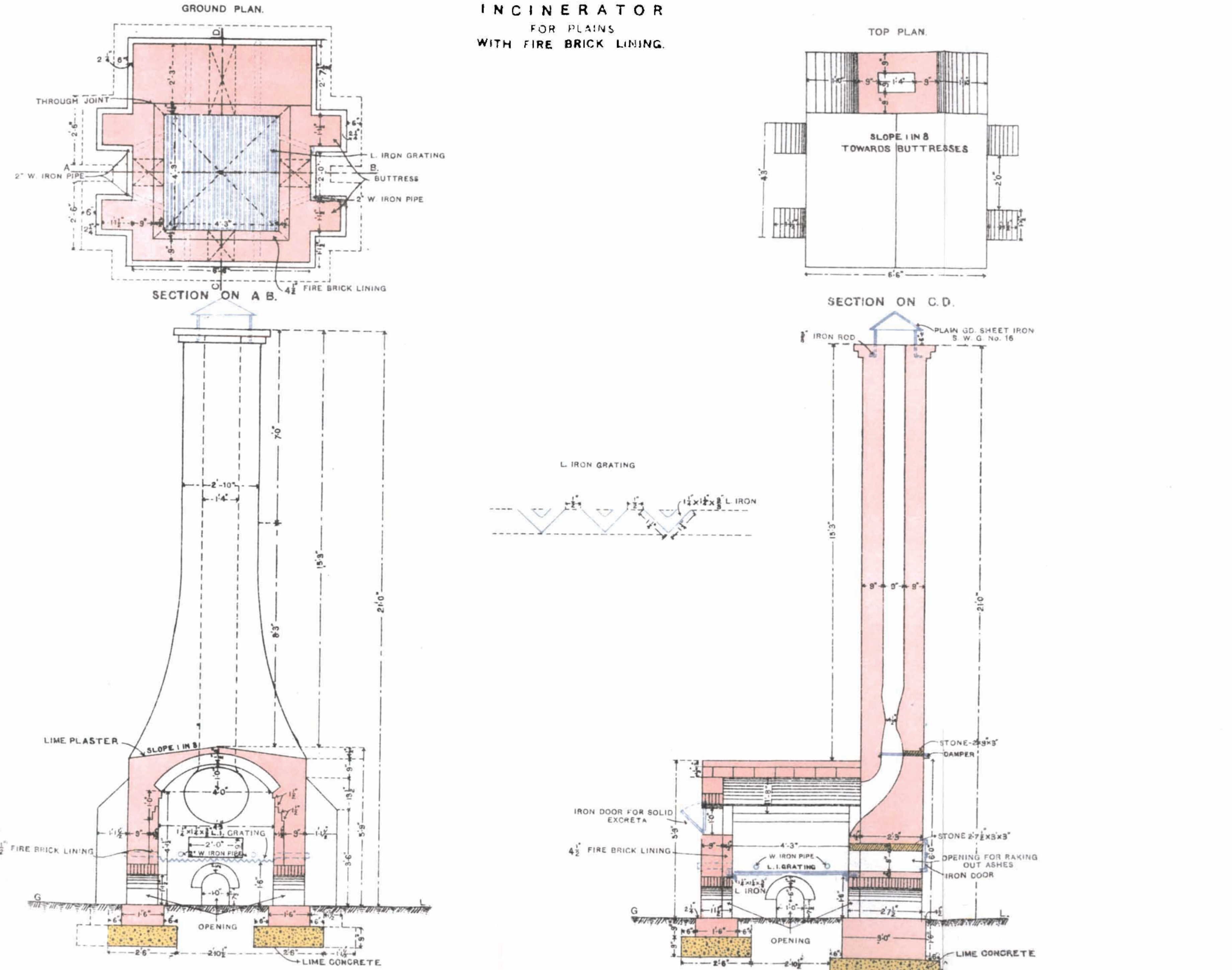
Appendix III-II.
TYPE DESIGN
OF
INCINERATOR
FOR HILL STATIONS
(CHEAP PATTERN).



G. McC. HOEY,
Superintending Engineer, Public Health Department.

Appendix III-iii.

TYPE DESIGN OF INCINERATOR FOR PLAINS WITH FIRE BRICK LINING.

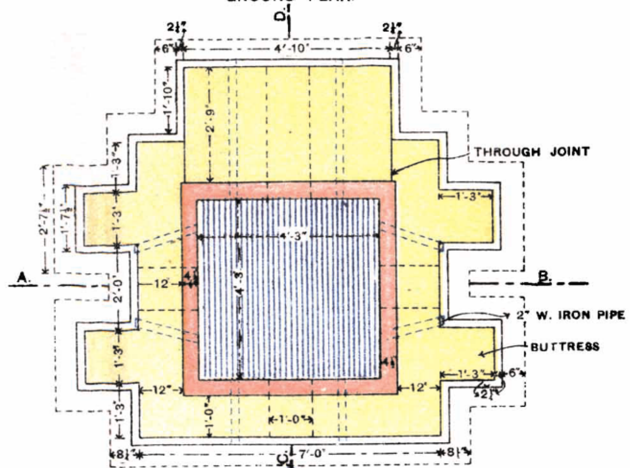


G. McC. HOEY,
Superintending Engineer, Public Health Department, United Provinces

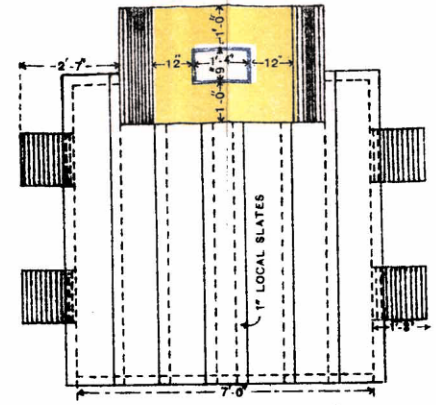
Photo. Zinco., May, 1925 —No. 1211-2.2060

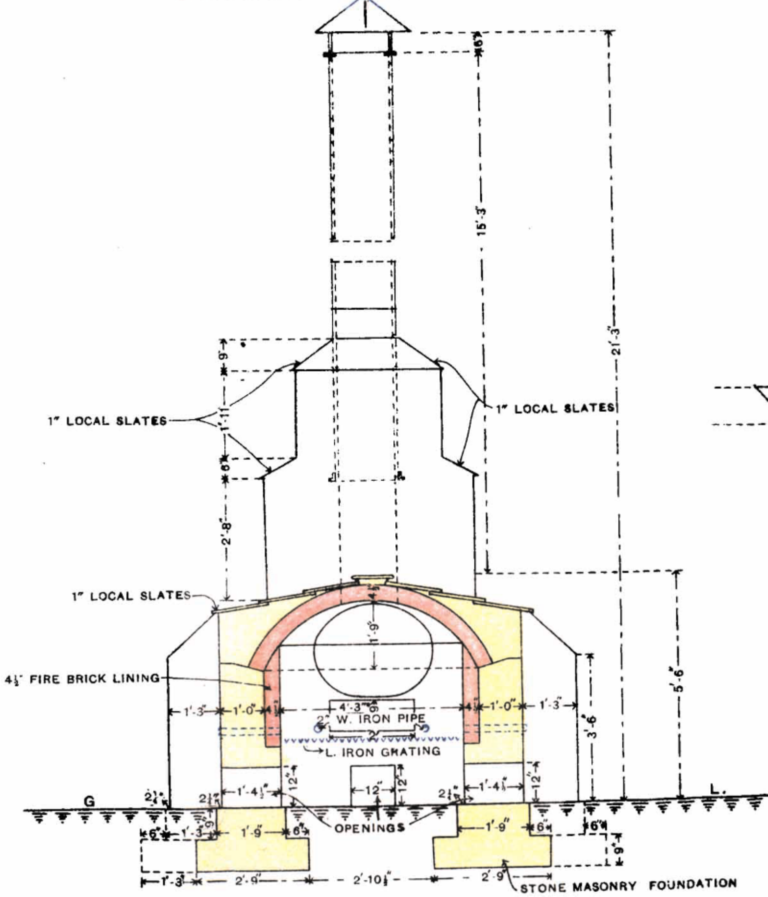
Appendix III-iv.
TYPE DESIGN
OF
INCINERATOR
FOR HILL STATIONS WITH FIRE BRICK LINING

GROUND PLAN.



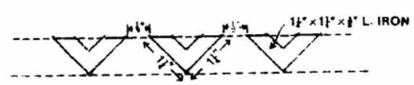
TOP PLAN

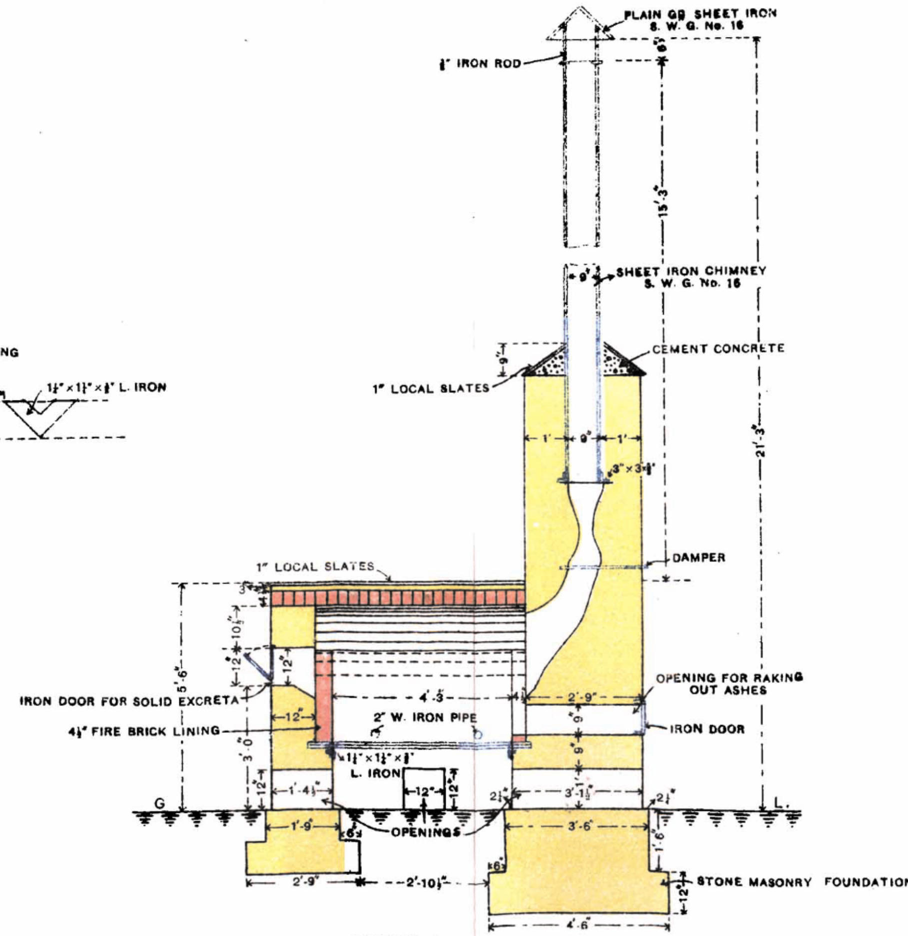




SECTION ON A B.

IRON GRATING





SECTION ON C D.

No.12II-3.2060

G. McC. HOEY,
Superintending Engineer, Public Health Department, United Provinces.

APPENDIX IV

Standard of appliances in towns with water-borne system.

1. *Latrine seats.*—For the calculation of seats the town cannot be taken as a whole, as in some areas inhabited by well-to-do people private latrines abound, whereas in poorer quarters a greater number of people use the public latrines, so the two areas should be taken separately.

