NUTRITION AND VICTORY

FOOD PROBLEMS IN WAR AND PEACE

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TO

WINSTON SPENCER CHURCHILL

STATESMAN, HUMANIST, ORATOR OF ACTION,
CHAMPION OF HUMAN DIGNITY

" There is indeed at the present moment no more important thing than the question of the proper feeding of the nation, and there is no greater need than the enlightenment in the nutrition problem."

SIR ROBERT MCCARRISON.

INTRODUCTION

AS you eat so you will fight.

This may appear an extravagant or astonishing statement. The claim that there is a close connexion between vitamins and victory may seem an impractical theory in the midst of bombardments. But it is not.

It is not denied—the evidence, fully documented, is to hand—that the last World War was not decided by force of arms alone. The armies of the Central Powers were finally overcome less by the forces of the Allies than by hunger and malnutrition. The German and Austrian governments were unable to provide food adequate in caloric value and in vitamins for their subjects; in consequence a new enemy rose up to defeat them, an invisible Fifth Column which attacked them from within, rotting their moral and physical stamina, and ruthlessly encompassing their ultimate collapse with all the secret weapons of disease.

This fact—and it is a fact, not the unsubstantiated theory of the apologist—holds a lesson for us now, and the better we grasp its bearing upon the conditions of the present conflict, the more weight we shall be forced to attach to the arguments that will be developed in these pages.

The present war is nothing like the last. The conflict of 1914-18 was one of battles or entrenched warfare on certain military fronts, and success depended on the morale of the troops in the field. But in the death-struggle in which we are engaged to-day, it is the civilian

who is the decisive factor. To-day we are waging " total warfare," and the whole populations of the opposing Powers are fighting, actively or passively, in the front line or in the shelter; there is and can be no exemption. A successful termination depends, therefore, not on the armed forces alone, however highly mechanised, however imbued with the will to win, but on the resistance which the whole nation, men, women and children, is capable of offering.

If the importance of national morale is thus paramount, every contributing factor must be examined and evaluated. The resistance of a whole people depends on the highest common factor of its efficiency, and therefore the question of nutrition is one of actual and immediate importance. We know to-day to how great an extent our mental state is governed by our bodily fitness, and we have discovered how far both physical and mental vigour can be affected by diet. It remains for us in the immediate future to make practical use of this body of newly acquired and clinically tested information, and to lose no time about it; we have none to lose. Never before was Brillat-Savarin's epigram, that the fate of nations is determined by their food, so true as it is to-day.

It is a well-proved fact that nutriment affects the body in all its functions. We can, by means of the food we eat, increase our efficiency and power of resistance. But what food must we eat? In what form and quantity must we eat it? How are we to use it to the best advantage? What must we avoid? These questions are now more than ever of vital importance, and the following pages are an attempt to answer them practically, scientifically and as fully as the limits of space allow.

We know the deleterious effect of salt, refined sugar and acid nutrition, which are caused by the excess of

protein and salt in our ordinary diet. But we also know how to combat these dangers, and how to influence, by alkalisation, the administration of potassium and vitamins, both our efficiency as workers and our resistance to fatigue and infection.

The problem of nutrition is not a simple one. Some of the chapters which follow may seem, perhaps, obscure to the general reader, but they are necessary for the specialist, and as the author regards this subject as one of universal interest at the present time, he has attempted to combine a popular review of dietetics for the layman with more recondite information for the expert. He hopes that the one will not be overawed by the depths nor the other scorn the shallows, but that both will derive some profit from this work, which he regards as his modest contribution to the war effort.

I want to express my sincere thanks to Mr. L. Sleigh and Mr. A. R. Warner for their painstaking effort in translating this book.

RETROSPECT

THE problem of nutrition is one of great difficulty. Erroneous theories have taken heavy toll of the health of our people in the past; they have not ceased to prejudice it to-day. At one time we were told that proteins in food were the only thing that mattered. Then calories came into fashion. The real issue—that even the most generous supply of calories and proteins is incapable alone of maintaining life, whether in men or animals—was utterly misunderstood. We failed to grasp the dietetic value of foodstuffs; malnutrition was identified with undernutrition, oblivious of the fact that malnutrition by no means implies any deficiency in quantity in the food consumed.

After the Four Years' War, theories of nutrition entered on a new and decisive phase. It was at last realised that various diseases were effects of malnutrition, and at the same time the distinction between malnutrition and undernutrition became manifest. Malnutrition came to be understood as the result of a lack of certain food elements which are now recognised as "accessory foods." And it is our realisation of the influence of these accessory food elements on health and sickness which has changed our whole attitude towards the problems of nutrition.

It is worth remembering that our modern knowledge as to nutrition was initiated by the school of the American physiologists Chittenden and Wisconsin. Their researches were of fundamental importance, and led to

an entirely new outlook. It is surprising, however, to learn that a connexion between food and ill-health was proved to exist as early as 1720, when the Austrian army doctor, Kramer, discovered the successful method of treating scurvy, and was able to cure this disease by means of oranges, lemons and other fruit. Scurvy was a complaint prevalent among sailors during long voyages, when for weeks or months at a time they lived almost entirely on salt meat and ship's biscuit; it was one of the major perils of a seafaring life. The symptoms were a weakening of the entire muscular system, apathy, bleeding of the gums and skin, hæmorrhage of the intestines, succeeded by cardiac weakness and death. Kramer's observations were later confirmed by Captain Cook. It is scarcely credible that information so precious as this should have remained so long ignored.

Beri-beri, another disease with numerous and complicated symptoms, had long been rife in Japan, when its cause and treatment were discovered in 1897. To no highly qualified specialist is due the credit for this discovery. Surprisingly enough, it was made, not in any well-equipped research laboratory, but in a Javanese prison camp, and by an ordinary General Practioner named van Eijkman, who was medical officer to the inmates. He noticed the prisoners, one after the other, falling sick, and it occurred to him that their fatal illness must be due to their sole form of food, which was polished rice. Once convinced of this, he decided to make further investigations. He began to experiment on chickens, and found that only those fed on polished rice developed the symptoms of beri-beri. Birds which were given a diet of unpolished rice or millet barley displayed none of the symptoms, while fowls suffering from beri-beri, when fed on the unpolished grain, were cured.

These experiments of van Eijkman demonstrated that polished rice tended to produce a certain disease for which unpolished rice possessed curative properties, thus proving for the first time that one of the world's most serious maladies was due solely to the lack of a particular food element. By providing patients with this element missing from their former diet the disease could be not only cured but prevented. It is to van Eijkman, therefore, that we owe the basis of our knowledge of deficiency diseases. And these missing elements in the polished rice are among those food factors which have since been christened vitamins.

In spite of their significance, van Eijkman's observations remained completely neglected by the medical world. Not until 1906 were they rediscovered and made the starting-point for further research.

The ball was set rolling when Hopkins and Funk, who are the originators of the " vitamin " theory (1912) provided the theory of vitamins with its scientific foundation. Then, in a very short space of time, important investigations were begun, and new results emerged in quick succession. Vitamins of various kinds were discovered and their effects explained. The course followed by these researches led gradually to one of the most imposing achievements in medical history. Suddenly the whole world awoke to the importance of this new knowledge, and with it grew the realisation that our old theories of nutrition were basically unsound. We learned that food has a biological as well as an energy value.

Meanwhile the effects of salt-free and unfired food were also discovered. It was found that malnutrition affects not only the individual but the population as a whole, and that its effects endanger the health of generations to

come; that it will harm not only physique, but character and intellect as well.

Intensive research and clinical observations have yielded a wealth of new knowledge on the whole subject of nutrition, which has been carefully collected, and throws a new light on medical problems. Thus the connexion between mental and physical afflictions has become better understood, and their common origin traced; the curative value of dietary treatment has gained recognition and, step by step, the value of special diets has been established, so that we know to-day that " healing food " may also become " protective food."

The discovery of vitamins and the results of vitamin research can be seen, now we look back on them, as a revolution in medicine, and more than that, as a turning-point in the history of mankind. Had mankind earlier understood the true relation between nutrition and disease, which has been brought to light only by investigating the properties of vitamins, the science of nutrition would have been duly honoured. As usual, mankind was blind, and now once more must be taught how to see.

In conclusion, it should perhaps be pointed out that the most important research work on vitamins was done by British scientists. Men like Hopkins, McCarrison, Drummond, Mellanby and John Orr will be for ever famous in the history of medicine, as the pioneers in this branch of the science. Not only are they the pride of their own nation, but they deserve the gratitude of the whole scientific world and the thanks of every human being. Their work was done quietly, unassumingly and without recognition, yet they have done more for the race than all the film stars and record-breakers put together.

CHAPTER ONE

THE EXPERIENCE OF THE LAST WAR

THE Four Years' War gave rise to certain diseases directly, and to certain others indirectly. Some of these died down almost as soon as hostilities ended, others attained their full virulence only after all active combat has ceased. They may all, however, be grouped under three main classes: infectious diseases, kidney affections and hunger œdema.

INFECTIOUS DISEASES

The principal infectious diseases were typhoid, dysentery, cholera, tetanus and pneumonia, each being the effect of certain recognised bacilli. To prevent their spread, general inoculation was made obligatory for the fighting forces, the medical world at the time being still under the impression that a knowledge of bacteriology was the be-all and end-all of medicine. Doctors understood the nature of germs, but very little indeed of their action. Something may have been known of the mechanism which protects the body against infection, but the organism was regarded as nothing more than a helpless victim of the microbe gangster. The medical profession was, as it were, a Watch Committee which investigated the immoral activities of bacteria and their toxins. The one and only safeguard against infection was prophylactic inoculations, the sole cure the appropriate curative sera.

The extent to which nutrition could influence the protective powers of the human organism was unknown, and while the importance of the part played in the fight against infection by the defensive agents present in the body was fully realised, knowledge of the measures necessary to overcome infection was lamentably deficient, the influence of vitamins and minerals was scarcely recognised, and the connexion between immunity and metabolic conditions was quite unknown.

Only during the last few years has our attitude towards infectious diseases been fundamentally changed. Only recently have we learnt that it is not only the various *bacilli* and their toxins which determine the course of an infectious disease, but that the defensive mechanism of which the body disposes can equally affect it, and that, while antitoxins are decisive in the progress of an infection, the defensive forces produced by the vitamin and mineral content of the tissues can be recruited and controlled.

We know to-day that tissue excessively supplied with acids is more susceptible to infection than is alkaline tissue; we know how much the course of an infection depends on the salt content of the tissue, and we have come to appreciate the value of a saltless diet for the successful treatment of infectious diseases; and while during the last war we were still unaware of the fact that sugar, as well as salt, can influence infectious diseases, we now know that large quantities of sugar can eliminate the poison in the system by neutralising the toxins produced by bacteria: that sugar, in fact, increases our capacity for building up antitoxins.

In recent years the relation between prophylactic therapy and the production of hormones has become increasingly obvious, and we have by now learnt that the

issue of any disease depends mainly on the working of our blood-vessels. The physician's most important task to-day is to increase vascular tone, since infection lowers the blood-pressure and a weakening of tone in the vascular system brings with it the threat of collapse, to prevent which is the main object in the treatment of all infectious diseases. It is astonishing to realise that our knowledge of the regulation of the vascular system was so restricted at the time of the last war, while to-day it is common knowledge that this system is regulated by the hormone of the adrenal cortex gland, and that the more actively this gland functions, the stronger is the defence which the organism can put up. It can in fact be demonstrated, though in varying degree in individual cases, that every infectious disease leads to a deficiency in the adrenal cortex hormone.

As explanation of all these processes may well be demanded, and can be obtained by reference to the investigations recently carried out into the relation of the adrenal cortex gland to the utilisation of vitamins B and C. Only when the hormone of this gland functions effectively will the organism be able to make use of the two vitamins in question. This explains why a diphtheria infection, for instance, takes a different course according as the organism affected is rich or poor in vitamin C; and why the administration of vitamin C, together with adrenal cortex hormone, which enable the organism to make full use of this vitamin, can interrupt and prevent the progress of this infection.