(*a*) Where privies do not abound.

(*b*) Where privies abound.

Five minutes on an average are taken by each person for using a latrine at a time.

This gives roughly 12 persons per seat per hour. As a rule the latrines are ordinarily used for four hours in the morning and generally the same persons use the latrines in the evening, and hence the number of persons using the latrine in the evening is not to be taken into account.

If 12 persons take an hour per seat, 50 will take four hours per seat.

On the basis of this, it has been found that in *places where private latrines do not abound* or there are only a few houses with privies, one seat for every 100 to 150 of population is sufficient.

For areas where private latrines abound.—The number of houses having privies should be found out and the population of these houses should be calculated by multiplying the total number of such houses by five. This will give the population who do not use public latrines. After deducting this figure from the total population the number of persons who need public latrines can be estimated. The seats should be calculated for this number only on the standard suggested above.

2. *Urinals.*—One seat for every 500 to 600 of population should be provided. Their sites should be fixed at suitable spots, i.e., at convenient places where they are principally required. No separate staff is required on them.

3. *Night-soil carts.*—Night-soil carts are not required in a sewered area, as water-flushed latrines and pail-dépôts ought to be provided in such places.

4. *Sullage carts.*—These are not needed in a sewered area.

5. *Rubbish carts.*—There is no decrease in the number of these carts by adoption of the water-borne system. On an average one cart for 2,000 of population or five carts for 10,000 should be provided.

The number of carts required will vary according to the distance of the dumping ground. The lead generally is 8 to 9 miles daily and the trips and the number of carts can be calculated accordingly. One cart for every 1,500 to 2,000 of population is recommended.

6. *Silt carts on sewers.* These are required for removing silt from detritus pits, manholes and house connections.

In Benares, which is the only more or less completely sewered town in the United Provinces, there are 36 miles of sewers and 72 carts are required for the removal of silt. This comes to two carts for every mile of sewer.

In Cawnpore there are only six silt carts. It is impossible to fix their number for a sewered area. It depends on the local conditions, such as the following :—

(1) The number of house connections
(2) Density of population.
(3) Whether sewer carries for storm water in addition to sewage.

The proposed standard of establishment for municipalities with water-borne system.

(1) *On latrine seats.*—One female sweeper is sufficient for cleaning a latrine of 24 seats. From 24 to 48 seats one male and one female sweeper should be employed.

(2) *On roads with sullage drains on either side.*—The distance that a sweeper could clean was found to be 20,000 square feet of road (length 1,000′ × 20′ width) *plus* 2,000 l. ft. of drain It is recommended that one sweeper may be employed for every 15,000 square feet of road *plus* 1,500 l. ft. of drain to 20,000 square feet of road and 2,000 l. ft. of drain.

(3) *On roads without sullage drains.*– One sweeper can clean from 30,000 to 50,000 square feet of road daily in congested areas and from 50,000 to 100,000 square feet of road where there is little or no population and the traffic is less.

(4) *On lanes with sullage drains.*—One sweeper can do from 10,000 to 15,000 square feet of lane *plus* 1,000 to 1,500 l. ft. of drain daily.

(5) *On lanes without sullage drains.*—One sweeper can do from 20,000 square feet to 30,000 square feet of lane daily.

In this case the sweeper has to remove the rubbish to a greater distance, as carts cannot enter into lanes and therefore the total amount of area he can clean is less than in the case of roads

(6) *On drains*—One sweeper can clean 3,000 to 4,000 l. ft. of ordinary sized drain daily and in addition one bhisti is required to flush it, if no flushing apparatus has been provided at the head of drain.

(7) *Total establishment on roads, lanes and drains.*—

(*a*) *Sweepers*—A complement of 15 to 20 sweepers on 10,000 of population should be appointed for a place where there are surface drains. For sewered areas without sullage drains the previous standard holds good, i.e., 10 sweepers for 10,000 of the population.

(*b*) *Bhistis*—Bhistis are required to flush surface drains. On a population of 10,000 eight bhistis will be needed.

(8) *Sweepers or beldars on sewers.*—Same remarks as for silt carts apply in this case.

(9) *Rubbish carts.*—There will be one cart driver on each. For a population of 10,000 five carts will be needed.

(10) *On slaughter-houses.*—In every large municipality there are generally two slaughter-houses, one for cattle and the other for goats and sheep. The staff required on one slaughter-house is one sweeper and one bhisti and, if the offal is to be carted, one cart-driver.

(11) *Jamadars.*—One jamadar can supervise the work of 30 sweepers on an average. On 10,000 of population three jamadars will be needed, i.e., two on general cleanliness and one on sewers.

Standard af appliances in towns without water-borne system.

(1) *Latrine seats.*—On actual observation it was found that each person took five minutes, and two and a half minutes on an average were taken for cleaning the filth receptacles. Consequently seven and a half minutes are required per user. This, worked out as before, comes to 1 seat per 60 to 80 of population where privies do not abound. This holds good for big towns. This is somewhat more than the standard laid down in the Municipal Manual before but it is well known that the number of privies in large towns has largely increased since that standard was fixed and consequently fewer people use the public latrines. For places where privies abound calculate as mentioned under sewered area.

In smaller towns, however, the conditions have not improved as regards the increase in the number of privies and therefore the same standard is given in the Municipal Manual, i.e., 1 seat per 50 to 70 of population as recommended.

(2) *Urinals.* Their number will be as mentioned under sewered area.

(3) *Sullage carts*—The number of these will differ in proportion to the extent of drainage provided.

(*a*) Where surface drains are provided no sullage carts are required.

(*b*) Where cesspools exist, carts are necessary.

The capacity of a sullage cart is generally 75 gallons or 12 c. ft. The number of carts required will depend on the number of trips made by a cart and on the number of cesspools required to be emptied The average quantity of sullage in the cesspools should be ascertained and the number of trips made by a cart each day should also be calculated, the lead being 8 to 9 miles per day. There is economy in having double bullock carts which can carry three times the quantity of sullage removed by a single bullock cart and require only one driver and one filler per cart instead of 3 drivers and 3 fillers. The adoption of double bullock carts is recommended where the roads leading to the site of disposal of sullage are *pakka.*

(4) *Night-soil carts* —In most of the municipalities solids and liquids are separated and this is the system recommended for general adoption.

Solids.—The average quantity of night-soil, excluding urine and ablution water, is 8 c. ft. per thousand persons daily. The amount of night-soil of 10,000 persons will be 80 c ft. This will roughly require seven carts of 12 c. ft. capacity. Find out the lead and the number of trips and calculate as above.

Liquids.—These will consist of ablution water and part of the urine passed in 24 hours ; consequently the quantity to be removed will be about 40 oz. instead of 80 oz per head. Calculate as before on the number of persons for whom latrine seats have been provided.

(5) *Rubbish carts.*—The number will be the same as for sewered area.

The proposed standard of establishment for towns without water-borne system.

1. *On latrine seats.*—One sweeper can clean 10 latrine seats daily. Calculate their number on the number of seats provided

2. *On roads with sullage drains on either side.*—20 to 25 per 10,000 of population.

3. *On roads without sullage drains.*—The same as for sewered area.

For small municipalities where only storm water drains exist the standard given in the Municipal Manual holds good.

4. *On drains.*—The same as for sewered area.

5. *On lanes.*—The same as for sewered area.

6. *On rubbish carts* —The same as for sewered area.

7. *On night-soil carts.*—There will be one cart driver for each cart. No fillers are required.

8. *On sullage carts.*—One driver for each cart will be needed for efficient removal of sullage ; same number of fillers are also required.

9. *On slaughter-houses.*—The same as for sewered area.

10. *On trenching grounds.*—There should be one beldar-sweeper for two carts or one beldar for one double bullock cart.

11. *The number of jamadars for supervision.*—One jamadar will be able to supervise the work of 25 sweepers, so roughly two jamadars will be required on a population of 10,000.

Appliances for water-borne area.

1. Latrine seats.	1. (*a*) One seat for every 100 to 150 of the population where private latrines do not abound. (*b*) Calculate as mentioned above for places where private latrines abound.
2. Urinals.	2. One urinal for every 500 to 600 of the population.
3. Rubbish carts.	3. One cart for every 1,500 to 2,000 of the population.
4. Silt carts.	4. According to requirements.

Requirements per 10,000 of the population.

1. Latrine seats.	(1) Will vary.
2. Urinals.	(2) 16 to 20 urinals.
3. Rubbish carts.	(3) Five carts per 10,000 of the population.
4. Silt carts.	(4) Will vary.

Standard of establishment for water-borne area.

1. On latrines.	(1) One sweeper for every 24 seats preferably a female.
2. (*a*) On roads with side drains.	(2) (*a*) One sweeper from 15,000 sq. ft. of road and 1,500 l. ft. of drain to 20,000 sq. ft. of road and 2,000 l. ft. of drain.
(*b*) On roads without side drains.	(*b*) (i) In congested areas one sweeper on 30,000 to 50,000 sq. ft. (ii) In sparsely populated areas one sweeper on 50,000 to 100,000 sq. ft. of road.
3. Lanes. (*a*) with surface drains.	(3) (*a*) One sweeper for 10,000 to 15,000 sq. ft. of lane and 1,000 to 1,500 l. ft. of drain.

(*b*) Without surface drains.	(*b*) In ordinarily populated areas one sweeper on 20,000 to 30,000 sq. ft. of lane.
4. On surface drains (ordinary size).	(4) One sweeper and one bhisti on 3,000 to 4,000 l. ft. of drain.
5. On pail-dépôts.	(5) One beldar sweeper on each pail-dépôt.
6. On detritus pits.	(6) One beldar, one coolie and one cart driver for every 12 detritus pits.
7. For sewerage (including flushing tanks, manholes, traps and detritus pits).	(7) Will vary according to the requirements of the place.
8. On rubbish carts.	(8) One cart driver for every 2,000 of population.
9. Silt carts (including those required for detritus pits).	(9) Will vary according to the requirements of the place.
10. On slaughter-houses.	(10) One sweeper, one bhisti and one cart driver for every slaughter house.
11. Jamadars.	(11) One jamadar for every 30 sweepers, i.e., two jamadars on general cleanliness and one jamadar on sewers for a population of 10,000.

Staff required per 10,000 *of population.*

1. Latrines.	(1) Sweepers—Calculate their number as mentioned above.
2. (*a*) Roads, lanes with drains.	(2) (*a*) 15 to 20 sweepers.
(*b*) Roads and lanes only.	(*b*) Ten sweepers.
3. Drains.	(3) Eight bhistis.
4. Cart drivers on rubbish carts.	(4) Five drivers.
5. ,, on silt carts.	(5) Will vary.
6. Staff on sewers (including flushing tanks, detritus pits, manholes and traps).	(6) Will vary.
7. Slaughter-houses.	(7) Two sweepers, two bhistis and two cart drivers on two slaughter-houses.
8. Jamadars.	(8) Three jamadars.

*Staff of sweepers.	One sweeper per 125 to 150 of population.

**Summary of sweepers for* 10,000 *of population.*

	Minimum.			Maximum.	
1	3	...	...	... 4	
2	15	...	...	... 20	
4	5	...	...	... 5	
5	5	...	...	... 5	will vary.
6	30	...	...	... 40	will vary.
7	4	...	...	... 4	
Total sweepers	62			78	

Conservancy appliances for unsewered towns.

1. Latrine seats.	(1) (*a*) One seat for every 60 to 80 of the population where privies do not abound. (*b*) Calculate as mentioned above for places where privies abound.
2. Urinals.	(2) One seat for every 500 to 600 of the population.
3. Night-soil carts.	(3) One single cart for every 2,500 of the population or one double cart for every 5,000 of the population.
4. Sullage carts.	(4) Calculate as stated above.
5. Rubbish carts.	(5) One cart for every 2,000 of the population.