It is interesting to note that we can now recognise when the conditions responsible for a disturbance of the nervous system are due to infection. The nervous system will be affected only if vitamin B is lacking. The adrenal cortex hormone regulates not only vitamin metabolism but also

sugar metabolism. Knowledge of this fact has improved the treatment of infantile paralysis; it has taught us that we can at any rate influence its course by administering large quantities of sugar, calcium and vitamin B.

VITAMINS AND INOCULATION.

All these facts force us to revise our views as to the importance of dietetic treatment for infectious diseases. One of our main objects must be, therefore, to improve the defensive mechanism of our organism against germs.

Increasing the supply of vitamins C and A reduces the danger of infections. Inoculation with preventive vaccines is only a prophylactic measure against a particular germ, but the supply of vitamins, if the hormones are acting normally, will be a preventive against all kinds of germs. This is of the highest importance, for protective inoculation can be employed with any hope of success only against typhoid, dysentery, diphtheria, etc., not against such diseases as influenza and infantile paralysis, which are a serious threat to the health of the nation.

A personal experience may serve to illustrate how far opinion has changed since the Four Years' War. As a young doctor, I had to deal with a serious epidemic of pneumonia. To my great concern, the death-rate among young soldiers was higher than 50 per cent. I was deeply impressed by this fact, and by the explanation given by my teachers, *i.e.*, that we were to distinguish between malignant and non-malignant pneumonia, and that there was no remedy for the malignant form. This explanation did not satisfy me. I soon observed that the course of malignant pneumonia depended solely upon the resistance of the vascular system and the proper functioning of the heart. Realising this, I began to treat the patients with remedies which increased the vascular tone and prevented

cardiac weakness from the outset. The death-rate was reduced to 2 per cent.

This result was startling enough. But what a difference between my treatment then and treatments based on our present knowledge! To-day we know how decisively pneumonia can be influenced by unsalted food and the use of large quantities of fruit and vegetable juices, sugar and vitamins. By this treatment even the gravest cases of malignant pneumonia can be cured in a few days.

How can these results be explained? By the administration of fruit and vegetable juices and of vitamins, and by the deprivation of salt, the body receives potassium and becomes alkalised; by this change of diet the tissues are altered and the effect of bacillus toxins is nullified. Sugar and potassium increase the vascular tone and prevent cardiac weakness; by an unsalted diet the inflammation of the lungs is influenced. In fact, by these means every remedy becomes still more effective.

These results are based on a general law: that acid food increases susceptibility to infection and decreases bodily resistance to germs; that sodium chloride (salt) assists infection, while potassium, sugar and all vitamins counteract it. In other words, the food we take can reduce or increase our liability to infection by mobilising our defensive reserves through correctly administered vitamins and minerals.

The efficacy of preventive inoculation can also be increased by the right kind of diet. The success of inoculation varies with the individual, a fact which is to be explained by the difference in the vitamin and sodium content of the tissues of those individuals. Tissues rich in protein and salt tend to diminish the efficacy of inoculation, while those rich in vitamins, sugar and potassium tend to increase it.

ALLERGY AND INOCULATION

Recent investigations into allergic diseases have thrown much light on the problems of inoculation. The fact that an allergic person is more susceptible to a disease than a normal person must be taken into account. In the treatment of certain infectious diseases a specific serum therapy is indispensable, and this raises the question whether an allergic person should be prophylactically inoculated or not. This, again, raises a still graver and wider issue: that of compulsory inoculation; a problem whose solution must be left to the authorities responsible for the public health.

KIDNEY DISEASES

The kidney diseases observed during the last war were actually all a special form of nephritis: not the common Bright's disease, but an affection of the kidneys accompanied by fever and renal colics, or rather a combination of inflammation of the pelvis of the kidney with nephritis. I made a special study of this malady, calling it " War Nephritis," as a new clinical entity, and it was proved that this particular kidney affection was a consequence of various infectious diseases from which the soldier-patient had previously suffered. Here, as in so many other cases, present-day knowledge has vastly improved treatment. We have learnt to prevent as well as to cure the inflammatory process by a saltless, alkalising diet, rich in potassium and vitamin C.

CONSTIPATION.

Here vitamin B again comes into the picture. Inflammations of the pelvis of the kidney, and of the gall bladder, are caused by an infection which takes its rise from constipation; for constipation causes a poisoning of the

organism. It is due to sluggishness of the intestines consequent upon a deficiency in vitamin B. By taking vitamin B this condition of the intestines and the resulting constipation can be cured. This explains the real efficacy of the old-fashioned use of baker's yeast for this ailment.

The frequent occurence of constipation after infectious diseases was formerly not understood. To-day we know that every infectious disease leads to deficiency of the adrenal cortex hormone and of vitamin B. During an infection the organism is not only robbed of a great deal of its vitamin reserve, but is prevented from putting it to proper use. For this reason a radical change of diet is imperative, and the present-day treatment of every description of intestinal malady should consist in administering vitamins and minerals, and avoiding animal proteins. Here I must call attention to gastric influenza, with its muscular and nervour pains. These are due to a lack of vitamin B, giving rise to a latent chronic intestinal infection, which, in turn, produces chronic constipation.

All this only goes to show the great importance and interest of recent dietetic discoveries, made since the last war, in their bearing on infectious ailments.

HUNGER ŒDEMA.

Another disease frequently observed during the last war was hunger œdema. It was caused, as we now know, by malnutrition.The symptoms were a sudden swelling of the face, arms, legs and of the whole body, accompanied by anæmia and dilatation of the heart, and it was occasionally even fatal. The malady was so prevalent, not only among soldiers but also among the civil population, that it could, without exaggeration, be called an

epidemic. To-day we know that it was a disguised form of beri-beri, due to lack of vitamin B and disordered mineralisation. Later chapters dealing with vitamins and minerals will explain the influence of accessory food elements on infections, and on their action.

I have attempted to point out in the foregoing pages how greatly our teaching on dietetics has benefited by recent discoveries, and to show from my own experience how severely we were handicapped in our fight against infection and malnutrition by our lack of knowledge during the last war. Even when it was over we were left with a legacy of rickets and scurvy, both due to malnutrition. Malnutrition, again, was one of the causes of the fatal influenza epidemic which swept the whole of Europe in 1918 and 1919. Owing to shortage of minerals and vitamins, the heart and vascular system failed to function adequately, so that resistance to infection was almost nil. Had we known then what we know to-day, we should have been able to ward off this terrible scourge which struck down more victims than the battles of four years.

"The nutrition problem is one vast marvel, and keeps one in a constant state of amazement at one's self. For the naive layman the most natural thing in the world, for the investigator of nature it conceals the ultimate riddle of life."

C. N. SCHLEICH.

CHAPTER TWO

FOOD REQUIREMENTS

THE KIND OF FOOD WE NEED

WE were brought up in the past to consider the nutriment contained in food of any kind solely from the point of view of the production of energy. Nothing was worth discussing except calories, which were looked upon as the focal point of the whole question of nutrition.

Teaching on nutrition was based on the calorific value of foodstuffs, because it was believed that the nutritional value of any food product was dependent on its calorie content alone. Scientists of a more theoretical turn of mind informed us that the more calories a food contained the more nutritious it would be. It occurred to nobody that food had other work to do as well as energise. The biological value of foods was entirely overlooked, because the scientific opinion of the period had forgotten that the human organism is not a mere mechanical apparatus, but a structure made up of living cells. Such an attitude has become untenable since the discovery of vitamins improved and altered our whole conception of nutrition. We have now learnt to distinguish between malnutrition and undernutrition; the latter implying a shortage of food, and the former meaning that one or more of the ingredients necessary for good health is either lacking altogether or present in an insufficient quantity. Vitamins are the elements of biological value in food, as dis-

tinguished from the energy-producing elements. The importance of this distinction is clear when we remember that a body may be in a state of malnutrition although supplied with all the energy food and protein it requires.

The production of energy in the body is, however, an important function of food, and we can classify foods according to their capacity for producing energy by oxidation. Calories are the units by which this energy is measured, one calorie being the amount of heat required to raise the temperature of one kilogramme of water one degree Centigrade. Thus, when we say that the caloric value of bread is 1,088 calories, we mean that when one pound of bread is " burnt up " in and by the body it warms the body to the extent of 1,088 calories. The caloric value of the principal articles of diet is given in most modern cookery books.

Malnutrition is determined by deficiency of biological nutriments and undernutrition by deficiency of energy-producing nutriments. As has been mentioned already, it is quite possible to consume a sufficiency of calories in the form of proteins, carbohydrates and fats without adequately nourishing the system, because there may still exist a deficiency of those food elements which are necessary for good health, though these last are required only in minute quantities. These elements form a biological unit, under the name of *protective food.* They consist of the accessory foods; vitamins and minerals. It is the want of these accessory foods which leads to the condition of malnutrition. To-day we know that these minute quantities are just sufficient to protect the body from diseases, but never enough for increase in health and efficiency. For that aim much larger quantities are needed and in my opinion we need for instance more than thousand International Units of Vit. B1 daily.

To sum up: diet, in its nature and function, has a threefold aspect.

It must include: *Energy-producing food*, which gives us energy and heat and comprises carbohydrates and fats, such as butter, margarine, flour, potatoes and farinaceous products (cereals, bread, cake, macaroni, biscuits).

Body-building food, i.e., proteins, which are found in milk cheese, eggs, meat, fish and all vegetable (leguminous) products.

Protective food, rich in minerals and vitamins, including dairy products (milk, butter, cream, cheese and eggs) market-garden products (green vegetables, raw salads and fruit), sea products (herrings, bloaters, kippers, mackerel, salmon and eels) and citrous fruit (oranges, limes, lemons and grapefruit).

It will be seen that several foodstuffs in the above list belong to more than one class. Milk, for instance, is both a body-building food and a protective food.

To-day we know that protective food has definite nutritive values. It is used and prescribed not only to protect the organism against certain diseases, but in large quantities it increases our health and raises the all-round standard of efficiency.

RECOMMENDATIONS OF THE LEAGUE OF NATIONS

The most recent investigation into the theory of food values was made by a Commission of the League of Nations. In 1935 the League summoned a mixed commission, consisting of twenty-one agricultural, economic and dietetic experts, to survey the whole field of nutrition and health. Its final report was published in 1937, and contained the following findings and recommendations:

(1) *Calorie requirements.* Two thousand four hundred calories *per diem* are considered adequate for an

adult living in a temperate climate while not engaged in manual work. To this basic quantity the following supplements should be added if he indulges in muscular activity:

Light work, 50 calories per hour of work.
Moderate work, 50 to 100 calories per hour of work.
Hard work, 100 to 200 calories per hour of work.
Very hard work, 200 calories or more per hour of work.

In present conditions, and for war work, 200 calories per hour of work is the minimum requirement.

(2) *Protein requirements.* The daily consumption of protein for every adult should not fall short of 1 gramme per kilogram of the weight of the body. This protein should be derived from a variety of sources; part only of the protein should be of animal origin.

(3) *Fat requirements.* Fats should be a constituent of normal diet, but the data to hand are not complete enough to allow of any precise statement as to the quantity required.

(4) *Mineral and vitamin requirements.* The Commission recognises the fact that the deficiences of modern systems of diet are usually to be found among the protective foodstuffs rather than among the strictly energy-producing foodstuffs. First in importance of the former are milk and milk products, eggs and glandular tissues, and then green-stuffs, vegetables, fruit, oily fish and meat. Among the energy-producing foods of little or no protective value are sugar, milled cereals and certain fats. Refined sugar is entirely devoid of minerals and vitamins. The increasing habit of consuming large amounts of sugar tends to lessen the quantity of protective elements in the diet and is to be regarded with concern.

The majority of persons in civilised countries obtain sufficient food for energy purposes and an adequate supply of proteins.

The Commission came to the following conclusions:

(*a*) It is a general principle that a varied diet makes for safety, provided it contains a sufficiency of the protective types of food materials.

(*b*) White flour is deprived in the process of milling of important nutritive elements.

(*c*) The consumption of an excessive amount of sugar is to be condemned, and its partial replacement by potatoes is urged.

(*d*) Milk should form a conspicuous element in the diet at all ages.

(*e*) Fresh vegetables and fruits should always be constituents of the normal mixed diet.

(*f*) Extra quantities of vitamin D, either in the form of cod-liver oil, or as irradiated products, should be given whenever sunshine is not abundant, especially during the period of growth and during pregnancy.

The importance of an " optimum nutrition," that is, best possible type of diet, is stressed. During our present war effort this "optimum" can be considered only as the " minimum " needed for proper nutrition. Moreover, the caloric requirement which is demanded for very hard work is about 4,000 calories daily. In this connexion it must be stressed that efficiency depends not only on calories, but even more, and far more, on the "protective foods." It used to be mistakenly supposed that the importance of the accessory food elements to the organism was biological only, and that they had no influence on efficiency. But it has now been proved that efficiency is definitely increased if vegetables and uncooked foods are eaten in larger quantities than animal proteins.

The conclusions of the Commission still show that it was principally concerned with the importance of protective foods, and that it considered the average diet of civilised countries to be unbalanced, as being too rich in proteins and sugar. With this conclusion I am unable to agree. In spite of the fact that the refined sugar we are accustomed to eat is deleterious, owing to its deficiency in minerals and vitamins, sugar remains the most valuable representative of the carbohydrates. From a biological point of view, sugar, though not, of course, in its refined state, is indispensable, and of far greater importance than we believed. As we shall see later on, when we discuss carbohydrates, it would not be difficult to produce a suitable sugar containing all the vitamins and minerals which we need.

The Americans have gone far beyond the Committee of the League of Nations. This is illustrated by the difference in standard of an adequate diet set up by the League of Nations and by the Food and Nutrition Committee in Washington recently. The American standards of adequacy are for vitamins A, B1 and C three times those proposed by the League of Nations.

PROTEINS.

Above we discussed the threefold aspect of food: its functions of producing energy, body-building and protection. In this section we shall discuss in greater detail the body-building elements provided by proteins.

The protein requirements of the body were the subject of discussion for more than fifty years, as one of the crucial problems of nutrition. Opinions were divided. While some experts were advocates of larger quantities of protein, others were opposed to any increase in the amount already habitually consumed. The controversy finally led

to the conclusion that 57 grammes of protein daily is enough to maintain physical fitness for a long period, whereas formerly 115 grammes daily was regarded as the minimum demanded for a healthy body.

Meat is not the only food which contains protein. There is also vegetable protein, which is very valuable, as well as that contained in the articles of diet enumerated above. Protein, however, has hitherto been taken chiefly in the form of meat, and wherever we look in history we shall find that the dominant races were great protein eaters, and that there has always been an instinctive longing for flesh food among all those peoples who prized physical energy. This subconscious feeling is expressed in the Old Testament passage which tells us that the people of Israel lusted after the fleshpots of Egypt. And in Homeric Greece, when there was no real distinction between " holy " and " strong," the heroes shared the meat offerings sacrificed to the gods in order to participate in their divine vigour.

But now that we have discovered the value of accessory foods we know that a diet rich in vegetables has also a body-building power, since vegetable products also supplies the organism with the proteins it needs. On the other hand, too much meat, or other animal protein, is deleterious. More than 600 grammes of meat a week for one adult is not only unnecessary, but harmful, as recent research has told us. Now the English are the largest meat eaters in Europe. While in normal times 53 kilograms of meat suffices a Frenchman for a year, 51 kilograms satisfy a German, and a Spaniard is content with 29.5 kilograms, and Englishman demands 59. The average German eats about 92 grammes a day, the Frenchman about the same, the Dutchman or Belgian 86 grammes, the Italian 29 grammes, while the English-

man eats 130. Now, the maximum average quantity of meat necessary for health lies between 58 and 75 grammes *per diem*, so that the average amount eaten daily in this country is double what it should be. It is true that the succulence of an English steak and the flavour of a British sirloin are unsurpassed, except perhaps by the excellence of a Welsh saddle of mutton (no, *not* the leg, which is far inferior), and that other less favoured races are compelled to disguise their rank sheeps' flesh and stringy beef with vegetables and sauces; but the shifts to which these unfortunates are put, in order to make their dishes palatable, have led to a most salutary addition of mineral and vitamin-containing accessories, which would save the despiser of "kickshaws" from half the ailments that afflict him.

But what is the harm done by too much protein? The more animal protein we consume, the more salt will be stored in the tissues, because the animal proteins which are decomposed in our organism retain a large amount of water and salt. Therefore, the salt content will be decreased if the organism is poor in animal proteins. Another factor is of highest importance in this connection, namely, that vegetable proteins, owing to their potassium content, do not retain salt, but decrease the salt content in the tissues; at the same time they alkalise the tissues.

The acidity in the tissues caused by animal proteins will in its turn cause diseases such as rheumatic affections, dental decay and paradentosis. But excessive protein and salt not only produce disease; they also diminish our power of resistance and thereby increase liability to infection and fatigue. Fatigue and lassitude are due to a disturbance in the vascular and hormone system brought about by chronic protein poisoning. An over-acid organism loses the capacity for making use of the vitamin

supply contained in our food, and though such an organism consumes vegetables, fruit and potatoes, the vitamins will not be adequately absorbed and will remain largely ineffective.

THE FUEL OF LIFE.

Heat is the first prerequisite of any vital process. Muscular energy is a prime condition of human life, and must therefore be incessantly maintained. Both heat and muscular energy are produced by the combustion of food in the cells of the body, every living cell assisting in the process, and the energy of muscular contraction is derived mainly, if not entirely, from the combustion of carbohydrates.

The term carbohydrates is applied to starch, sugar and cellulose, and the particular form which carbohydrates take in the muscles is a substance known as animal starch or glycogen. The carbohydrates are burnt, in so far as they are not stored in reserve, in order to set free energy. For the combustion of these nutrients oxygen is used.

If carbohydrates are lacking in our food, the body has the ability to produce them. Protein is not, under normal conditions, the fuel used for energy, as this fuel must be free from nitrogen, and neither protein nor fats can be burnt up by the muscles until they have been converted into carbohydrate or some other related substance. In order to make them usable as fuel for combustion in the muscles, fat and protein must first be converted into glycogen. But the muscles are not the only tissues in which energy is liberated; the glands, the brain and the nerves need these food elements equally in order to fulfil their proper functions.

There is abundant evidence that if sufficient carbohydrates are present they supply the energy necessary for

muscular activity. Recent investigations have shown that while the energy for muscular activity derives from the combustion of either carbohydrates or fats, there is no doubt that the efficiency due to the combustion of carbohydrates is greater than that of fats. We know also that the more severe the muscular effort demanded, the greater the quantity of available carbohydrates oxidized. Heat production corresponds to oxygen consumption. A carbohydrate diet will enable a worker to keep up a strenuous effort far longer than a diet of fats. An average diet will include carbohydrates in sufficient quantity; these being partly contained in the food as carbohydrate proper, and partly formed from proteins.

Sugar that has been ingested with the food may be at once " burnt up " to supply immediate needs. The cells of the organism absorb the sugar, which provides by this combustion the energy required for work and heat. The various kinds of sugar are not, however, oxidized at a uniform rate; fructose, for instance, oxidizes more rapidly than glucose. If the disproportion between the small supply of, and the large demand for, carbohydrates lasts only a short time, e.g., a few hours or days, the glycogen is used first as a reserve. Together with such amounts of carbohydrates as are pre-formed in protein and become liberated from it, it forms a source of supply for the muscles and other sugar-consuming cells.

The deficit thus created ultimately exhausts the supply. In both men and animals whose nourishment has been seriously defective, or who have been starving for a long period, and who may in addition have performed strenuous muscular work, traces only of glycogen are found in the liver and muscles. After exhausting work the blood sugar falls. In spite of defective nutrition, neither the formation nor the combustion of sugar ceases, for every

muscular action necessitates the consumption of sugar by the muscles. The opinion that the muscles are also capable of maintaining their power and heat production by the decomposition of protein can be refuted by experimental evidence.

A considerable quantity of nitrogen-free compounds must be burnt in the muscles, these compounds being derived neither from the glycogen reserves nor from the decomposing proteins, since both these sources combined are inadequate for supplying the requisite energy. According to the generally accepted opinion of to-day, the substance which makes good this deficiency can only be *fat*. We know that for strenuous muscular activity a large amount of fat is burnt, this being derived partly from the ingested food, partly from the fat in the body. From this we may conclude that the fat, prior to being supplied to the muscle, and used as a source of energy, is changed into a suitable form. According to recent clinical and experimental investigations, when the need arises, the fat is changed into glucose in the liver. The formation of sugar from fat is a normal, daily and hourly process.

With a superabundant supply of carbohydrates, provided the excess is confined within moderate limits and lasts only for a short time, the glycogen store in liver and muscles is replenished. It has furthermore been shown that all the cells of the body are capable of storing carbohydrate in very limited quantities in the shape of glycogen or other polymerised varieties of sugar. The estimated amount of glycogen stored in the body is about 300 grammes. If, however, there is a large surplus of carbohydrates, so that there is no room left in the glycogen storage centres, this surplus is changed into fat, which is then deposited in the extensive adipose layer of the sub-

cutaneous tissues and other parts of the body. According to Fletcher and Hopkins, however, sugar must be considered as the exclusive direct supply of energy for the metabolism of the muscles.

Carbohydrates have all fundamentally the same components: carbon, hydrogen and oxygen, the two latter in the same proportions as they are found in water, *i.e.*, 2 : 1. Their chief importance for diet lies in their ready combustion.

In their simplest form, carbohydrates are found in the various kinds of sugar, glucose (or grape sugar), and fructose (or fruit sugar). Honey and sweet fruits are rich in sugar. Common table sugar, whether produced from beet or cane, is a combination of glucose and fructose.

Other forms of sugar are maltose, derived from malt, and milk sugar. Milk sugar and glycogen are the only carbohydrates not derived from a plant source, glycogen being an animal muscular substance found in meat. It is stored in the liver and muscles, just as plants store sugar in the form of starches in their roots, stems and seeds. Malt sugar, which provides malt with its high nutritive quality, is of special importance. It is the sugar which most effectively rids the blood and tissues of protein poisoning. It is therefore to be regarded as antipathetic to proteins, and the convivial bachelor, who takes his glass or two of beer in the evening, and the spinster sipping her concoction of malted milk before she retires, are both of them, in fact, providing themselves with a valuable nutrient, however divergent their surroundings and views may appear.

The most important representatives of the carbohydrates in our diet are sugar, potatoes and bread. Sugar contains 100 per cent. of carbohydrates, potatoes 19 per cent. of carbohydrates and 80 per cent. of water, while

the proportion present in bread varies according to the ingredients it contains.

VITAMIN SUGAR

Sugar, as a source of carbohydrates, has already received some attention in the last two sections. But as it is still a subject of controversy I feel that it calls for even more exhaustive treatment in order to emphasise its real importance as an article of food and clear up misunderstandings. This is essential in any discussion of diet in wartime.

The body needs a constant supply of carbohydrates, as it appears that many vital processes cannot be performed without them. Muscular exertion, according to present-day conclusion, is only possible with the aid of pure sugar.