Requirements per 10,000 *of population.*

1. Latrine seats.	(1) (*a*) 125 to 166 seats where privies do not abound. (*b*) Will vary.
2. Urinals.	(2) 16 to 20 urinals.
3. Night-soil carts.	(3) Will vary—generally 4 single or 2 double bullock carts are required.
4. Sullage carts.	(4) Will vary according to requirements.
5. Rubbish carts.	(5) Five carts.

Conservancy establishment for unsewered towns.

1. On latrines.	1. One sweeper for every 10 seats.
2. On roads (*a*) With side drains for sullage.	2. (*a*) One sweeper for 15,000 sq. ft. of road and 1,500 l. ft. of drain to 20,000 sq. ft. of road and 2,000 l. ft. of drain.
(*b*) Without side drains.	(*b*) (*i*) In congested areas one sweeper for 30,000 to 50,000 sq. ft. of road. (*ii*) In sparsely populated areas one sweeper for 50,000 to 100,000 sq. ft. of road.
3. On lanes (*a*) With side drains.	3. (*a*) One sweeper for 10,000 to 15,000 sq. ft. of lane and 1,000 to 1,500 of drain.
(*b*) Without side drains.	(*b*) One sweeper for 20,000 to 30,000 sq. ft. of lane.
4. On drains (ordinary size).	4. One sweeper and one bhisti to every 3,000 to 4,000 l. ft. of drain.
5. On rubbish carts.	5. One driver on each cart.
6. On night-soil carts.	6. One driver on each cart.
7. On sullage carts.	7. One driver on each cart.
8. On slaughter-houses.	8. One sweeper, one bhisti and one cart driver on each slaughter-house.
9. On trenching ground.	9. One beldar for 2 single carts or one for one double cart.
10. Jamadars.	10. One Jamadar on 25 sweepers.

Staff required per 10,000 of population.

1. Latrines.	*Sweepers.* Calculate their number as mentioned above.
2. (*a*) Roads, lanes with drains.	(*a*) 20 to 25.
(*b*) Roads and lanes.	(*b*) Same as for sewered areas.
3. Cart drivers on rubbish carts.	(3) Five.
4. „ „ „ night-soil „	(4) Will vary.
5. (*a*) Cart drivers on sullage carts for house cesspools.	(5) (*a*) Will vary.
(*b*) Cart drivers on sullage carts for latrines.	(*b*) Will vary.

6. Slaughter-houses.	(6) Two sweepers, two bhistis and two cart drivers for two slaughter-houses.
7. Trenching ground.	(7) Four sweeper beldars.
8. Jamadars.	(8) Two jamadars.
* Staff of sweepers.	Will vary. A summary of staff of sweepers usually required is given below :—

*

Summary of sweepers.

(*a*) *For unsewered areas with surface drains and flushing.*

	Minimum.	*Maximum.*	
1.	10	15	Will vary.
2.	20	25	
3.	5	5	
4 & 5*b*	4	8	,,
5*a*.	...	...	There will be no cesspools, hence no staff is required for carting sullage.
6.	4	4	
7.	4	4	
Total...	47	61	

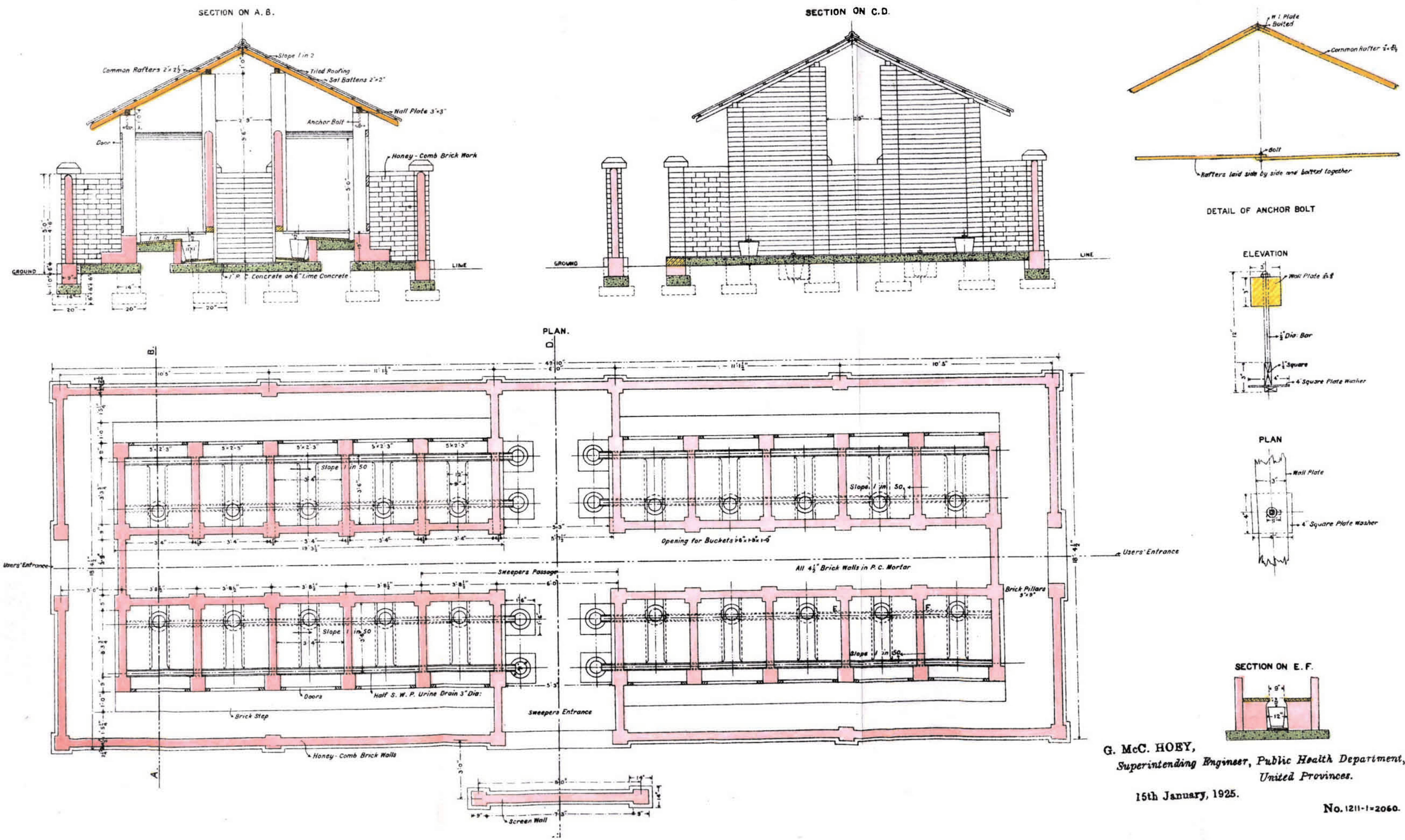
(*b*) *For unsewered areas with cesspools*

	Minimum.	*Maximum.*	
1.	10	15	
2.	10	*12	*In this case sweepers are required on roads and lanes only. A maximum of 12 will be sufficient.
3.	5	5	
4. & 5*b*.	4	8	Will vary.
5*a*.	20	†20	†Fillers have not been taken into account. In Bombay there is a filler and a driver on every cart ; including their number the total will be 77 and 88 respectively. If one filler is engaged for every 2 carts then the minimum total staff will be 67.
6.	4	4	
7.	4	4	
Total...	57	68	

Note.—Existing standard is 50 to 70 sweepers for all purposes.

APPENDIX 5.

TWENTY SEATED LATRINE.



G. McC. HOEY,
Superintending Engineer, Public Health Department, United Provinces.

15th January, 1925.

No. 1211-1=2060.

APPENDIX VI

THE STATE BOARD OF MEDICAL EXAMINATIONS, UNITED PROVINCES, INDIA.

DIPLOMA OF PUBLIC HEALTH.

PART I.

Physics, Meteorology and Climatology.

June 13, 1921, 7 to 10 A M.

1. Explain the effect of proximity to the sea, altitude and vegetation on the climate of a district.

2. Why is a barometer reading lower in moist air than in dry air and lower at 8,000 feet than at sea level?

3. The weight of a cubic foot of dry air at 32°F. is 566 85 grains; what is its weight at 80°F.?

4. What is the "dew point" and how is it calculated?

5. How can the velocity of wind be calculated?

Bacteriology and Parasitology.

June 14, 1921, 7 to 10 A M.

1. What are the chief anaerobic micro-organisms and how do you prepare an anaerobic culture?

2. Describe the process of examining a sample of water for faecal contamination.

3 Describe the organism of kala-azar as found in the spleen of man. What is its extra corporeal host?

4. How would you demonstrate the fact that a man is suffering from ankylostomiasis? Describe the process in detail.

5. Describe in detail the pasteurization of milk and indicate what effect it produces in the milk.

Practical Bacteriology.

June 17, 1921, 7 to 10 A.M.

1. Examine the material in the tube marked A. State what you find therein and make plate culture in the presence of the examiner.

2. Stain the emulsion marked B for the presence of spores and describe what you find in the specimen.

3. Stain the blood film marked C by Leishman's method and describe what you find therein.

Leave the finding focussed under the microscope.

4. Identify the specimens Nos. 1, 2, 3, 4, 5, 6, 7 and 8.

Chemistry—Practical.

June 15, 1921, 7 to 11 A.M.

1. Examine the sample of water marked A and write a full report as regards its fitness for domestic use, giving reasons.

2. Examine microscopically the contents of the packet marked B for adulteration.

3. Estimate by Werner-Schmidt process the number of grammes of fat in 100 c.c. of the sample of milk marked C.

PART II.

Hygiene.

Paper I

June 23, 1921, 7 to 10 A.M.

1. What are the chief impurities in the air of towns and what are the sources of these impurities? How much Co_2 does an ounce of low grade oil give off and how much does a male adult at rest?

2. What are the chief diseases of cattle for slaughter which can be detected by an examination of meat at the slaughter-house?

3. How would you, apart from sand filtration, advise a board to deal with a river water containing (a) algæ, (b) a large amount of sediment, (c) peaty acids.

4. How is an epidemic of cholera usually originated in a district or town; how does it spread and what steps would you take to stop the epidemic.

5. What advice would you give a local authority in order to abate the nuisance arising from the offensive trades of (a) bone boiler (b) blood boiler and (c) gut scraper.

Hygiene.

Paper II.

June 24, 1921, 7 to 10 A.M.

1. What is immunity and how is it produced in the body? Describe the constituents of the blood concerned with immunity.

2. Give the life history of the benign tertian parasite in the mosquito and in man.

3. What is the approximate geographical distribution of the following infectious diseases in India :—

Relapsing fever, Typhus fever and Kala-azar?

4. Describe and draw a sketch of an infectious diseases hospital containing accommodation for the treatment of different diseases with special reference to the disposal of fomites.

5. How is the population of a town estimated for the middle of any year.

If the population was 100,000 in 1911 give the formula for the estimated population in the middle of 1914.

Sanitary Law.

Paper I.

June 25, 1921, 7 to 10 A.M.

1. What are the rules given in the Municipal Manual for the disinfection of materials?

2. How would you proceed by law to compel an occupier of a house to abate a nuisance in his own private ground?

3. Describe a model dairy according to the bye-laws.

4. What are the model bye-laws governing the sale of meat?

5. What are the model bye-laws regarding burial grounds?

Sanitary Law.

Paper II.

June 27, 1921, 7 to 10 A.M.