The nutritional carbohydrates are almost without exception of vegetable origin, the one important exception to this rule being lactic acid. But the most important carbohydrate in our food is starch (amylum). This constitutes a series of sugar molecules, whence it derives the name of polysaccharide. Starch, however, not being absorbed, must be transformed into carbohydrates of lower molecular weight which are more easily soluble. The transformation entails a splitting-up process in which the large starch molecule, by taking up water, yields several smaller molecules of carbohydrate. In ordinary foodstuffs are found di-saccharides, *i.e.*, varieties of sugar which contain twelve carbon atoms in each molecule, as well as mono-saccharides, which contain six carbon atoms in each molecule, the most important of these latter being glucose, fructose.

The process of refining sugar is a somewhat antiquated one. It extracts vitamins and minerals from the raw product and releases them as molasses for cattle. By this method vitamin C is destroyed, and all the remaining

vitamins are absent from the finished article. Much attention has been given to the nutritive value of molasses in America, where communities using raw molasses have been found to enjoy better health than those using refined sugar.

Refined sugar has no valuable vitamins or minerals, and for many years continental biochemists have called attention to its evil effects. The most eminent nutritional experts such as Bircher-Brenner (Zürich), Gerson (New York), and the Norwegian Ragnar Berg, call refined sugar the " murderer of civilised man." Berg has produced a commodity he calls "full sugar," by adding basic substances to refined sugar and thus reinstating the vitamins and minerals in the finished product. This sugar was made in Germany (in a factory directed by a Dr. Klopfer) where there was a large demand for it.

We have already seen how the League of Nations Commission condemned the use of refined sugar and recommended in its place an increased consumption of potatoes, forgetting that sugar contains 100 per cent. of carbohydrates in an easily assimilable form, while potatoes contain only 19 per cent. of carbohydrates and 80 per cent. of water; besides which sugar, measured in calories, is by far the cheaper of the two.

We know from experience that the mineral salts contained in plants have a natural stimulant effect and tend to reinforce and prolong capacity for work. But sugar stimulates in the same way, while it should not be forgotten that it is pleasant to take: an important factor in the psychology of nutrition.

It is only in recent years that the importance of sugar for the treatment of many diseases has been discovered, with the growing recognition that a deficiency of sugar is the cause of a number of morbid conditions of the system,

including lowering of muscular activity, low blood pressure, increased tendencies to phlebitis, thrombosis, liver disorders and all kinds of allergic diseases. Still later discoveries have shown that many nervous disturbances of the heart and the vascular system are due to the same cause, and that even aggravated symptoms of these syndromes will yield to administration of sugar. It should be realised that sugar acts as an instantaneous stimulus to oxidation in the system; hence it alleviates fear and depression, which are caused by decreased oxidation.

This newly-gained knowledge explains certain long-established habits. Mountaineers have for many years fought exhaustion and other symptoms caused by the rarefied air of high altitudes, such as palpitations, giddiness, fear and faintness, by eating large quantities of sugar or chocolate, and every sportsman uses the same means to increase his muscular activity, while horses are notoriously fond of sugar. This suggests how our aircraft crews would benefit by consuming large quantities of sugar.

It may be objected that sugar does not appear to produce an instantaneous effect. This is true, but only of refined sugar, which, as usually taken, does not possess the virtues of raw sugar; but it should be remembered that the effect of sugar on the individual organism varies. It is so important that the carbohydrates contained in our food should do their work properly, that we should know as much as possible about the subject. I propose therefore to discuss the question in greater detail.

Sugar is the main vehicle of carbohydrates. In order to be fully effective the carbohydrates must meet with suitable conditions in the organism. If, for instance, vitamin B is lacking, they will be largely inoperative. Again, if the adrenal cortex hormone is not functioning

properly they will not be properly assimilated. Finally, physical and mental efficiency depend on the reserves of glycogen stored in the liver, muscles, brain and heart. Sodium chloride prevents the storage of glycogen, while potassium assists it. An excessive consumption of salt, therefore, will tend to undo all the potential benefits of sugar, while an adequate supply of potassium will promote them. As we know, the more carbohydrates are contained in food, the more vitamin B is needed. The harmful effects of refined sugar, as we have seen, lie in its deficiency in vitamins and important elements, and its elimination of vitamins from the system.

To obtain the full benefit of sugar, therefore, we must avoid an excess of salt, increase our consumption of vitamin B and popularise a sugar similar to that produced by Ragnar Berg, which might be called " vitamin sugar." Such a commodity would increase the efficiency of our workers, fortify our airmen and increase resistance to infection, depression and fear complexes throughout the population of the country.

BREAD AND POTATOES

Bread is made principally from either wheat or rye. Rye, however, became a staple food several thousand years later than wheat; wheaten bread was the only kind known to the civilised nations of antiquity and it was only in those districts and periods of time in which the climate was unfavourable to wheat growing that rye gradually won pre-eminence. In protein content, and in the ease with which it is reabsorbed by the bowels, rye is inferior to wheat; but from the medical point of view rye bread is preferable to wheaten bread, as it is particularly rich in vitamins, and its effect on the bowels fortifies the digestive organs. Mass production has, however, robbed it of its

flavour and attractiveness, and it has been pushed into the background by the cheap and excellent wheaten product. Furthermore, the European grain market has been flooded by surplus wheat from North and South America, while fashion has added its decisive influence, as it does in all food questions, to the demand for the wheaten loaf. We find to-day that rye bread, in this country and many others, is unknown to all but the cultured classes, and among them its appeal is due to advertisement emphasising its slimming effect on the female figure. Another cause of the growing popularity of wheat may be found in the tendency to softness among European nations as evidenced by their increasing femininity.

There are also signs that bread in any form is losing in popularity. Economic surveys show that the average consumption of bread per head has sunk considerably since before the last war; in Germany from 105 to 90 kilograms per annum, in France from 248 to 189, in United States from 154 to 125, and in England from 187 to 125. Only in Italy has it increased from 125 kilograms to 193.

Rye is of the great practical importance, in that it is cheap and yet rich in protein. By means of proper milling the resorption of this protein may be increased and the diet assured of a high albumen content. At the same time, the flavour of rye products can be enhanced by adding to it 10 to 15 per cent. of vegetable albumen. Soya bean meal is the most suitable material for this purpose, and it also increases the protein content.

As a general rule, each country will be anxious to obtain its supply of albumen, as well as its other food supplies, from territories lying within its own sphere of influence. It will therefore be necessary in those countries where wheat is grown on a large scale at least to add rye meal to the wheat flour in order to produce a palatable

bread with a high protein content. The preparation of rye bread would be more appropriately left to the individual baker than to large industrial concerns, as the baker is better able to make both bread and fancy products in a large variety of ways, and so to appeal to as many personal preferences as possible; everybody knows the difference in flavour and texture between a loaf from a large wholesale bakery and that from a country oven.

But whether agriculture and trade favour rye or wheat bread, the decrease in the consumption of bread is matter for serious regret. Bread is indispensable as one of the cheapest forms in which flour starch can be provided in edible form. When properly made, bread is the article of diet which can provide the whole nation with vegetable proteins; wholemeal bread, therefore, as well as potatoes, should be the basis of daily sustenance. The white bread commonly eaten is not only entirely useless, owing to its lack of vitamins, but also poor in protein. An addition of soya bean meal would again provide a remedy here; the importance of this little-known article of diet is so great that a special section will be devoted to it later in this book.

Like the potato, bread is a most important farinaceous product, and it is an interesting fact that the growth and health of the peoples of Europe have been closely linked up with the consumption of large quantities of bread. It is, therefore, the duty of every doctor to insist on more bread being eaten.

Of all the farinaceous products bread is richest in albumen and will provide a great part of the albumen requirement of the system. Meat also gives us albumen, but it is unnecessary to point out that vegetable albumen is vastly superior to animal albumen.

Wheat, as a vehicle for protein, is preferable to rye, because it can be digested and assimilated in larger

amounts. Assimilation is facilitated according as more of the whole wheat grain is milled, so that more bran is included in the flour. In the ordinary process of milling, failure to include the essential components, to the extent of 94 to 96 per cent. of the whole grain, is wasteful both from the economic and nutritional point of view. But, in any case, rye meal should be added to the wheat flour for the average consumer, as this not only increases the protein and vitamin content of the bread, but in addition, stimulates the action of the bowels.

But in any form of bread, and whether rye or wheaten is preferred, we should insist on wholemeal; the husk must be present. The doctor must make it clear that this applies not only to bread, but to all varieties of confectionery; wholemeal, as a palatable foodstuff, as a stimulant of intestinal activity, and as a vehicle for vitamins and salts, has every advantage over white flour, provided always that it is known to be wholemeal of guaranteed high quality. If bread is to be called the staff of life, it must be wholemeal bread, for compared with it white bread is but a broken reed.

Potatoes call for special mention. Their carbohydrate, vitamin and iron content makes them almost indispensable for nutrition, but they have also a high potassium content and an alkalizing effect. Ever since they were introduced into Europe they have played a principal part in popular nutrition. Among the Dutch working classes " potato eating " means having dinner. But the potato has even further virtues. It contains several vitamins, which it may be of interest to enumerate.

The vitamin value of the potato has been made the subject of extensive study. It varies considerably in different types of this vegetable, and can be destroyed altogether by a sudden change of temperature. The

potato is, however, a most valuable food, as it contains both carbohydrates and iron salts.

Therefore, while we may regard the potato as a most valuable source of carbohydrates and iron, we cannot give it a secure place as a source of vitamins, as it is in this respect unreliable, and therefore not to be considered as an ideal food for wartime purposes. It should never be looked upon as providing a substitute for sugar, and though it may replace bread to a certain extent, we should never regard it as capable of providing us with sufficient calories or vitamins for our needs.

In vitamin C, the overall maximum variation in the case of the potato is from 3.14 to 41.0 milligrams per 100 grammes of ascorbic acid. The peel contains 2.2 to 4.5 milligrams per 100 grammes, and evidence exists to show that vitamin C is distributed inside the tuber. Many observations have proved that the potato loses its vitamin C content when stored, and there is evidence that the unripe vegetable contains more than the ripe. Onokhova has, however, stated that no loss of vitamin C occurs when the potato is stored at a temperature of 8 degrees Centigrade, though freezing causes a loss and thawing a still greater loss. Morris, however, found that thawing caused loss of vitamin C, but that freezing did not.

As regards the vitamin A content of potatoes, opinions vary. Some investigators found minimal amounts of carotene present (0.0028 to 0.0026 grammes per 100 grammes), while others could find none at all.

The vitamin B1 content seems to vary between 8 and 60 international units per 100 grammes. Riboflavin was found to be present by certain experimenters in amounts varying from 0.0075 to 0.06 milligrams in 100 grammes.

Vitamin D has never been found in potatoes, and only very small traces of vitamin K.

Potatoes, though possessing vitamins C, B1 and B2, cannot supply them in the quantities needed for health, and rank far below oranges, grapefruit and even bananas; but they are not to be despised, and, having an important alkalizing effect, should be eaten in large quantities.

THE SOYA BEAN

In a booklet, *The Soya Bean*, by Elizabeth Bowdidge, written in 1935, the author says: " It is unfortunate that the inherent conservatism of the English people to anything new has been the cause of past failures to popularise soya bean food products for this country in spite of its protein yield of twice that of eggs, six times that of bread and nine times that of milk."

After the Russo-Japanese war there were some scientists and agriculturists who even at that time realised the great importance of the cultivation and preparation of soya. One of the first was E. L. North, the plant physiologist, who planted soya beans between 1920 and 1934. His misfortunes are described in the booklet from which the quotation that opens this section was taken. He found four varieties which could be acclimatised in England, differing a little from the American and Canadian types. These had astonishingly high protein contents, 40 per cent. or even more.