1. What are the measures to be taken in the Districts under the cholera scheme when an outbreak occurs?

2. What are the duties of a Deputy Sanitary Commissioner in charge of a fair?

3. What are the duties of the Civil Surgeon or District Health Officer in connection with vaccination inspection.

4. What are the duties of Health Officers under the Adulteration of Food and Drugs Act ?

5. What are the model bye-laws for the storage of hide and skins for tanning ?

Sanitary Engineering.

Paper I.

June 28, 1921, 7 to 10 A M.

(20 full marks for each question).

1. What conditions would you expect to find in a storm water channel in an area where the subsoil water level is high ?

What improvement would you suggest for such a channel through a populated area ?

2. What circumstances are necessary for the success of a tube well ?

A tube well affords a supply of one hundred gallons per minute when depressed by pumping to a depth of fifteen feet ; what depression would you expect with a supply of 200 gallons per minute from this well ?

3. Enumerate briefly the effects of storage on crude water.

4. Describe the process of slow sand filtration and state what the usual rates of filtration are in these Provinces.

5. Sketch and describe the working of a common type of lift and force pump.

Sanitary Engineering.

Paper II.

June 29, 1921, 7 to 10 A.M.

(20 full marks for each question).

1. In sewage treatment, compare the relative merits of continuous and quiescent settlement.

2. What factors govern the grade at which a sewer should be laid ?

3. What are the main points requiring attention in specifications for first class glazed stoneware pipes and fittings ?

4. During construction, explain how and where you would set about testing a pipe drain.

5. Sketch and describe the use of a good type of manhole intercepting trap.

Out-door Inspection.

June 30, 1921, 7 to 11 A.M.

Visit the house in......Street and make such observations and notes as may be required for drawing up a sanitary report.

Return to the examination hall at the King George's Medical College, Lucknow, before 8 A. M. and draw up the report. You will be allowed 3 hours for this.

The report must include a statement of any action you would recommend to be taken, your reasons for such recommendations, and the powers under which the necessary action may be carried out.

PART I.

Physics, Meteorology, Climatology, Air and Ventilation.

November 7, 1921, 10 A.M. to 1 P.M.

1. What is the effect of heat on the body metabolism ?
2. What is a hygrometer ? Describe one in common use.
3. What are the effects of high atmospheric pressure on the human organism ?
4. How is air vitiated in over-crowded areas ?
5. What is the plenum system of ventilation ?

Bacteriology and Parasitology.

November 8, 1921, 10 A. M. to 1 P. M.

1. What are the chief pathogenic bacteria found in meat which is unfit for human consumption ?
2. What are the cultural reactions and sugar reactions of *Bacillus paratyphosus* A and B ?
3. What is the organism of Syphilis ? Describe the Wassermann reaction.
4. What are the common pathogenic organisms found in the throat ? How is the diphtheria bacillus differentiated ?
5. Describe the life history of *Tænia solium.*

Practical Chemistry.

November 9, 1921, 10 A.M. to 2 P.M.

1. Make an examination of the sample of water marked A and write your opinion as to its fitness for domestic use, giving reasons. (State the letter on the bottle).

2. Examine the sample of ghee marked B with the aid of Jean's Oleorefractometer in the presence of the examiner and give your opinion as to its purity.

3. Identify the disinfectants in the solutions marked C and D.

Practical Bacteriology.

November 10. 1921, 10 A.M. to 1 P.M.

1. Examine and report on the culture marked A.
2. Make such cultures and carry out such procedures as you may consider necessary to demonstrate the presence of Anthrax in the specimen marked B.
3. Stain and examine the film C and report what you find.
4. Describe briefly and name the microscopical preparations 1-6.

PART II.

Hygiene.

Paper I.

November 14, 1921, 10 A.M. to 1 P.M.

1. Describe the process of slow sand filtration and mention the factors that affect the purity of the filtered water in the process.

2. In a town with a pail system for the removal of fæces and urine, whose population is 50,000, how do you find the amount by weight of night-soil which must be removed daily ?

3. What is the action which takes place in a septic tank and what factors are necessary to ensure satisfactory results from such a tank ?

4. In what trades is lead poisoning likely to occur, and what sanitary precautions would you take to prevent it ?

5. What is a "life table." How is it prepared and what are its objects ?

Hygiene.

Paper II.

November 14, 1921, 2 to 5 P.M.

1. What preventive measures would you take to stop an epidemic of relapsing fever in a village ?

2. What are the requirements of a class room for scholars in a middle school ?

3. What are the chief diseases which scholars in a primary school in India suffer from ? For which of these diseases would you exclude them from attendance ?

4. What measures can a trained "dhai' take at present in Indian towns to reduce the infantile mortality ?

5. What measures would you advise to reduce the death rate from respiratory diseases in Indian towns ?

Sanitary Law.

November 16, 1921, 10 A.M. to 1 P.M.

1. What are the duties of a Medical Officer of Health, as laid down in the Municipal Manual ?

2. What are the model byelaws regulating the registration and compilation of births and deaths ?

3. What are the model byelaws regulating the manufacture and sale of ærated water ?

4. What are the model byelaws regulating the storage of bones ?

5. What are the provisions of the Municipalities Act regulating the removal to hospital of patients suffering from infectious diseases ?

Minor Sanitary Engineering.

November 17, 1921, 10 A.M. to 1 P.M.

1. Explain what is meant by lowland sources of water supply and state what out-standing characteristics are usual in such waters.

2. In a case where samples of town water in a piped supply are found to be unsatisfactory, explain what steps you would take to trace out the source of contamination.

In an intermittent pumped supply where impure samples are only obtained from standposts and private connections and not from the clear water reservoir, what would you consider to be the most likely cause ?

3. What is meant by the terminal head on a distribution main ; how is it measured and what is the usual head in towns in the United Provinces ?

4. Describe any method you are conversant with for measuring the turbidity of water.

5. Describe any method of sewer ventilation with sketches.

6. What are the advantages claimed for Ovoid sections of sewers over ordinary circular sections ?

Out-door Inspection.

November 18, 1921, 10 A. M. to 2 P. M

1. Report on the sanitary condition of the premises shown giving your suggestions with legal support under the municipalities Act, for the same.

2. Draw a sketch of the water flush urinal in use in Lucknow showing its disadvantages and suggest improvements in it.

LUCKNOW UNIVERSITY.

D. P. H. EXAMINATION.—April, 1922.

PART I.

Physics, Meteorology, Climatology, Air and Ventilation.

Time—Three hours.

1. Define the following terms :—Specific gravity, specific heat, latent heat.

2. What are the chief factors which affect atmospheric humidity ?

3. Discuss the effect on bodily health caused by diurnal changes of temperature in the hot weather in Northern India and the physiological changes produced by the great variation in temperature.

4. What system of ventilation would you propose for a new council chamber in Lucknow in which sittings are held in the hot as well as the cold weather, giving your reasons for the choice ?

5. What are the chief chemical impurities in the air of an overcrowded quarter of an Indian town and whence are they derived ?

Bacteriology and Parasitology.

Time—Three hours.

1. Describe the process of disinfection by steam under pressure and state how you would satisfy yourself that the disinfection is satisfactory.

2. Describe the causative organism of relapsing fever and give its life-history in full.

3. Describe the method of demonstrating the presence of the cholera vibrio in a sample of fæces with confirmatory tests.

4. Describe the Widal reaction for demonstrating the presence of anti-typhoid bodies in the blood stre.m.

5. What is an antitoxin ? how are they prepared in the laboratory ?

Practical Bacteriology.

Time—Three hours.

1. Prepare stained films from growth in tube "A" and examine microscopically and describe what you find.

2. Make agar plate cultures from the mixture of organisms in tube "B" in the presence of the examiner and describe the micro-organisms you find in it.

3. Water sample in tube "C" is to be examined bacteriologically. The different steps of the technique adopted must be shown to the examiner.

4. Identify the specimens numbers 1 to 8 under the microscope.

Practical Chemistry.

Time—Four hours.

1. Examine the sample of water "A" both qualitatively and quantitatively, for evidence of animal contamination. Write a full report giving your reasons as to its fitness for domestic purposes.

2. Estimate the amount of available chlorine in the disinfectant marked "B."

3. Identify the preservative in the sample of milk marked "C".

PART II.

Hygiene.

Paper I.

Time—Three hours.

1. What impurities would you expect to find in :—(*a*) Water from a shallow well in a village ? (*b*) A river water pumped up into a settling tank ? (*c*) An upland surface water in the hills ?

2. Describe in detail a sewage and sullage farm for a town of 50,000 inhabitants.

3. Describe an up to date disinfecting station for a large town.

4. What are the essentials of a small municipal infectious diseases hospital ?

5. How would you advise a municipal board to deal with the effluent from a sugar factory in an unsewered area ?

Hygiene.

Paper II.

Time—Three hours.

1. How is immunity supposed to be produced in the human body against infection by a specific organism ?

2. What measures would you take to control an epidemic of influenza in a town ?

3. Discuss the value of vital statistics in relation to public health work.

4. What are the chief causes of infantile mortality in an Indian city and what measures would you propose to a municipal board to ameliorate these causes ?

5. How would you prepare an autogenous vaccine for typhoid fever ?

Sanitary Law.

Time—Three hours.

1. What pleas in defence of prosecutions are barred under the Prevention of Adulteration Act ?

2. What are the rules governing the extension of the Vaccination Act to municipalities ?

3. What are the model byelaws in the Municipal Manual regulating places used for the preparation and storage of gut ?

4. Detail the powers of the District Magistrate to prevent outbreak or spread of infectious disease under the Village Sanitation Act ?

5. What powers are given to a Municipal Board under the Municipalities Act with reference to the filling up or draining of excavations ?

Minor Sanitary Engineering

Time—Three hours.

1. Describe by means of sketches the action of a hand suction pump and state its limitations.

2. What is meant by "permeability" in soils? With a well in sandy soil, describe what would happen if the water is lowered progressively by continuous pumping.

3. Give a dimensioned sketch and explain how you would make a joint in a six-inch glazed earthenware pipe.

4. Before passing as satisfactory a newly constructed length of piped drain, what tests would you insist upon?

5. What factors influence a decision to recommend sewage farming as the best system for sewage disposal, to a Municipality?

6. Give a longitudinal sketch of a settling tank shewing weir inlet, scumboards, baffles and outlet, with arrangements for self-sludging.

7. Compare the outstanding characteristics of Portland Cement, Kankar Lime and White Lime, and state their several uses.

8. What timber would you recommend
   (*a*) For a well curb?
   (*b*) For rafters?

9. Draw to scale the plan and elevation of a tetrahedron, edges two inches in length, with one edge parallel to the planes of projection.

10. A circular well is eight feet internal diameter with masonry steining two feet thick. How many cubic feet of masonry are required for its construction per foot of height.

D. P. H. EXAMINATION—October, 1922.

PART I.

Physics, Meteorology, Climatology, Air and Ventilation.

Time—Three hours.

1. What is the effect of heat upon a gas, a liquid and a solid respectively?

2. State briefly the different factors which determine the climate of a place and discuss their influence on the health of its inhabitants. What special factors influence the climate in the different seasons in the United Provinces?

3. Explain how the percentage of moisture in the atmosphere is usually calculated and state how it varies with the atmospheric pressure.

4. What are the dangerous gases to life and under what circumstances may they be met with in an industrial town?

5 State your opinion as to cubic space per individual required in (a) modern dwelling houses, (b) soldiers' barracks, (c) lodging houses, (d) general hospitals and (e) infectious diseases hospitals. How would you calculate the amount of fresh air required ?

Bacteriology and Parasitology.

Time—Three hours.