The average protein content of the soya bean lies between 35 and 43 per cent., and its fat content between 16 and 24 per cent. The modern cultivation of soya is the result of some five thousand years' experience gained by those brilliant gastronomists and cultivators, the northern Chinese. Their knowledge of the plant was used by the Japanese, who were attracted by its cheapness and efficacy, to promote its exploitation after the conquest of Manchuria. In Germany, scientists and manufacturers have made great efforts to educate farmers and house-

wives to make use of soya products, which contain twice as much albumen as meat and nine times as much as milk. The chief obstacle to the popularity of soya was its bitter taste, but this was overcome by the labours of Dr. Berczeller of Vienna. After him many processes for utilising the bean were patented by Hildebrandt and others, but it was left to a Dr. Michael Cohn, of Hamburg to evolve a really cheap and simple means of removing the bitterness. Cohn soya is produced by a large number of factories in Germany and elsewhere on the Continent. The inventor of the method also took out an English patent, but he could find no English baker who would risk loss on this exotic product. Yet it is a fact that the soya chocolate produced by Berczeller and Cohn is pleasant to taste and very nutritious. While the cocoa used in England contains only 19 per cent. of protein and 9 to 20 per cent. of cocoa butter, this soya chocolate contains about 40 per cent. of proteins and 24 per cent. of fat.

In addition to these merits, soya protein is extremely rich in the delicate glutaminic acid, of which the British Isles consume annually 250,000 tons, without even knowing its name, although it is the chief constituent of wheat albumen and gives wheat flour and all wheat products their peculiarly refined flavour. Glutaminic acid is also contained in meat. Many flavouring preparations on the market consist mainly of glutaminic acid.

Further uses for this almost miraculous plant have also been discovered. Soya straw contains more albumen than cow's milk. It is one of the raw materials for good toilet soaps and glycerine. Another patented process of Cohn's converts the starch in soya into glucose. Then again, after many experiments, the world-famous Swiss biochemist Reichstein produced *desoxycorticosteron,* the

chief synthetic substitute for the adrenal cortex hormone, from the bean. This, if nothing else, is enough to prove its sovereign worth.

As well as protein in a high percentage, soya beans contain the whole vitamin B group. One pound of beans contains about 3,000 calories and about 40 per cent. of proteins, the whole group of vitamin B, potassium and phosphorus. And a pound of bread contains nothing but 1,100 calories and 8 per cent. of protein. A hard-working man needs about 4,000 calories a day, and the protein content of a pound of soya would give him his requirements in protein for about two days. We have mentioned soya chocolate, but soya can be ground into flour and used for all farinaceous foodstuffs, and owing to its ample fat content it can be used to produce oil and margarine.

The price of soya in the world market is cheaper than that of wheat. Thus, while costing so little, it has the highest value as giving us calories, proteins and fat. So concentrated a food is obviously invaluable both in peace and war. The Germans, in fact, who boast that they won their easy conquests of Poland, the Netherlands and France on this palatable and concentrated food material, have an annual turnover of 600,000 tons of soya bean. The United States, Canada, Denmark, Russia, Rumania and Slovakia were all, according to the most recent information to hand, increasing their soya cultivation; only this country, in its radical conservatism, has steadily abstained from attempting to promote its cultivation and use, though it is true that the Kew Gardens research station has found a Canadian variety of soya bean which will ripen in England in September. The general neglect of so valuable a foodstuff, however, is, at such a time as this, inexplicable, unintelligible and unpardonable.

"Food is an essential if not, indeed, the most important cause of spiritual, moral, physical and cultural development and of power of resistance against diseases."

McCollum.

CHAPTER THREE

PROTECTIVE FOOD: VITAMINS

IN a discussion of vitamins a full survey of the subject cannot be expected in a work of the present scope. In any case there are numerous excellent standard works on vitamins to be bought at any reputable bookseller's. Besides, a discussion of vitamins in this country is, or should be, superfluous, as England may be called the birthplace of vitamin theory. It is most surprising what little practical use is made of the wealth of knowledge available. It was Sir John Orr who drew attention to the strange fact that more than 50 per cent. of the population of the country suffers from malnutrition caused by deficiency in minerals and vitamins.

Here our foremost concern is with the question of vitamins in war-time. In the early days of vitamin research and teaching, before vitamin Concentrates and Synthetics were available, the emphasis naturally was on food comparatively rich in vitamins. In spite of the insistence on a highly vitaminised diet, little attempt is being made to appreciate the conditions that are essential if such a diet is to be properly effective and of real value. We shall therefore discuss the conditions required if the organism is to derive due benefit from the vitamins it consumes.

The efficacy of vitamins does not merely depend on their mere consumption, though people are frequently to be found who seem to imagine that they have only to eat

quantities of vegetables to obtain supplies of all kinds of vitamins automatically. The average man, in any case, consumes far too few vegetables and fruit, and furthermore, the vitamin content of vegetables varies in several ways.

The nutritive value of vegetables is fourfold; their importance and indispensability in our diet is due to their proteins, their minerals, their vitamins and their alkalising effects. But not every vegetable supplies all four requirements. Their nutritional value as vehicles of vitamins and minerals depends on how they are fertilised and how they are cooked. Their mineral content varies according to the fertiliser used, while bad cooking will destroy both vitamins and minerals. Even their alkalising property can be vitiated by incorrect preparation; spinach, for example, when boiled in the ordinary way, has an acid instead of an alkaline effect.

If we suppose that our need for vitamins is met simply by the addition of a certain amount of fruit and vegetables to our diet, we are making a very great mistake. In the first place, not all vegetables are equally rich in vitamins; secondly, the usual method of boiling destroys the vitamins; lastly, an undernourished organism must be conditioned before it can assimilate the vitamins it consumes. And bearing in mind our main object—to increase efficiency and resistance—we require not merely the minimum, but the maximum supply. How this is obtained will depend on the vitamin value of the fruit and vegetables chosen; how it is utilised will depend on the degree to which the various minerals in the tissues are in correct balance, and also on the extent to which the tissues are acidified or alkalised.

With regard to supplying the organism with the necessary amounts of vitamins by diet, Jolliffe, one of the most

eminent nutritionists of America, states: "If a man were dependent exclusively on fruit, vegetables and milk for a liberal supply, he would have to consume 1½ lb. of fruit, an equal amount of potatoes, 2 lbs. of other vegetables, and three quarts of milk daily."

One is often tempted to ask whether vitamins are really of such importance, and not merely a fashionable fad. The answer is given by a number of surprising confirmations of their value. Large quantities of cod-liver oil, for instance, which contains a high percentage of vitamin A, are an infallible cure for night blindness; and xeropthalmia, a disease of the eye characterised by the drying up of the cornea and conjunctiva, together with ulceration and degeneration, which, until recently, was regarded as incurable, can now be cured by the same means. The nervous system is also influenced by vitamin B, lack of which leads to neuritis and nervous disturbances. All these facts are so incontrovertible and overwhelming that it is incredible they should have been ignored for so long.

The first clear evidence that the growth of animals was dependent on other factors than fats, proteins, carbohydrates and salts, was obtained from the experiments of Hopkins. His decisive pioneer work was carried out in 1912, and his published results, which are of classic importance, made possible the enormous advance since achieved in this field of study.

Vitamins have been described by Drummond as "essential constituents of the diet, organic in nature, incapable of synthesis by the body and effective in playing a part in the maintenance of the normal functioning of tissues in amounts minute by comparison with those of the foodstuffs which supply structural material and energy." Today we are far more advanced in our know-

ledge of vitamins since Synthetics and Concentrates are available. Synthetic vitamins are those which investigators have learned to produce artificially, *i.e.*, to synthetise after discovering the chemical structure of the original vitamin.

In the Concentrates the vitamin is left in a much more highly concentrated form than it can ever be found in nature. Vitamins are divided into groups, on the basis of their biological activity, and the chemical structure of several is known. We shall now discuss them in alphabetical order.

VITAMIN A

Deficiency in vitamin A, as already mentioned, causes pathological states of the eyes such as night blindness and xeropthalmia; it is therefore known as the anti-xeropthalmic vitamin. It is found in great quantity in cod-liver and halibut-liver oil. As these oils also prevent rickets, it was formerly thought that a single vitamin cured both types of disease. But McCallum discovered that the oxidation of cod-liver oil deprives it of its efficacy as a cure for xeropthalmia, but not of its power of preventing rickets. It was also found to contain a second substance, known as vitamin D. Another discovery showed that there was a relation between a yellow pigment contained in plants, known as carotene, and vitamin A; though it has since been established that carotene itself is not vitamin A, but only an " embryonic " form which is changed into the vitamin proper in the animal body. Carrots, yellow sweet potatoes and yellow grain are rich sources of vitamin A, which incidentally is not present in white grain. Besides giving rise to the diseases already mentioned deficiency of vitamin A arrests growth, causes

dryness of the skin, loss of hair, affects the mucuous membranes and lowers resistance to infection. Many cases of Furunculosis are caused by lack of vitamin A.

VITAMIN B1

For reasons now known to the reader (see "Retrospect") lack of vitamin B1 causes beri-beri. Hence it is sometimes called the anti-beri-beri vitamin. It is also known as the anti-neuritic vitamin, from its power to prevent and cure polyneuritis, the chief symptom of beri-beri. Its general anti-neuritic activity has been demonstrated by the clinical use of B1 in pure crystalline form for various forms of neuritis. Beri-beri, however, gives rise not only to neuritis, but also to œdema, or swelling of the extremities, dilation and weakness of the heart, and muscular pains. For some time the therapeutic effect of B1 on these symptoms was not understood, but we now know that it facilitates the metabolism of carbohydrates. If it is lacking, sugar cannot be adequately utilised by the system and too much lactic acid accumulates. Now lactic acid is a substance that is continually being produced in the muscles, especially while they are expanding and contracting at an increased rate during the performance of hard physical work, when it seemingly tends to poison the cardiac muscle and prevent its working at its full rate. Vitamin B1 eliminates this lactic acid, so that the heart can beat at its normal rate again. Hence we see that vitamin B1 regulates certain of our metabolic processes.

Beri-beri, however, does not always show its full complex of symptoms. Much more frequently we meet with disguised forms, the so-called frustrated beri-beri, which may show one or more symptoms only, among these being

various forms of sciatica, lumbago and neuritis, all of them results of a deficiency of vitamin B1.

The natural sources of vitamin B1 are wheat germ, tomatoes, yeast, liver, nuts, oatmeal, rice and potatoes.

To-day we know the chemical structure of Vitamin B1, *i.e.*, Thiamine chloride. Synthetic crystalline thiamine is now on the market in tablet form and in solution ready for injection.

VITAMIN B2

Vitamin B is a complex which includes a series of different vitamins. Having already discussed vitamin B1 in the preceding paragraphs, we will now pass on to the others.

Vitamin B2 benefits the skin, which without it becomes brown and tends to ulcerate. This cutaneous affection is known as pellagra, and vitamin B2, which prevents and cures it, is known as the anti-pellagra vitamin. It plays an important part in the oxidation of the tissues. If it is lacking, oxidation decreases and combustion is disturbed. Recent research has shown that vitamin B2 is divisible into two components: lactoflavin or riboflavin and nicotinic acid.

The chief sources of vitamin B2 are spinach, carrots, lettuce, pears, bananas, milk, eggs, liver, beef and yeast.

The human requirement of vitamin B2 has not yet been accurately determined. It should be something like 1.5 mg. daily for children and 2 to 3 mg. daily for adults.

The lack of vitamin B in European diet has been responsible for ever graver effects. Not only is it the main cause of many heart affections, but it leads to sluggishness of the intestines with resulting chronic con-

stipation. Chronic constipation in turn brings about auto-intoxication, which produces fatigue, lack of determination and concentration and rheumatism. Constipation in its chronic form also upsets the action of the liver and gall bladder. It is astonishing that, in this country especially, where rheumatism with concomitant liver troubles is so prevalent, the connexion between this ailment and the lack of vitamin B should have been so far entirely neglected. Abundant raw vegetables, fruit and wholemeal bread instead of white bread would do incalculable service in supplying this vitamin and banishing chronic constipation with all its attendant evils.

Vitamin B should be taken through the medium of daily food, but it must be remembered that its effect is not automatic; lack of sugar and excess of salt always tend to undo its beneficent work.

We have, however, to consider not only normal circumstances but the means by which an abundant supply of vitamin B can be made available in war-time, so as to provide all the energy needed for the pursuit of our war effort. Under present conditions the ordinary sources of supply, such as fruit and vegetables, are far from adequate for the end we have in view. It is therefore essential that we should augment the normal supplies by using the most efficacious vehicles known, which are yeast and the soya bean. In this country there exist several proprietary yeast preparations (*e.g.*, Marmite), which are excellent for this purpose, one of these possessing the additional advantage that it can be used in soups, sandwiches and various dishes.

In modern cookery, baking powder is largely used instead of yeast, because it is simpler to employ and needs less attention. But yeast is far richer in vitamins, and its

value does not lie in its vitamin content alone, but also in the fermentation properties which enable the organism to derive full benefit from all other foodstuffs. It should, however, be borne in mind that yeast can act effectively only if the system is not overloaded with salt and protein. Salt and acidity destroy the vitamins which yeast contains, and these vitamins can only do their good work effectively in an organism which is alkalised and rich in potassium and glycogen. A mineral balance is therefore needed to give them full play.

While up to now nutritionists, though aware that the average diet was grossly deficient, believed that what was lacking could be made up by an increased consumption of fruit, green vegetables and potatoes, have recently come to realise that even a very liberal use of these so-called protective foods cannot ensure a sufficient supply of the most important vitamin B1. Jolliffe demonstrated that our population subsists on a diet of " borderline adequacy " in vitamin B1. It is of the highest interest to realise that even the paupers of 1838, fed under the Poor Law of London, received twice as much vitamin B1 as the rich of London whose diet was studied in 1937!

VITAMIN C

Most of our knowledge of vitamin C derives from clinical observation. As has been explained, scurvy is caused by lack of vitamin C, and it has long been known that fruit acts here as a preventive. Szent-Györgyi discovered that it is the ascorbic acid in the fruit that provides the antidote, and he was the first to extract this compound from plants and from the adrenal cortex. The natural sources of vitamin C are fresh vegetables, particularly spinach, peas, cabbage, lettuce, carrots and fresh

fruit. Paprika, oranges and grapefruit contain the largest percentage, but potatoes, tomatoes and bananas are comparatively rich in it. The greener the vegetable, the richer it is in vitamin C; grain and bran have very little.

Vitamin C is called the anti-scurvy vitamin. It has also been found that the sterilisation, pasteurisation or condensing of milk reduces its vitamin C content and brings on a serious infantile disease, a "baby scurvy," known as Barlow's disease. The symptoms are blood in the fæces, hæmorrhage of the gums and serious loss of weight. No medical preparation can even alleviate the malady, and infant mortality from this illness was common until malnutrition was found to be the cause. Food rich in vitamin C is the only cure.

Even in fresh milk the vitamin content is poor, and shows seasonal fluctuations. From May to July it is highest, when the cows graze on fresh grass, while in the winter months it is lowest, because hay when stored loses much of its Vitamin C.

Cooking and heating of all vitamin C vehicles quickly reduces it. By boiling for twenty minutes, it is greatly diminished, and after one hour five-sixths are destroyed. Dried vegetables and stored products are also poor in vitamin C, and tinned vegetables and fruit retain it only if prepared by modern processes which do not allow oxidation. Tinned commodities prepared in this way should alone be used.

Besides being responsible for scurvy and Barlow's disease, lack of vitamin C makes the organism susceptible to all kinds of inflammatory processes and hæmorrhages. It also causes falling out of the teeth, swelling of the mucous membranes (asthma, hay fever, eczema), and a condition of malnutrition which induces rheumatism, kid-

ney and gall stones. Vitamin C is indispensable for our protection against the inflammatory processes caused by infections, as by increasing oxidation it helps the hormone system, in particular the sexual hormones which chiefly control oxidation in the system, to function easily. From this we can see that vitamin C plays an important part in the process of metabolism.

VITAMIN D

Vitamin D regulates the deposit of calcium and phosphorus in the bones and teeth. In its absence rickets and other diseases of the bones, such as osteomalacy, develop, so that it is known as the anti-rachitic vitamin. Sir Edward Mellenby demonstrated that cod-liver oil, butter and fats have a marked anti-rachitic effect, and it has been proved that food deficient in vitamin D develops anti-rachitic properties after exposure to ultra-violet light. It is the only vitamin which can be produced in food, as well as in the organism itself, by exposure to light radiation. The richest natural vehicle for vitamin D is bananas; three bananas a day will provide the average quantity required.

The best natural source for vitamin D is cod-liver oil, in which vitamin D is contained together with vitamin A; but it should be remembered that fresh vegetables, fruit and even eggs and milk are very poor in vitamin D. They contain only the provitamin and, as a source, are to be considered from this angle.

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We have now seen to some extent the importance of vitamins for the health of the body. They are necessary, moreover, not only for physical well-being, but essential for vigour of mind. It has been demonstrated that large

doses of vitamin B1 and B2 can cure certain types of defective memory, absent-mindedness and indecision. Such a claim may seem as fantastic as the pharmacopœia of a witch doctor, but it is a well-authenticated fact and no superstition.

The normal functioning of the brain depends on its supply of carbohydrates. If sugar is not present in sufficient quantities in the blood and tissues and brain, they will not obtain enough carbohydrates; in other words, without vitamin B, which, as we have seen, facilitates the metabolism of carbohydrates, the brain cannot obtain the energising elements on which it works. The result will be partial lack of memory, inability to concentrate, lassitude and insomnia.

It must be borne in mind that vitamin B1 cannot be stored in the body. Since the discovery of vitamin B6 we know much more about vitamin B. Deficiency of B6 (Pyridoxin) is responsible for a characteristic disease of the skin and hair and possibly also for a disease of the central nervous system. Moreover we have learnt that vitamin E is necessary for reproduction, and is required both by the male and the female. If this vitamin is lacking, there is a dysfunctioning in the hormone of the pituitary gland. Vitamin F is the so-called skin vitamin, and one of the most important findings is vitamin K which prevents death from hæmorrhage. It has been shown that this vitamin is indispensible for a normal functioning of the liver.

Another important combination of symptoms is also interesting in this connexion, particularly as it was observed during the last war. Its characteristics are breathlessness, fatigue, and exhaustion, palpitations, dizziness, sweating, blueness or mottling of the hands and

other neurovascular phenomena. The pulse, when the sufferer is at rest or sleeping, is normal, but is easily accelerated by exercise or emotion, and abnormally slow in returning to normal after exertion. One most significant symptom is phosphaturia, which is an increase of the quantity of phosphorous in the urine, particularly after light exercise. This condition was especially prevalent among the troops, and was given the name of neuro-circulatory asthenia.

To-day, however, we know not merely its name but its basic cause: defective sugar metabolism, which occurs when the blood sugar is insufficient and the blood pressure consequently lowered; this defective sugar metabolism arises solely from a disturbed vitamin equilibrium. If vitamin B is present in inadequate amount or is not acting properly, and there is a lack of balance between it and vitamin C, the carbohydrates will not function, and all the symptoms mentioned, and more, will arise.

In this connexion, very valuable work has been done at the Mayo Clinic at Rochester, U.S.A., which was published in December 1939. The results show the importance of a liberal allowance of vitamin B1 for a people engaged in war. The restriction of this vitamin in a group of healthy subjects otherwise adequately fed gave rise to moodiness, fear, indifference, sluggishness, mental and physical fatigue, and still further symptoms, all exactly the opposite of those characteristics desirable in a population from whom courage, energy and resolution to the utmost are required. Other subjects were given thiamin, *i.e.*,vitamin B1, in quantities almost equal to the standard demanded by the League of Nations Commission mentioned in Chapter Two(*b*). These subjects remained in apparent good health for several weeks, but as soon as the dose was increased to six hundred international units

a day alertness was enhanced and the measured capacity for physical work almost doubled. This suggests that efficiency for the prosecution of the war can be increased merely by providing the public with a slightly larger quantity of vitamin B1 than it is already receiving. Three hundred international units a day of vitamin B1 was the amount recommended by the League of Nations, but for soldiers, factory foremen, civil defence workers and farm labourers, working in war-time with long hours and little sleep, three hundred units are not calculated to produce the best results. I would suggest 1000 to 1500 units.

Therefore we have to increase the daily supply of vitamin B1. For this reason vitamin Concentrates and Synthetics are indispensable.

We cannot go into further detail on this aspect of the vitamin problem, though it is hoped that even this short résumé has given some idea of its importance, particularly at a time like the present. But since the efficacy of vitamins depends not only on the consumption of an adequate amount either through the medium of our daily food or by special administration, but also on the extent to which the organism is capable of putting them to proper use, a further question of practical importance arises, one which has so far been underestimated in practice, namely the question of utilisation.

Before embarking on this new department of the subject, the reader should understand what is meant by the term " vitamin units." This standard was chosen by an international conference under the auspices of the League of Nations, which allowed the foodstuffs examined in different parts of the world to be measured in a uniform manner.

For vitamin A the best experimental animal proved to be the rat. The old biological, or "red" unit of measure-

ment represented the smallest daily dose that would increase by 3 grammes weekly the weight of at least 60 per cent. of the rats chosen, when they were fed on food in which no vitamin A was present. But the red unit has been superseded by the international unit, whose effect corresponds to that produced by 0.6 gamma of pure vitamin A, a gamma being one-thousandth of a milligram. Three international units equal one biological unit.

For vitamin B the best experimental subject was the dove. Tests made on these birds cured the typical symptoms of beri-beri by means of vitamin B. Hence the term " dove unit," which is the amount of vitamin B needed to cure a dove suffering from beri-beri for one day. It corresponds to about two complete 5/10 gamma of pure crystalline vitamin B1. One mg. of vitamin B1 corresponds to 300 i. units

If vitamin B2 (lactoflavin) is missing from the diet of a growing rat, its rate of growth will slow down, stop completely and lead to death; minor cutaneous affections will also be caused in some cases. The amount of lactoflavin needed to raise by 20 grammes in twenty days the weight of young rats which have been undernourished represents one " rat unit."

The next animal in this vitamin zodiac is the guinea-pig, whose name graces the vitamin C unit. Deprived of this vitamin, the unfortunate animal falls ill in about a fortnight, and contracts scurvy. The unit here is the amount of vitamin C that prevents the appearance of scurvy. It corresponds to 0.05 milligrams of crystalline ascorbic acid, and is the amount present in one cubic centimetre of lemon juice.

For establishing the vitamin D unit we again make use of the rat. The rat unit used here is the smallest daily

dose that preserves the young growing animal from rickets. This can be determined by X-ray examination. If 80 per cent. of such a dose is enough to prevent rickets the preparation is of the required standard; but the subject must be fed on a special preparation invented by McCollum. The international vitamin D unit is actually the equivalent of one milligram of irradiated ergosterin or of 0.025 gamma vitamin D.

CHAPTER FOUR

PROTECTIVE FOOD:

MINERALS (OR " INORGANIC VITAMINS ")

THE more we know about vitamins, the better we can appreciate the value for the organism of a balanced mineralisation, and without going too far into details it will be well now to discuss the dependence of health on a normal mineralisation as affected by hormones and vitamins.

In modern dietetics minerals are known as inorganic vitamins. They differ from the organic food elements in that they are not sources of energy. Nevertheless, their function as protective foods and regulators of the whole metabolism is indispensable.