1. What is Malta fever and how is it caused and propagated ?

2. Describe the morphological and cultural characteristics of *Bacillus Coli communis* and *Bacillus Shiga* and *Flexner* of dysentery.

3. A suspected case of bubonic plague having died, give the details of the necessary steps for making a complete bacteriological diagnosis.

4. Describe briefly the characteristics of the food poisoning group of bacilli and state shortly the symptoms produced by each.

5. What are (a) toxin, (b) antitoxin, (c) vaccine and (d) antiserum. Give examples of each

Describe shortly how to prepare an antistaphylococcic vaccine,

Practical Bacteriology.

Time—Three hours.

1. A pure culture of pathogenic bacteria A is supplied. Examine the growth and then prepare stained microscopical specimens. Describe and name the organism you find.

2. Make a plate culture after adding 1 c.c of the water sample B to the medium in the presence of the examiners.

3. Stain, examine, describe and name the film marked C.

4 Identify the specimens 1-10 under the microscope.

Practical Chemistry.

Time—Four hours.

1. Estimate the following in parts per 100,000 in the sample of water A, and write a report as to its value for drinking and domestic purposes :

(*a*) Chlorine.

(*b*) Hardness.

(*c*) Total solids.

(*d*) Free ammonia.

(*e*) Albuminoid ammonia.

(*f*) Oxygen absorbed in two hours.

2. Examine the sample of milk B for total solids and fat and determine its specific gravity. Give your opinion as to the quality of the milk.

3. Estimate the percentage of available chlorine in the sample of bleaching powder marked C.

4. Identify the grains used in adulteration of the samples of wheat flour marked D and E.

PART II.

Hygiene.

Paper I.

Time—Three hours.

1. What are the chief diseases carried to man by an impure water supply? How would you protect your source of supply in an Indian village and render it safe in time of epidemics?

2. What are the dangerous trades associated with anthrax? How does it affect man and how is it usually transmitted?

3. What are the dangers of tuberculosis in cattle? Which parts would you specially inspect in a carcase of animal suspected to be tuberculous?

4. Describe fully and illustrate by a sketch the kind of water-closet you would recommend for use in a primary school with a daily attendance of 100 pupils, and state the amount of water required per head per diem and the capacity of cistern.

5. Describe the aspects of a relapsing fever outbreak in an Indian town.

How would you stamp out the epidemic?

Hygiene.

Paper II

Time—Three hours.

1. Describe shortly a modern sewerage system for a large town.

2. Describe shortly the sanitary arrangements you would recommend for a large mela of several lacs of pilgrims.

3. What are the principal measures at our disposal for the disinfection of (*a*) a house (*b*) clothing (*c*) stools and other discharges, and discuss the efficiency of the various measures proposed.

4. In what ways may Asiatic cholera be spread? Mention the preventive measures that should be taken to check its spread in a large factory.

5. How would you examine the vital statistics of a municipality of 100,000 population with a view to acquiring a reasonable estimate of its state of health over a period of 5 years ?

Sanitary Law.

Time—Three hours.

1. State the byelaws that you would suggest to your local authority to regulate the lodging houses in an urban area.

2. Frame byelaws for a soda water factory in a municipality.

3. State the main provisions of the Vaccination Act and give your views with regard to the sections which in your opinion require amending.

4. What powers has a local authority with regard to sanitation in an Act XX town ?

5. What are the cholera rules framed by Government for rural areas in the United Provinces ?

Sanitary Engineering.

Time—Three hours.

1. To what depth of subsoil water level from ground surface would you recommend the use of hand suction pumps, and why ?

2. Describe with the aid of sketches how you would protect a well from surface contamination.

3. What effect has storage on crude water ?

4. Give a dimensioned sketch of a 6" roadside gully, and describe what is meant by "Water Seal".

5. Sketch the method of connecting a house drain to a public sewer.

6. Describe the essential components of a drainage installation for a large residence, where no public sewer exists.

7. Describe the uses of the various kinds of lime and tests you would apply to such before use in building.

8. (*a*) What is the volume of a sphere of four feet diameter ?

   (*b*) Sketch a plan and elevation of an octagonal prism, side one inch and height six inches, with one face parallel o the vertical plane.

D. P. H. EXAMINATION—MAY, 1923.

PART I.

Bacteriology and Parasitology (including Entomology).

Time—Three hours.

1. Describe fully the methods you would employ to examine the pus bacteriologically and state on what evidence you would found a diagnosis of bubonic plague.

2. Describe the morphological and cultural characters of the Cholera spirillum.

State the methods you would adopt to isolate it in a suspected case. By what experiments or other methods would you prove its pathogenic activity.

3. Give a detailed account of the processes employed in the preparation of (*a*) typhoid vaccine and (*b*) tetanus antitoxin. What is the essential difference in the mode of action of these two preparations ?

4. Mention two typical forms of food poisoning and describe the causative organisms in each case.

5. How may flies of the genus Glossina be distinguished from other Diptera ?

Describe in detail the methods you would employ to detect the presence of trypanosomes in a case of sleeping sickness.

Chemistry and Physics.

Time—Three hours.

1. Describe the processes and discuss the rationale of the methods for discovering in a sample of water (*a*) oxygen consuming power and (*b*) oxygen dissolved.

2. Describe briefly the chemical methods for estimating the purity of a sewage effluent and its suitability for discharge into a river.

3. Describe a method for estimating the amount of (*a*) carbonic acid and (*b*) organic matter in a sample of polluted air.

4. How would you estimate the amount of fat (*a*) in milk and (*b*) in butter.

5. How do the following disinfectants act chemically upon putrescent organic matter :

(*a*) Potassium permanganate

(*b*) Bleaching powder.

How would you determine the amount of oxygen and chlorine available in (*a*) and (*b*) respectively.

Practical Bacteriology and Parasitology (including Entomology).

Time—Three hours.

1. Examine macroscopically and microscopically the culture marked "A" and describe fully the characters of the colonies and the nature of the organisms.

2. Make a bacteriological examination of the sample of water marked "B" for the determinatiou of a total count in the presence of the examiners.

3. Examine the specimen of pus marked "C".

4. Examine the specimen of fæces marked "D".

5. Examiue and report on the microscopical specimens numbered 1—6.

Practical Chemistry.

Time—Four hours.

1. Examine the sample of water provided

    (*a*) qualitatively for

    1. Nitrates
    2. Nitrites
    3. Poisonous metals

    (*b*) quantitatively for

    1. Chlorides
    2. (*i*) Free and saline ammonia (*ii*) Albuminoid ammonia.

Give your opinion as to its suitability for drinking purposes.

2. Examine the sample of milk provided and state your opinion as to its quality.

3. Determine the percentage of available chlorine in the sample of bleaching powder marked "A".

4. Examine microscopically and report upon the composition of the samples of starches in packets marked "B" and "C".

D. P. H. EXAMINATION—APRIL, 1924.

Part II.

Hygiene.

Paper I.

Time—Three hours.

1. Describe the method of purification of river water by means of sand filtration. Mention the conditions necessary to obtain the most efficient results. What bacteriological standard would you adopt for judging the efficiency of results ?

2. How may a fell-monger's yard be rendered as little offensive as possible ?

3. What are the main points to observe in inspecting a carcase of an animal intended for sale as food for human consumption ?

4. What steps would you take to reduce the number of house flies in a town ?

5 Discuss the value of chlorine group of disinfectants and the chemical properties in virtue of which they act. State the advantages and disadvantages of each.

Hygiene.

Paper II.

Time—Three hours.

1. How would you dispose of the night-soil of a small town ?

2. Describe the epidemiology of enteric fever and specify the steps you would take in the investigation of an outbreak of the disease in a boarding school.

3. Describe briefly how you would proceed to carry out a malarial survey of a small town.

4. What are standard death-rates ? State by what method and for what purposes these rates are calculated.

5. Insanitary area—In condemning such an area mention the various directions in which a study of the mortality might assist your object, and give a general description of structural conditions and sanitary defects which would justify your action.

Sanitary Law.

Time—Three hours.

1. What powers exist for the control of burning grounds and prescribing routes for the removal of corpses to burial or burning grounds ?

2. State shortly the legal advice which a Medical Officer of Health should give to a Sanitary authority of a large town threatened with

   (*a*) an epidemic of plague,

   (*b*) an epidemic of small pox.

3. What are the chief provisions of the model bye-laws with reference to the proper regulation of lodging houses ?

4. Summarise the existing legal powers of a Municipal Board to deal with the adulteration of 'Ghee'. How do they require modification ?

5. Mention the chief sanitary provisions of the Indian Factories Act, 1911.

Sanitary Engineering.

Time—Three hours.

1. Describe what is meant by the maturing of a filter-bed and why it is necessary to prevent rapid variation in heat on a filter-bed.

2. Describe the action of a strainer in a tube well. In what kind of strata is a strainer used ?

3. Sketch a cross section of a 24″ circular brick sewer in bad ground and state what work is essential for sound construction.

4. For what purpose is a liquefying tank used in sewage disposal and what are its limitations ?

5. (*a*) What do you consider to be the safe minimum depth for foundations of walls of ordinary dwelling houses in the plains of the United Provinces ?

   (*b*) Sketch such a foundation, showing the width, depth and height of wall below ground level.

6. Where would you use the following :—lime, cement and mud mortar ? Compare their relative advantages ?

7. How can you discriminate between "fat lime" and "hydraulic lime" ?

8. Write short notes on damp-proof course, ballast, surkhi, first class masonry and asphalt.

D. P. H. EXAMINATION—APRIL, 1925.

PART I.

Chemistry and Physics.

Paper I.

Time allowed—Three hours.

Maximum Marks—50.

1. What are the physical and chemical characters of a good drinking water?

Indicate the limits of safety which would enable you to classify a water as (*a*) potable or usable, (*b*) suspicious, (*c*) unfit for human consumption.

2. Describe briefly the standards you would suggest for a satisfactory sewage effluent. Give a brief account of the tests you would employ in estimating the quality of a sewage effluent.

3. Describe in detail Pettenkoffer's method for estimating the amount of CO_2 in an air sample. What is the value of this estimation in judging of the purity of an atmosphere?

4. Give the average composition of cow's and buffalo's milk in this country. Comment on the following analysis of cow's milk :—

Specific gravity	1026
Fat	2·5%
Solids not fat	7·5%

Boracic acid 2 grains per pint.

5. What are the different chemical preservatives added to articles of food, and how would you test for their presence? To what extent would you allow the addition of these preservatives?

Physics and Chemistry.

Paper II.

Time allowed—Three hours.

Maximum Marks—50.

1. What is the importance of chlorides and nitrates in drinking water? How are they derived?

2. Describe the Kjeldahl's process for estimating the total nitrogen in a sample of sewage.

3. Of what value is an estimation of the volatile fatty acids in a butter sample as an indication of its purity or otherwise?

How would you perform the estimation experimentally?

4. What injurious foreign substances are liable to be found in the following materials ?—

(1) Milk.

(2) Butter and Ghee.

(3) Vinegar.

(4) Lime Juice.

How would you detect them in (3) and (4) ?

5. Describe the laws governing the expansion of gases and atmospheric pressure. Discuss their bearing on ventilation.

Bacteriology, etc.

Paper I.

Time allowed—Three hours.

Maximum Marks—50.

1. Give a description of the important characters (morphological, staining and cultural) of *Bacillus pestis.*

2. Describe the procedure of the examination of fæces for helminthic ova.

3. Give the Rideal-Walker's test for estimating the dose of bleaching powder for disinfection purposes.

4. What are the naked eye and microscopical characters of the stools of bacillary dysentery ?

5. Describe fully the procedure for collecting material from the throat in an investigation of diphtheria.

Bacteriology, etc.