The discoveries of recent years have shown not only that the vitamins, but that minerals also, are nutrients. To take the case of copper; its biological importance has not long been known, yet copper is present in all living matter, and it has definite effects on ascorbic acid (vitamin C). Bertrand was most unexpectedly able to show that the importance of certain elements, traces only of which are found in the system, may be just as great as that of the known foodstuffs, and that a deficiency in any single one of these elements is enough to cause serious symptoms to appear. A food may contain abundant organic and inorganic substances and vitamins, but

without the necessary traces of copper, zinc or iron, it will be improperly balanced. These highly interesting facts incline us to ask whether some of the effects ascribed to vitamins may not be partly due to minerals. In any case we now know that minerals are indispensable, and active, even when taken in the same minute quantities as vitamins.

Healthy tissues and healthy organs demand a supply of minerals such as sodium, potassium, calcium, iron, copper, manganese, phosphorus and fluorine. These minerals must be present in the system in amounts bearing a certain mutual relation; hence we speak of a balanced mineralisation. Different minerals affect the organism in different ways, but we should not forget that some are antagonistic to others: for instance, sodium and potassium. In tissue rich in potassium, sodium disappears, and vice versa, and we know that exhaustion and fatigue increase the sodium in the body and reduce the potassium. Sodium and calcium similarly affect each other, the loss of the one automatically producing an increase of the other. It is on this principle that the salt-free diet indicated in all inflammatory processes is based; the elimination of salt from the tissues automatically increases their calcium content.

This knowledge is not only of theoretical interest; it is of the greatest practical value. It explains why some persons are more liable to colds, migraines when the weather changes, or attacks of rheumatism: for tissues rich in salt are inclined to swell and become inflamed. This tendency is due to a lack of potassium and calcium, and it can therefore be corrected by reducing the salt (sodium chloride) consumed, and at the same time administering calcium and potassium.

On their potassium and calcium content is based the nutritive value of vegetables, and the great importance of milk in our dietary is due rather to its mineral content than to its supply of vitamin C. Milk is our best provider of calcium and phosphorus. Two glasses of milk a day will furnish enough of these two minerals to preserve the balance needed by the body, provided only that the body in question is properly nourished.

Much information is now available as to the inorganic salts in milk, but more has yet to be learnt about the forms in which these occur and the manner in which the body employs them. Certain recent researches by Nordbö into the concentration of ionized calcium and magnesium in cow's milk are of the highest importance. He proved that the amount of calcium in milk can be increased by combining the milk with citric acid and lactose. These observations may explain how the loss of calcium due to the precipitation of phosphate in the intestines may be reduced. It may also be called that there is evidence that the presence of milk sugar (lactose) in the food enhances the effect of calcium on the growing animal. It has been shown that milk sugar may be important in calcium metabolism, but, in any case, the fact that it combines with calcium to form soluble compounds would seem to indicate that milk sugar, like citric acid, not only serves as a source of energy, but also affects the condition of the calcium in milk.

Investigators who have analysed the effect of potassium on metabolism now know that it activates muscular and nervous energy. In this country, A. Lasnitzki has published numerous papers on the action of various metals on the metabolism of yeast, and on animal tissues such as the kidney and brain cortex. He tested potassium, calcium, sodium and mixtures of their salts. His conclusion

was that potassium salts are the most powerful activators of tissue.

Many other investigators have published similar results. In the literature of Central Europe there are to be found a great number of observations on the favourable effect of a potassium increase in the diet in healing wounds and on hay fever. We would point out in particular the effects of a diet containing abundant potassium on allergic manifestations, such as asthma, hay fever, psoriasis, eczema, gout and rheumatism, which are all so common in this country.

The difference in potassium metabolism at high and low altitudes has been intensively studied, and it has been shown that animals which had lost about 150 milligrams per cent. of potassium from their liver, or those which had gained about 200 milligrams per cent. of sodium, have died when taken into rarefied air, while animals with a balanced supply of potassium and sodium have survived. Experiments carried out on animals by treating them with ultra-violet light, darkness, hunger and vitamin D, have proved that animals with a supply approaching normal were invariably healthy, while those abnormally mineralised distinctly showed an opposite reaction.

Such experiments show us how far-reaching is the influence of the minerals on the metabolic process as a whole, and how far the mineral balance is determined by climatic conditions. This sets us a new task; that of increasing the potassium content of our tissues when muscular or nervous energy and activity are required, particularly if it is demanded in a rarefied atmosphere. This question is of very real importance to airmen. Our present knowledge has shown us why individuals react in various ways to high altitude, and that they can be made more fit by reducing their consumption of sodium

and salt, while increasing their supply of sugar and potassium. It should of course not be forgotten that the whole balance of our mineral metabolism is regulated by the hormone of the adrenal cortex. If this hormone functions defectively mineralisation is unbalanced, and we shall find that the sodium supply has gone up, while the supply of potassium, phosphorus and glycogen has gone down.

Just as there are diseases caused by lack of vitamins, so there are diseases due to lack of minerals. A large number of affections of the bones are due to insufficient calcium and phosphorus. Again, if iodine is lacking in the water drunk or food eaten, various disturbances of the thyroid gland, such as struma, cretinism or myxœdema will appear. On the other hand, we know that persons taking too much iodine, or hypersensitive to iodine, are subject to another thyroid disease, the notorious Graves' or Basedow disease.

We know that anæmie is caused above all by lack of iron; iron being indispensable for the building up of the red pigment in the blood known as hæmoglobin. The metabolism of iron is regulated by the liver and by vitamin B. If the function of the liver is disturbed it not only renders vitamin B ineffective, but the iron in the system will remain idle.

These considerations help to show that mineralisation depends on many factors, both internal and external. The internal factors are the hormone glands; so that the adrenal cortex hormone may be called the central regulator of the mineral balance and the vitamins. If its functions are disturbed the mineral balance is upset and the consumption of vitamins will be useless.

The external factors are the vehicles of minerals; vegetables and fruit. If these are not rich in minerals,

our system will be under-mineralised. The mineral content of vegetables depends on how they are fertilised and how they are cooked. These two important matters will be treated successively in the two following chapters.

CHAPTER FIVE

MANURE

THE food value and mineral content of agricultural products depend to a very large extent on the manuring of the soil. Nowadays, when artificial fertilisers are so extensively used, it is worth while asking whether these products of the mine and the factory really provide the earth with a sufficient quantity or a proper combination of the organic and inorganic elements to provide ideal nutrition for animals and men.

The most important minerals can certainly be obtained in the form of artificial fertilisers, but whether such manufactured products contain all the minute elements that are found in natural manure is still an open question. They may, it is true, have a considerable catalytic effect, and act, as it were, as vitamins for the fermentation of the soil, in particular so far as the radio-active elements are concerned. But they are likely to alter the composition of the food product treated and may easily cause diseases such as high blood pressure, which is far more frequent now than formerly.

The hormones regulate, as we know, the smallest blood-vessels (capillar-vascular system) of the kidneys and other organs, and affect the blood pressure. As the food we eat is the source of our supply of hormones, and as the whole of the blood system is affected by the potassium in vegetables and other foods, these facts, and our knowledge of the influence of minerals on the regulative processes of the organism, demand that more atten-

tion should be given to improvements and to the preventing of deterioration in agricultural products.

The natural manures, which consist of the excrement and urine of animals, provide the soil with important organic materials and supply the potassium, calcium and phosphorus it needs. But neither the artificial nor the natural manures are ideal for the cultivation of plants. Vegetarians are increasingly insistent on the use of natural manure, which has great merits; but there are hygienic objections to the use of latrine manure.

The value of a manure depends, of course, on the quality and quantity of the fertilising agents used, which affect the flavour and value of every type of crop. But since the introduction of artificial fertilisers during the last thirty years, both flavour and nutritive value have been neglected in favour of size and appearance, so that the shops are better equipped to please the eye than to satisfy the palate or nourish the system. The giant-marrow principle, which did no harm when confined to the adornment of the pulpit at harvest festivals, if applied wholesale, means a serious loss of nutriment and a poor supply of calories. To take the case of asparagus, particularly that imported from Holland before the war. The thickest sticks were regarded as the best, though gourmets, the natural philosophers of food, always and rightly prefer the smaller types. Those fat white growths, resembling candles rather than vegetables, have neither taste nor nutritive value. The greener and bluer the heads, the more sunlight they have absorbed and the greater their flavour and nourishing qualities.

To improve the flavour of fruit, manure rich in phosphoric acid and potassium is invaluable.

With the knowledge to hand, it is a great pity that the mineral content of agricultural products has not been

improved as it should have been. Potatoes, for instance, one of the chief suppliers of iron and vitamin C, can be enormously improved by a suitable manure containing a high percentage of potassium and phosphorus which will automatically augment these elements. Sugar beet could be improved in the same way. The vitamins of earth fermentation should be one of the chief considerations of modern agriculture, and this applies to cattle fodder as much as to directly-edible human food. Grass and clover, which form the staple diet of the cow, determine the quality of milk and cheese, which are in turn the main sources of phosphorus and calcium in our own daily diet.

Manure plays its part in providing us with potassium, phosphorus and calcium. We can to-day test foodstuffs for their vitamin C content. A systematic examination of the various kinds of potato and tomato for the purpose of determining their vitamin and mineral content, in order that the varieties with the highest percentage of vitamin C, phosphorus and calcium, could be cultivated and made abundantly available, would be a most interesting and profitable task.

CHAPTER SIX

THE BOILING OF VEGETABLES

IF we boil vegetables in large quantities of water and then pour off the water we lose many soluble minerals, vitamins and plant acids.

There are a number of vegetables on the market which need blanching or scalding before they are boiled, stewed or steamed. This will remove the unpleasant taste and smell so often associated, for instance, with cabbage, and caused in point of fact by the manure used in cultivation. In this respect winter vegetables are the worst offenders, those in season being far less, if at all, so. Boiling or even parboiling after blanching are not to be recommended, as they largely destroy the nutritive elements. If all vegetables are to be boiled, a large quantity of raw fruit and salad will have to be added to the menu to make up for the food elements thus lost. In any case, if it is considered essential to boil vegetables instead of steaming them, owing to personal predilections or because the cook is not open to persuasion, the water poured off should be kept for use in soup, sauce or gravy. Gravy made with vegetable water is excellent in flavour, and nourishing as well. It is almost universally admitted that boiling destroys the flavour of vegetables, and good cooks have always preferred to steam their vegetables. The famous Robert Koch based his process of sterilisation on steaming fifty years ago.

While minerals may unwittingly be eliminated through incorrect methods of preparation, it is sometimes necessary deliberately to eliminate them in invalid or emergency diet. Thus a salt-free diet is prescribed to reduce the salt content of the system, and plays an important part in modern treatments, but it should not be regarded as a normal regimen.

During the last war there was a serious deficiency of phosphorus, calcium and vitamins in the popular bill of fare, particularly in the towns, where milk, cheese and meat were barely obtainable.

CHAPTER SEVEN

ACIDS AND ALKALIS

WE have already mentioned the connexion between acidosis and susceptibility to infection as well as the destructive effect of acids on the vitamins, but this short chapter aims at a more particular discussion of how an excess of acid affects endurance and energy. As we know, the average Englishman's diet contains far too many acid elements; and these not only injure the body in various ways, but counteract the effects of the vitamins.

Foodstuffs can be classed according to their acidifying or alkalising effect on the tissues, but the classification is not as obvious as might be supposed. For instance, lemons, oranges, apples and lettuce, which a superficial judgment would at once class among acid foods, because of their acid content, have an alkaline effect on the system; there are still some old-fashioned doctors who have not yet realised this. Another common error is to suppose that different kinds of meat, such as beef and chicken, have different effects on the metabolic system and affect the amount of uric acid present in the body. Beef and chicken have, in fact, exactly the same effect in this respect.

The foods that have an acid effect on the tissues are the following: all kinds of meat, eggs and cheese; those containing a slight excess are flour, bread and such farinaceous products as macaroni and spaghetti. The foods rich in alkalis are potatoes, carrots, spinach and most green vegetables, and all kinds of fruit and milk.