Paper II.

Time allowed—Three hours.

Maximum Marks—50.

1. What morphological and cultural characters are possessed in common by the various members of the Typhoid-Coli group of bacteria ?

How would you determine the presence of *B. typhosus* in stools of carriers ?

2. By what different methods is tuberculin prepared ? In what ways may it be employed ? What are your views as to its diagnostic and prophylactic value ?

3. What is the cause of epidemic cerebro-spinal meningitis ? How would you proceed to establish the differential diagnosis between the specific organism and other cocci liable to infect the meninges ?

4. What is the causative agent of relapsing fever? How would you proceed to make a laboratory diagnosis of a suspected case?

Give the life history of the insect carrier.

5 Give an account of the procedure you would adopt in the bacteriological examination of a sample of drinking water.

What standard of purity would you suggest?

Practical Bacteriology.

Time allowed—Three hours.

Maximum Marks—100.

1. Describe the naked eye and microscopical characters of the bacterial culture A and state the probable species.

2. Examine the materials B and C and determine as far as you are able the character of its pathological contents.

3. Stain the slide D and report on it,
(Show the stained specimen to the examiners).

4. Inoculate the tubes supplied for lactose fermentation test with the sample of water marked E in the presence of examiners.

5. Identify the microscopical specimens 1 to 6

Practical Chemistry.

Time allowed—Four hours.

Maximum Marks—100.

1. A sample of water marked A is given. Examine quantitatively :—

(*a*) Chlorides.

(*b*) Free and saline ammonia

(*c*) Albuminoid ammonia.

(*d*) Oxygen absorbed in 2 hours at room temperature.

Comment briefly on the potability of the water.

2. Examine the sample of milk provided (marked B), and comment on its quality.

3. Identify the gases contained in jars C and D.

THE STATE BOARD OF MEDICAL EXAMINATIONS, UNITED PROVINCES, INDIA.

LICENCE IN PUBLIC HEALTH.

PART I.

Physics, Meteorology and Climatology.

June 13, 1921, 7-10 A.M.

1. State and explain the general law of the diffusion of gases.

2. What are the causes of high temperature in India and why is the temperature of the Punjab in summer higher than that of Ceylon which is nearer the equator?

3. What are 'Cyclones' and 'Anti-cyclones' and how are their intensities measured?

4. What is rainfall due to? Describe the circumstances which may affect the rainfall of a country?

5. Describe the maximum and minimum thermometers.

Bacteriology and Parasitology.

June 14, 1921, 7-10 A.M.

1. How would you sterilize cholera cultures by moist heat? Describe the process in detail.

2. How would you obtain a pure culture of cholera vibrios from the fæces of a patient?

3. How would you stain a specimen of sputum to demonstrate the presence of tubercle bacilli?

4. Describe the organism of relapsing fever as seen in the blood.

How would you prepare a specimen of blood to demonstrate the organism?

5. Describe the sexual form of the malignant tertian parasite when stained by Leishman's method.

Practical Bacteriology.

June 18, 1921, 7-10 A.M.

1. Examine the sputum in the petri dish marked A for the presence of tubercle bacilli.

2. Fill the capsule and make blood film from your own blood.

3. Examine the specimen of fæces marked B for the presence of ova of intestinal parasites and leave the finding under the microscope.

4. Describe briefly the objects 1, 2, 3 and 4, and state what they are. (Do not move the slides).

Chemistry—Practical.

June 16, 1921, 7-11 A.M.

1. Estimate the following constituents in parts per 100,000 in the sample of water A and write a report as to its value for drinking purposes :—

(*a*) Chlorine

(*b*) Poisonous metals

(*c*) Nitrites

(*d*) Nitrates.

2. Identify the flour in packet marked B and report as to its freedom from adulteration.

3. Find out the specific gravity of the sample of milk marked C and give your opinion as to its purity.

PART II.

Hygiene.

Paper I.

June 23, 1921, 7-10 A.M.

1. Given a free choice what place would you choose as the site for a new town of 10,000 inhabitants ?

2. What provision would you make in the way of sanitary works for such a town to safeguard the health of the inhabitants ?

3. Describe an up-to-date school class room for 20 scholars ; give floor and window space, ventilation, lighting, etc.

4. Describe a good method of disposal of night-soil at a mela.

5. How would you disinfect a house in which (*a*) cholera and (*b*) plague has occurred ?

Hygiene.

Paper II.

June 24, 1921, 7-10 A.M.

1. What prophylactic steps would you take to prevent an outbreak of cholera in a village ?

2. How would you inspect vaccination in a village in order to determine what proportion of the children had not been vaccinated ?

3. What are the chief breeding grounds of flies and give the life history of a fly ?

4. With what trade is Anthrax connected and how is it spread ?

5. What is the meaning of the following terms :—

(*a*) Corrected death rate.

(*b*) Standard death rate.

(*c*) Comparative mortality figure.

Sanitary Law.

Paper I.

June 25, 1921, 7-10 A.M.

1. What are the chief obligatory duties of a Municipal Board with regard to public health ?

2. What are the rights of a customary sweeper in a town and how could they be abolished under the existing law ?

3. What are the chief powers of a board in connection with privies, drains, cesspools, etc , in private land ?

4. What are the model rules with reference to the supply of water to water-flushed closets in private houses ?

5. What are the rules regarding the disinfection of water-supplies given in the Municipal Manual ?

Sanitary Law.

Paper II.

June 27, 1921, 7-10 A.M.

1. What are the rules for the prevention of the spread of Cholera in a town?

2. What are the rules regarding the registration of births and deaths in a town?

3. What are the "projection bye-laws"? Give briefly their most important provisions.

4. What are the model bye-laws regulating the inspection of animals for slaughter?

5. What are the chief rules regulating vaccination in a district and what are the duties of an Assistant Superintendent of Vaccination as laid down in the District Board Manual?

Sanitary Engineering.

Paper I.

June 28, 1921, 7-10 A.M

(15 Full marks for each question)

1. What conditions of subsoil are necessary to the success of a tube well?

2. Describe by aid of sketches and explain the use of the following instruments:—

Sluice valve; angle branch; ferrule

3. What are the disadvantages of an intermittent water supply?

4. How would you protect a well, in constant public use, from contamination?

5. What is the difference between plain spigot and socket and turned and bored pipes?

Sanitary Engineering.

Paper II.

June 29, 1921, 7-10 A.M.

(*15 Full marks for each question.*)

1. Sketch and describe the use of a good type of yard gully.

2. In what position would you recommend the use of kerb and channel drains?

Give a cross section of an approved type of such drain.

3. Enumerate the various methods of sewage disposal you are acquainted with and state which method you consider most suited to these Provinces, giving reasons.

4. What are the usual chemicals added as coagulants in precipitation processes?

5. How do you distinguish between first and second class bricks?

Out-door Inspection.

June 30, 1921, 7-11 A.M.

Visit the public latrine, Victoria Park, and make such observations and notes as may be required for drawing up a sanitary report.

Return to the Examination hall at the King George's Medical College before 8 A M. and draw up the report. You will be allowed 3 hours for this.

The report must include a statement of any action you would recommend to be taken, your reasons for such recommendations and the powers under which the necessary action may be carried out, if a portion of it were also a privy.

PART I.

Physics, Meteorology, Climatology, Air and Ventilation.

November 7, 1921, 10 A.M. to 1 P.M.

1. What is the effect of the rarefication of the air on the human organism?

2. What are specific and latent heat?

3. What are isothermal lines?

4. How is air vitiated by combustion?

5. Describe an easy method of ventilating a room in India.

Bacteriology and Parasitology.

November 8, 1921, 10 A.M. to 1 P.M.

1. Describe the organism of Cholera and its chief cultural reactions.

2. Describe the method of taking a blood culture to examine for enteric fever.

3. What are the chief gram negative pathogenic organisms?

4. Give the life history of the malignant tertian parasite, both intra and extra corporeal.

5. Describe the *Trichina spiralis*. Where is it usually found?

Practical Bacteriology.

November 10, 1921, 10 A.M. to 1 P.M.

1. Examine the meterial in tube (*a*) and state what you find therein.

2. Examine and report fully on the colonies present in the plate cultivation marked (*b*).

3. Examine and report on the film (fixed) marked (*c*).

4. Identify the specimens marked 1—4.

Practical Chemistry.

November 9, 1921, 10 A.M. to 2 P.M.

1. In the sample of water marked (*a*) estimate the amount of chlorine and free and albuminoid ammonia and give your opinion as to its fitness for drinking purposes.

2. Identify the poisonous metals dissolved in water in the bottle marked (*b*).

3. Identify the gases contained in the bottles marked (*c*) and (*d*).

PART II.

Hygiene.

Paper I.

November 14, 1921, 10 A.M. to 1 P.M.

1. What are deep tube wells? What are the requirements of a locality to produce a large supply of pure water from deep tube wells?

2. Describe an up-to-date system of removal and disposal of household rubbish.

3. What are the objections to lime kilns and brick kilns in the inhabited area?

4. Describe a small slaughter-house built on modern sanitary lines.

5. What is the value to Government of a correct knowledge of vital statistics.

Hygiene.

Paper II.

November 14, 1921, 2 to 5 P.M.

1. How does Cholera start in a town and how is it spread?

2. What is the seasonal prevalence of malaria in the United Provinces and why is it prevalent in certain seasons?

3. How is tuberculosis spread and what measures would you advise a municipal board to take to reduce the death rate from this disease?

4. Write a sample leaflet for distribution in villages instructing the villagers how to avoid infection from influenza.

5. What are the effects on children of being fed on milk adulterated with ordinary unboiled well water in a village?

Sanitary Law.

November 16, 1921, 10 A.M. to 1 P.M.

1. What are the duties of a Sanitary Inspector, as detailed in the Municipal Manual?

2. What steps would you take to obtain the prosecution of a man, for selling adulterated milk, under the United Provinces Prevention of Adulteration Act?

3. What are the rules governing the prohibition of cultivation of crops in or near a town ?

4. What powers have a board with reference to the protection of wells ?

5. What are the powers of a municipal board under the Vaccination Act ?

Sanitary Engineering.

November 17, 1921, 10 A M to 1 P M.

1. What are storm overflows used for ?

2. What is meant by (*a*) 'contour', (*b*) 'trap', (*c*) 'reflux valve' in drainage work ?

3. How should manholes be spaced on sewers ?

4. What is the usual requirement in a large city in Northern India in water per diem ? How is this allowance made up on an average for domestic and non-domestic purposes ? How does the demand vary with the seasons of the year ?

5. What is the difference between a 'fat lime' and an 'hydraulic lime' ? What other material is used where durability and quick setting is necessary instead of lime ?

6. Describe the operation of scraping a slow sand filter and putting it into operation again.

Out-door Inspection.

November 18, 1921, 10 A.M. to 2 P M.

(Either of the two questions may be replied).

1. Report on the sanitary condition of the premises shown, giving your suggestions with legal support under the Municipalities Act for the same.

2. Draw a sketch of the water flush urinal in use in Lucknow, showing its disadvantages and suggest improvements in it.

PART I.

Physics, Climatology, Meteorology, Air and Ventilation.

21st April, 1922, 7-10 A M.

1. What is meant by a boiling point and how does it vary with altitude ?

2. What are the uses of a dry and wet bulb thermometer ?

3. What is the dew point? Describe the factors which cause the deposition of dew.

4. What effect has artificial light on the air of a city?

5. What is the best practicable method of ventilating a primary school building in India?

Bacteriology and Parasitology.

22nd April, 1922, 7·10 A.M.

1. Describe the steps you would take to demonstrate the presence of the cholera vibrio in the stools of a patient.

2. How would you demonstrate the presence of *B. coli communis* in a sample of water?

3. Give the life history of the hook-worm inside and outside the body.

4. Describe Widal's reaction.

5. How would you stain a specimen of blood to demonstrate the malarial parasite and how would you look for it with the microscope?

Practical Bacteriology and Parasitology.

Time—Three hours.

I. Examine the material in the watch glass marked "A" and describe the microscopic abnormal constituent present in it.

II. Describe the colonies in plate culture marked "B" and make an agar streak culture from the same in the presence of the examiner.

III. Identify the specimens 1 to 6 under the microscope.

Practical Chemistry.

Time—four hours.

1. Estimate the amount of free and saline ammonia, the albuminoid ammonia, in the sample of water maked "A"; also test the same sample for the presence of nitrites, nitrates and poisonous metals.

2. Examine the samples of air marked 1 and 2, and state what, if any, gaseous impurities they contain.

3. Examine the powders in the packets marked "B" and "C"; state what they contain.

Part II.

Hygiene.

Paper I.

April 27, 1922, 7-10 A.M.

1. What factors would you take into consideration in choosing the site for a model village?

2. What water-supply would you advise for a model village with a population of 1,000?

3. How would you dispose of the offal and blood and wastings from a slaughter-house in an unsewered town?

4. Describe a properly supervised trenching ground.

5 Describe a good disinfecting station for a town of 100,000 people.

Hygiene.

Paper II.

April 27, 1922, 2-5 P.M.

1. How would you combat an epidemic of small-pox in a town?

2. Describe a properly constructed milk shop and its fittings.

3. How would you prevent the spread of cholera in a fair like the Magh Mela? Describe precautions to be taken before an outbreak.

4. How would you check the books of a village chaukidar to prove that births and deaths are being correctly recorded by him?

5. What is anthrax; how is it spread?

Sanitary Law.

April 29, 1922, 7-10 A M.

1. Give the methods of disinfection given in the Municipal Manual.

2. What are the model bye-laws regulating the sale of meat?

3. What are the chief provisions of the Epidemic Diseases Act?

4. What are the duties of a board when constructing public streets?

5. What are the emergent powers of a municipal board on the outbreak of an epidemic?

ııtary Engineering.

May 1, 1922, 7-10 A.M.

1. What are the usual sizes of drains used for house connections and what should their respective minimum grades be ?

2. In connecting a surface drain to a sewer, what points should receive particular attention ?

3. Sketch and describe any type of automatic flushing syphon with which you are acquainted.

4. Before permitting workmen to enter a manhole shaft where danger from sewer gas is suspected, what precautions would you adopt ?

5. Why are leaks on a water main in an intermittent system of water supply dangerous ?

6. Explain what is meant by the "maturing" of a sand filter-bed.

PART I.

Physics, Climatology, Meteorology, Air and Ventilation.

April 17, 1923, 7-10 A M.

1. What are the principal factors which determine the climate of a place ? Illustrate your answer by particular reference to the climatology of this country.

2. What are the principal instruments required to record meteorological observations and describe very shortly how you use them ?

3. What is meant by -(*a*) natural ventilation and (*b*) artificial ventilation ? What physical laws does the former depend upon ? What are the principal means of applying artificial ventilation to a large public building ?

4. How would you calculate the number of persons who should be accommodated in—(*a*) a common lodging house, (*b*) an army barrack, (*c*) an infectious diseases hospital, (*d*) public elementary school, with due regard to proper ventilation and health ?

5. What are the chief offensive trades met with in this country and what are the chief sources of nuisance attached thereto ? Frame bye-laws for the prevention of these nuisances.

Bacteriology and Parasitology.

April 18, 1923, 7-10 A.M.

[Five questions may be chosen].

1. Describe how you would isolate and identify the bacillus in a case of suspected bubonic plague.

2. Describe shortly the causative organism of—

(*a*) amœbic dysentery and

(*b*) bacillary dysentery.

3. Describe the causative organism of relapsing fever. How would you diagnose the case and state the means by which the infection is spread ?

4. What diseases are grouped under the term Leishmaniasis ? Describe the parasite involved in these diseases.

5. How would you proceed to diagnose bacteriologically a case of enteric fever at the end of the first week ? Give the relative value of your findings in arriving at a diagnosis.

6. Describe the cholera vibrio and how you would isolate it in a suspected case.

PART II.

Hygiene.

Paper I.

April 23, 1923, 7-10 A.M.

1. What type of latrine is suitable for—

(*a*) a village with no conservancy staff and inadequate water-supply ;

(*b*) a village with very small conservancy staff and inadequate water supply ;

(*c*) a town with a small conservancy staff and adequate water-supply ?

Give your reasons.

2. In what way tannery waste differs from ordinary sewage ? What is the best method of disposal of tannery waste ?

3. The reservoir of the water-pumping station of a town is suspected to be contaminated with cholera germs. How would you proceed to deal with the situation ?

4. To what points would you pay special attention while inspecting and examining an ærated water factory ?

5. On what lines would you proceed to combat an epidemic of Influenza ? What was the effect of the Influenza epidemic of 1918 on the census of 1921 ?

Hygiene.

Paper II.

April 24, 1923, 7-10 A.M.

1. Kala-azar. Give the cause and mode of spread and describe the preventive measures. To what extent is kala-azar endemic in the United Provinces?

2. How would you organise a baby clinic on a small scale?

3. Describe an infectious diseases hospital suitable for a town of 50,000 population.

4. Draw up a set of instructions for free distribution during a cholera epidemic in a town.

5. What sort of mechanism would you recommend for protecting articles of food from contamination of fly and dust in the case of—
   (*a*) A sweetmeat shop in a bazar;
   (*b*) A "khunchawala" in a mela
   Give a rough sketch.

Sanitary Law.

April 25, 1923, 7—10 A.M.

1. What is a public nuisance? In what way does it differ from a statutory nuisance? Under what section or sections would you deal with a case of public nuisance?

2. What sanitary provisions would you, as a factory inspector, insist on in a large flour mill?

3. Under what circumstances is improper feeding of animals an offence under the Municipalities Act?

4. A river from which a municipal town derives its water-supply is contaminated by disposal of dead bodies by drowning from a cluster of villages outside the municipal area. How can this be prevented?

5. What is a lodging house? How does a "dharamsala" differ from a lodging house? How are lodging houses regulated?

Sanitary Engineering.

April 26, 1923, 7-10 A.M.

1. What is the average daily demand per head of population in a large city for water-supply and how does this vary with the season ?

2. How is a slow sand filter-bed made up ? What are the materials used and the thickness of the various layers ?

3. What effect has "pressure" in a water-supply system ?

4. What appliances should be used in keeping sewers clear from obstructions ?

5. If a sewer shews a tendency for silt to deposit, what faults would you expect to discover in its construction ?

6. What is meant by "sewage sick" land and how is this fault dealt with ?

PART I.

Physics, Meteorology, Climatology, Air and Ventilation.

October 8, 1923, 10 A.M. to 1 P.M.

Time allowed—Three hours.

1. What are the uses of the following instruments—
   a. thermometers
   b. barometers
   c. hygrometers ?

   Describe the construction of a thermometer.

2. How is the velocity of the wind recorded and what precautions are necessary in order to obtain the best results ?

   What is a vane and how should its observations be recorded ?

3. What are cyclones and anti-cyclones and how are their intensities measured ?

4. What is meant by artificial ventilation ? Describe briefly the methods by which it can be effected.

5. How is rainfall measured ? What effect has vegetation and forests on the rainfall of a country ?

Bacteriology and Parasitology.

October 8, 1923, 2-5 P M.

Time allowed—Three hours.

1. Describe the method of preparation of the following culture media :—
   a. nutrient broth
   b. blood serum.

Name some of the diseases in which the latter is particularly usefnl in isolating the causative organism.

2. A patient is admitted to hospital suffering from sudden high fever with rigors, troublesome cough and pain in the chest. On post-mortem, fluid of the nature of pus is found in both the pleural cavities. Describe how you would proceed to obtain a pure culture of the causative organism and what methods of staining would you employ to demonstrate the organism ?

3. Enumerate the diseases which are propagated by the following :—
   a. The common house fly
   b. The anopheles and stegomyia mosquitos
   c. The tse-tse fly
   d. The tick
   e. The bed bug
   f. The body louse
   g. The house rat.

4. Describe the Widal test for the enteric group of fevers.

Practical Bacteriology and Parasitology.

October 10, 1923, 10 A.M. to 1 P.M.

1. Examine and report on the bacterial culture in test-tube marked "A".

2. Examine the material in the watch glass and describe the pathological constituents you find therein

3. You are given a sample of water marked "B". In the presence of the examiners you are required to go through the various steps to determine (a) total colony count in agar, in 1 c. c. and (b) the presence or absence of lactose fermenters.

4. Identify specimens 1 to 4 under the microscopes.

Practical Chemistry.

October 9, 1923, 10 A.M. to 2 P.M.

1. Estimate the amount of chlorides, hardness and total and volatile solids in water sample marked "A".

2. Identify the poisonous metal in water sample marked "B".

3. Determine the specific gravity and fat percentage of the milk sample "C".

4. Identify the packets of flour marked "D" and "E".

PART II.

Hygiene.

Paper I.

October 11, 1923, 10 A.M. to 1 P.M.

1. What are the conditions that should satisfy an ideal well ?

2. Mention the practical points to be followed in any scheme of ventilation.

3. Give the chief points to be observed in the construction of a slaughter-house.

4. What are the disadvantages of the dry system of removal and disposal of night-soil ?

5. In the selection of a site for a burial ground, what points are to be noted ?

Hygiene.

Paper II.

October 11, 1923, 2-5 P.M.

1. A new epidemic has been reported in a town. How will you proceed to investigate it ?

2. What methods would you adopt to reduce the fly nuisance in a town ?

3. Describe the measures you would recommend to reduce a high infantile mortality in a town.

4. What points should be observed when persons suffering from infectious diseases have to be isolated in their own houses ?

5. What are the advantages of compulsory notification of an infectious disease ?

Sanitary Law.

October 12, 1923, 10 A.M. to 1 P.M.

1. Under what conditions can a municipal board have a person suffering from infectious disease, removed to an infectious hospital ?

2. Mention the municipal regulations regarding the disposal of dead bodies of animals.

3. Give the model byelaws for the regulation and control of bakeries.

4. What are the duties of a Medical Officer of Health in a municipality ?

5. What are the instructions regarding collection and despatch of samples of milk under the Prevention of Adulteration Act ?

Sanitary Engineering.

October 13, 1923, 10 A.M. to 1 P.M.

1. In a sewerage system what do you u nderstand by the terms :
   (*a*) combined system
   (*b*) partially separate system
   (*c*) absolutely separate system.

For the ordinary Indian town which do you consider the most suitable, giving reasons for this opinion ?

2. If called on to inspect and pass an ordinary stoneware pipe drain newly laid, before being covered over by earth in its trench, what are the special points to which you would give attention before sanctioning the filling of the trench ?

3. Briefly explain what is meant by the following terms, and indicate their special properties or uses :—
   (*a*) flushing syphon
   (*b*) a "water seal"
   (*c*) septic tank
   (*d*) gradient of a pipe
   (*e*) water test
   (*f*) smoke test

4. What are the essential differences between lime concrete and cement concrete in respect to uniformity of quality, time of setting, strength, and durability ?

Under what circumstances would you insist on cement concrete being used in a work, instead of lime concrete ?

5. In estimating the cost of a small building, a water tank, or pipe-line with manholes, from a plan and section, how would you express the quantities of

(*a*) concrete (*b*) brickwork (*c*) cement plaster (*d*) iron and steel work (*e*) six inch pipes (*f*) windows and doors (*g*) lime pointing	Indicate separately whether by :— cubic feet, square feet, lineal feet, or by weight.

6. Describe briefly the construction and action of a "slow sand filter." How many gallons per square foot per day can an ordinary sand filter, in average condition, deal with ?

7. How many gallons of water per head per day do you consider should be supplied to meet the needs of (*a*) a small town of less than 10,000 people, without any private house connections to drains, or pukka drains requiring flushing, (*b*) a large town of over 100,000 people, with complete drainage system, surface water drains needing flushing, private water closets, public latrines, dumping depôts, etc.

PART I.

Physics, Climatology, Meteorology, Air and Ventilation.

April 9, 1924, 7-10 A.M.

1. What is meant by humidity of the atmosphere and what effect has excessive humidity on the human body ?
2. What is specific gravity and how is the specific gravity of a liquid estimated ?
3. What are the chief diseases caused by impure air ?
4. Describe the plenum system of ventilation.
5. What conditions affect the rainfall in the plains in the United Provinces ?

Bacteriology and Parasitology.

April 9, 1924, 2-5 P.M.

1. Describe the Pasteurization of milk.
2. How would you sterilize cholera stools and vomitted matter ?

3. Give the life history of the benign tertian malaria parasite in the mosquito.

4. When and how would you take a blood culture from a patient suffering from typhoid fever and demonstrate the presence of the *Bacillus typhosus* ?

5. How would you demonstrate the presence of the Leishman-donovan body in a case of *kala-azar* ?

Chemistry—Practical.

April 10, 1924, 7-11 A.M.

1. Quantitatively estimate parts per 100,000 of free and saline and albuminoid ammonia, chlorides and hardness present and qualitatively determine the presence or absence of nitrites and nitrates in the water sample marked A. State your opinion, with reasons, regarding the fitness of water for drinking purposes.

2. Determine the specific gravity and the percentage of fat in the sample of milk marked B.

3. Find out the percentage of available oxygen in the disinfectant marked C.

4. Identify the packets of flour marked D and E.

Bacteriology—Practical.

April 11, 1924, 7-10 A M.

1. Examine the material in the watch glass marked A and describe the pathological elements present therein.

2. Examine and report on the bacteriological culture in the test-tube marked B.

3. You are given a sample of stool of a case suspected to be one of cholera ; in the presence of the examiners go through the steps you would adopt in obtaining a pure culture of the organism.

4. Identify the specimens 1-6 under the microscopes.

Part II.

Hygiene.

Paper I.

April 14, 1924, 7-10 A M.

1. Describe the mode of spread of cholera and the measures you would adopt to combat the disease in a town with a population of 2,000 persons.

2. Describe with sketches an ideal sand filter for water purification.

3. Describe the life history of a common house fly. What are its chief breeding places? Why is it considered dangerous?

4. Give the mode of infection and duration of infectivity of the following diseases:—Malaria, Typhoid fever, Smallpox, Relapsing fever, Plague and Dengue fever.

5. What do you understand by the following terms:—

(*a*) death rate
(*b*) recorded death rate
(*c*) corrected death rate
(*d*) zymotic death rate
(*e*) birth rate
(*f*) expectation of life at birth
(*g*) infantile mortality rate.

What has so far been done in this country to reduce infantile mortality?

Hygiene.

Paper II.

April 14, 1924, 2-5 P.M.

1. Describe the mode of spread of tuberculosis and the preventive measures you would recommend to eradicate the disease.

2. Describe with sketches a practical method of disposal of night-soil at a fair like the *Magh Mela*.

3. Describe with sketches the cycle of development of the malarial parasite.

4. How will you define a 'shallow well'? To what conditions will you attend to, when sinking a shallow well in a village, to prevent its contamination from cesspool soakage or other forms of pollution?

Give a method by which you will find out the source and nature of polluting material contaminating the well.

5. What do you understand by the following terms:—

(*a*) proof spirit
(*b*) nesslerizing
(*c*) unit of work
(*d*) primary vaccination
(*e*) secondary vaccination
(*f*) re-vaccination.

(*g*) damp-proof course

(*h*) biological treatment of sewage.

What are the advantages and disadvantages of biological treatment of sewage ?

Sanitary Law.

April 15, 1924, 7-10 A.M.

1. A complaint is made to you, as Medical Officer of Health of a municipality, that unsound articles of food are kept exposed for sale at a certain market ; state under what authority you can make the inspection of the market. Give your line of action, if on inspection, you find the following articles of food :—

(*a*) rotten potatoes

(*b*) ghee smelling of cocoanut oil.

2. What action can be taken against the owner of a house with an overflowing cesspool to prevent the nuisance arising therefrom, in a town—

(*a*) with sewerage or drainage system ?

(*b*) with no sewerage or drainage system ?

3. What sanitary provisions would you recommend in cases of—

(*a*) cattle sheds and cow houses ?

(*b*) dairies ?

4. Draw up a set of model bye-laws for the regulation and inspection of places for the manufacture, preparation or sale of sweetmeats. Quote the authority under which you can make such bye-laws.

5. How will you define an "offensive trade" ?

What trades are included under the term "offensive trades" ? What action can be taken and under what authority, against the owner of a gut scraping factory opened without permission in a town where the Municipalities Act is in force ?

Sanitary Engineering.

April 16, 1924, 7-10 A M.

1. What are the principal materials used for pipes for :—

(*a*) water-supply purposes (both municipal and private) ?

(*b*) drainage purposes ?

Discuss them briefly, indicating their properties and special uses.

2. The supply of water is almost invariably in pipes "under pressure," whilst the taking away of sewage is almost always by drains or channels

flowing "not under pressure." Explain the reasons, objects, or special advantages of both practices.

3. What is the minimum gradient at which you would allow a 9″ stoneware pipe to be laid, so as to ensure that it has a "self-cleansing velocity"? Explain the meaning of the term, and say what is the usually accepted velocity in feet per second.

4. Give in summary form, not exceeding 6 lines each, brief details as to the manufacture, uses, and special properties of—

(*a*) portland cement
(*b*) kankar lime
(*c*) cast iron
(*d*) steel
(*e*) cement concrete
(*f*) good local bricks.

5. Being called on to advise a small town of 15,000 inhabitants as to its water-supply, and with a reasonably ample amount of money available for expenditure, how much would you suggest should be provided in gallons per day? (Assume the town to be in the United Provinces, and situated in the plains).

6. A group of buildings in a large compound has recently been drained on the modern system by 4″, 6″, and 9″ underground pipes by a local contractor, and connected to a public sewer a short distance away. The system is to be inspected and passed by you before being brought into use. Explain how you would carry out this inspection, the special points you would investigate and the tests you would impose.

7. Describe the functions of :—

(*a*) a storm-overflow
(*b*) a water-seal
(*c*) an air valve
(*d*) a sluice valve
(*e*) a catch-pit
(*f*) a flushing chamber
(*g*) a scour valve.

PART I.

Physics, Climatology, Meteorology, Air and Ventilation.

April 1, 1925, 7-10 A.M.

1. Define Charles' law. What is meant by the 'absolute zero'? Give the volume occupied by 1,000 cubic feet of air at 10°C., when raised to 30°C.

What are the essential differences between 'superheated' steam and 'saturated' steam ?

2. Discuss in detail (i) the special conditions met with in mountain climates and (ii) the influence of such climate on health.

3. Give an account of the wet and the dry bulb hygrometer. What is meant by 'relative humidity', 'absolute humidity' and 'dew point' ?

4. What noxious gases are met with in connection with :—

(i) lime kilns

(ii) manufacture and escapes of ordinary illuminating gas

(iii) old and blocked sewers.

Give an account of the causation of the unpleasant sensations experienced in ill-ventilated rooms, referring especially to excess of CO_2, excess of moisture and heat stagnation.

5. How would you examine the sufficiency of ventilation in a lodging house room ?

Bacteriology and Parasitology.

April 1, 1925, 2-5 P.M.

1. What is known as to the transmitting agent in kala-azar ? Discuss the laboratory methods of diagnosis of kala-azar from a sample of (i) blood, (ii) serum.

2. Give in detail (i) morphology and cultural characteristics of *B. coli communis*, and (ii) the sugar reactions differentiating it from *B. typhosus*.

3. Give the life-history of *Cimex lectularius* (the common bed bug)

4. What do you know of the life-history of ankylostoma ? How would you diagnose hook-worm infection from a sample of fæces ?

5. Give the laboratory and staining technique you would employ in the diagnosis of diphtheria from a throat swab.

Chemistry—Practical.

April 3, 1925, 7 15 to 11-15 A.M.

1. Estimate the free and saline and albuminoid ammonia in sample A.

2. Estimate the amount of available chlorine in the solution B

3. What do the powders C and D consist of ?

4. Find the specific gravity and preservatives in the sample of milk supplied.

Bacteriology—Practical.

April 4, 1925, 7-10 A.M.

1 Stain the specimen of sputum provided for *B. tuberculosis*.

2. Examine the specimens A and B of fæces for ova and give your diagnosis.

3. In the presence of the examiner carry out the technique of the following :

Inoculate the agar plates with the sample of water provided.

4. Examine and report on the six slides set out under the microscopes.

PART II.

Hygiene.

Paper I.

April 6, 1925, 7-10 A M.

I. What are the essentials in a good meat market for a small town ?

II. What are the essentials to be observed to obtain proper cleanliness in a village of a population of 1,000 people ?

III. Describe in detail the provision of a well water supply for a village, giving all the precautions you would take to ensure the water being potable without incurring any recurring charges.

IV Describe a model slaughter-house, giving the methods of disposal of the various products.

V. Describe a septic tank for a small town, giving the action that takes place in it and the result on the effluent.

Hygiene.

Paper II.

April 6, 1925, 2-5 P.M.

I. Describe a well organised child welfare centre in a small town and detail the duties of the staff.

II. Describe the action that you would take in a typical Indian village of 1,000 inhabitants to prevent malaria in the autumn.

III. The death rate in a town in the Meerut district rises week by week during April, May and June and subsides at the end of June ; what is the epidemic causing the high death rate likely to be and how would you confirm your suspicions ?

IV. How would you check the books of a village vaccinator ?

V. How is tuberculosis spread, and what steps would you take to prevent its spread in a town ?

Sanitary Law.

April 7, 1925, 7-10 A.M.

I. What are the rules for prevention of the spread of cholera in a town ?

II. What are the duties of a sanitary inspector as laid down in the Municipal Manual ?

III. What are the chief powers of a municipal board in connection with the registration of vital statistics ?

IV. What are the model byelaws regulating the sale of meat ?

V. What are the rules regarding common lodging-houses ?

Sanitary Engineering.

April 8, 1925, 7-10 A.M.

I. Describe a tube-well explaining carefully the factors on which the yield depends.

II. What difference should you expect between the quality and quantity of yield from a protected masonry well and a tube well ?

III. Detail the advantages and disadvantages of slow sand filters compared to the mechanical filter. Why do the rates of filtration in the two differ so widely ?

IV. What are the smallest sizes of brick sewers—circular or egg-shaped—used ? What are the limiting factors for the gradient ?

V. Explain the terms "surface drainage," and "underground drainage" and "sub-soil drainage." Should you expect a street-drain to carry sullage ?

VI. Describe briefly the advantages and disadvantages of sewage disposal by land irrigation in India.

VII. Specify the following—

(1) 1st class bricks

(2) 2nd class bricks

(3) 3rd class bricks.

VIII. Explain briefly where you will use the following—

(*a*) kankar lime, (*b*) stonc lime, (*c*) cement.