It should be noted that boiling and roasting increase the acidity of meat and even make the alkaline vegetables lose not only their vitamins, but also such of their minerals as are responsible for their alkalising effects. Even spinach is changed into an acid-forming foodstuff if boiled.

The nutritive value of salads and vegetables, apart from the vitamins they contain, is due exclusively to their alkaline contents. Their potassium and alkalis give them curative properties, but incorrect cookery may make vices of their very virtues. It is considerations such as these that led to the prescribing of salt-free and uncooked diets.

The harmful effects of salt have been repeatedly stressed in this book, and salt-free food is to be valued, not only as curative diet, but more particularly as a protective measure against infections and inflammations. The advocacy of uncooked diet, introduced by Bircher-Benner, is based on the fact that too plentiful supply of meat and other animal protein in the daily food tends to impair efficiency. Abundance of alkaline food is essential for fitness, and is best provided by including large quantities of uncooked food, such as raw vegetables and fruit, in the regimen, as these preserve their nutritive elements intact. The advocacy of diet of this kind must not be regarded as in any way dictated by sentimental vegetarianism, or by the tenets of any religious sect. It is advocated neither for moral nor occult reasons, but because it is rational, sound and scientific.

CHAPTER EIGHT

THE WORK OF THE VITAMINS: UTILISATION

WE began our discussion of vitamins in Chapter Three, since when we have discussed the other elements present in food. Now that we understand a little more about the minerals and acids and the work, good or bad, they do in the organism, we can return to the vitamins and enter in more detail upon the study of their functions, and how these are influenced by and related to those of other nutritive elements.

The efficacy of the vitamins is intimately related to the normal functioning of the hormones; if the hormone balance is disturbed the vitamins become ineffective. For instance, if the adrenal cortex hormone does not function properly, vitamin C becomes ineffective. Again, vitamins supplied to an acid system are valueless because acid tissues break them down. They can only do their work in an alkaline environment, that is, in one where no salt is present. Their effect is, therefore, enhanced by potassium in the tissues, but diminished by sodium chloride. This explains the virtues of a fruit and vegetable diet, which contains a high percentage of potassium. We shall find later what is the relation between potassium and phosphorus, calcium and glycogen. This came to light only after the discovery of how the efficacy of vitamins is governed by the degree of mineral balance in the system.

But to allow the vitamins full play by eliminating salt from the system—a procedure possible with invalids under strict medical control—is out of the question for a whole population. We can, however, counteract the acidity set up by salt and protein, and this is best achieved by giving phosphorus and sugar to combat the protein poisoning, and potassium in plenty to fight the salt and acids. Preparations are in existence which neutralize both salt and proteins and obviate the need for a change from normal diet. One of these, Equilibrin, I shall discuss in a later chapter.

Most people are convinced that boiled vegetables and a little fruit will be enough to give them all the vitamins they need, and that they will keep perfectly healthy if they add these items to their ordinary menu. But a mixture of foods of this kind has little or no effect on the vitamin content of the body; not only will the vegetables in nine cases out of ten be wrongly cooked, but those small quantities of vitamin food which are generally considered sufficient are far too small to be beneficial. For vegetables to have their full effect they must not only be properly cooked, but also must be eaten in large quantities; that is to say, eaten twice daily in abundance, and either raw or steamed.

But we do not require vegetables for their vitamins alone. We need their minerals and alkalis to assist the work of the vitamins. Hence the particular value of vegetables, whose vitamins, like good plumbers, enter the system accompanied by their mates, the minerals.

Another important aspect of vitamins is their catalytic action. The three vitamins, B1, B2 and C, belong to what is termed the oxidation group, and the systems of reduction which regulate cellular respiration. These are

good grounds for supposing that vitamin C is connected with the transport of oxygen, and recent experiments have shown that vitamins act catalytically and may be classed with the enzymes, or ferments, which regulate intermediary metabolism. This would explain the relation between vitamins and hormones, as the hormones, owing to their controlling effect on oxidation, intervene in all metabolic processes.

The Swiss physiologist Asher has shown that restoration of the skeletal muscles and heart is far more effective if vitamin C is added to the adrenal hormone; when the efficiency of contraction and all the chemical conditions will return to normal. There is therefore a close connexion between vitamins, minerals and hormones, and it is clear that vitamins play a decisive part in the vital processes of the living cells.

During the winter, and at times of scarcity, it is impossible to obtain all the vitamins we need from fresh vegetables and fruit, but at such times we can still obtain them from yeast preparations, brown bread and potatoes, while bananas, grapefruit and oranges are generally obtainable. It is only by taking plenty of these foods that we can secure at such times the supply of vitamins we need to give us adequate power of resistance and efficiency. It must, however, be remarked that a reserve supply of vitamins cannot be built up in a short time; a systematic diet must be observed for weeks and even months before the organism is equipped with the necessary reserves.

The extent to which our organism not only absorbs but transforms and utilises its nutriment is not a mere question of theory, but one of the greatest practical importance, in particular for the doctor whose daily task it is to deal with and solve our organic problems, which is not possible before he understands them.

How often we hear of people who cannot digest fat, that is butter and other animal fats, and who suffer from all the ill-effects ascribed to this condition. Observe how these effects vary from the mildest indisposition to the most serious gall bladder affection or, for instance, the symptom of spasmodic migraine in the right side of the head. In such cases we speak of an inability to digest fat, or of a hypersensibility to fat, presumably caused by a faulty utilisation of fat and arising from a disturbed functioning of the liver. To-day, thanks to recent research, we know that normal resorption, which is required for the proper utilisation of fats, is regulated by a certain vitamin, known as vitamin K. Absence or deficiency of this vitamin leads to disturbances in the functioning of the liver and an irregular, deficient assimilation of fatty matter. This hepatic affection is due to a change in the chemical constitution of the blood which has its source in a change in the iron metabolism. This brings about an increased perviousness of the blood-vessels, causing bleeding from the skin. If, however, the missing vitamin is administered, the resorption of fats is normalised and the fatty constituents of the food are properly utilised and digested, which puts an end both to the hepatic disturbance and to the bleeding.

The same holds good of carbohydrate metabolism, which is regulated by vitamin B. If vitamin B is absent or deficient, the sugar taken is not fully utilised. But here we should remember that nutriment rich in carbohydrates affects the vitamin B content, so that the more carbohydrate is taken the more vitamin B is needed.

The albuminoid bodies are split up in a similar manner. It was on his observations of the difficulty his patients experienced in assimilating and digesting animal protein that Bircher-Benner built up his uncooked food system.

It has been shown that an accumulation of unassimilated protein products gives rise to abnormal acidity. But this leads not only to acidity of the tissues but to a retention of sodium chloride through the agency of the protein, so that while the salt is retained, potassium is rejected.

The explanation of the various morbid symptoms which owe their appearance to a disturbance of the protein metabolism was discovered by the writer in 1934, when he proved that the splitting up of protein is regulated by the hormone in the anterior lobes of the pituitary gland. When this part of the gland is not working fully, so that there is an insufficiency of this important hormone, a disturbance in the assimilation of protein results. This morbid condition the writer christened Dysproteinosis, and listed among the metabolic diseases as a counterpart of diabetes. A further consequence of the retention of protein is a sluggishness in the intestines. This can be observed by taking tests of the urine, when an increase of the indican content will be noticed. If vitamin C is administered in such cases it is not assimilated and remains ineffective. But if animal protein is withheld or the hormone of the pituitary gland administered, so that the protein metabolism is regulated, the indican content of the urine disappears and the vitamin C is fully utilised.

Vitamin C can, however, be fully utilised without change of diet if a sufficient quantity of Equilibrin is given, to prepare the way for it by alkalising the tissues and enriching them with potassium and phosphorus.

These few examples should be enough to show how greatly the work of the vitamins and other food elements depends on certain other factors, and in what light we ought to regard their utilisation. In the same way, vitamin B depends for its good effect entirely on the normal

functioning of the adrenal cortex hormone and small doses of vitamin B will be more effective if the quantity of adrenal cortex hormone is also increased. All the hormones are to-day obtainable and usable in synthetic form.

The doctor who comes across disturbances in utilisation will find himself able to prove of real assistance only if he understands the connexions mentioned above. Here theory and practice are at one, and we can make practical use of our knowledge to regulate disturbances of utilisation or, as we may call it, to harmonise the bodily functions.

CHAPTER NINE

THE ELECTROSTATIC GROUPS

NUTRITION problems appeared in an entirely new light after Rudolf Keller had discovered that potassium and sodium are merely representatives of a whole group of kindred substances. The copper and iron in the system, for instance, increase in quantity parallel with the potassium, and play a very important part in nutrition. A diet abounding in potassium promotes both the vitamin and the sugar content of the tissues; the processes that bring this about can be explained by the aid of our knowledge of biocatalysts. The organic biocatalysts are the vitamins and hormones; their inorganic counterparts are potassium, phosphorus, calcium and iron.

Electrostatically nutritive substances may be derived into two broad groups. The members of the first group are electrically negative and accordingly tend to move, by attraction, towards the positive tissues and there to accumulate. The members of the second group, being positive, similarly find their way to the negative plasma, or blood-fluid, where they are stored.

The existence of contrasting groups of substances was discovered long ago by German and American investigators. The phenomenon itself was first observed by Justus von Liebig in 1842, and confirmed by botanists, who found that sugar moving in plant tissues was invariably accompanied by potassium and phosphorus. But

the actual discoverer of the potassium and sodium groups was Forster, of Strassburg, in 1875. He found that certain minerals—potassium, magnesium and phosphorus—were characteristic of tissues, calling them "tissue salts," and an opposite group—sodium chloride and calcium—which he named "fluid salts," were characteristic of serum.

Many of Forster's discoveries are quoted in the textbooks, but this, the most important of all, was entirely ignored and forgotten, to be made afresh by more than one investigator, each being unaware that another had anticipated him. Jacques Loeb in America, for instance, coined the term "ion antagonism," and under this name official physiology recognised the contrast between potassium and sodium; between positive ions and negative, non-ionised combinations. The tissue group consists, in the main, of potassium, phosphorus, sugar, vitamins and hormones; the plasma group comprises sodium chloride, bromine and others. Now we know that our tissues are positive, while the blood plasma is negative, and that glycogen can be stored in the liver only if potassium is present. It was found that when oxygen was inadequate the liver, brain and muscular system developed œdema and that muscular fatigue could be shown to occur simultaneously with a loss of potassium and sugar, and an increase of sodium, in the muscles affected. Similarly, loss of vitamins in the cells is accompanied by a loss of potassium.

It can be demonstrated that a loss of potassium and phosphorus is continually taking place in the tissues of old people, simultaneously with a gain in sodium chloride, and that during illness a similar process is at work in the young. It has also been observed that when the tissues

are fatigued or exhausted, and also at the end of the day, water enters the tissues accompanied by sodium chloride, and that after rest the water and sodium chloride leave the tissues again.

The whole group of minerals discussed above, together with organic dye stuffs, nutrients and urea, were examined from this point of view by Wertheimer in the twenties of this century. He found certain substances, carbohydrates, urea, magnesium and basic dye stuffs moving outwards from the skin of the live frog, while simultaneously sodium, chlorine, water and acid dye stuffs moved inwards. Thus the theory of electrostatic groups throws an entirely new light on the movements taking place in the cells and tissues, and we can now no longer doubt that electropolarity in tissues and substances is a dominating force in carrying the food elements through the body to the places where they are required.

In order to confirm the validity of my own conclusions I may be allowed to quote Professor Goldzieher of the Brooklyn Hospital, New York, who writes in a recent book:

> " A similar relationship exists between the adrenal cortex on the one hand and the potassium-sodium balance on the other. The physiological equilibrium of the two electrolytes, essential for the maintenance of life, is safeguarded by the function of the cortex.
>
> " Sodium, although absolutely essential for life, becomes toxic if its concentration is too high or if its ratio to the potassium salts is unfavourable. The toxicity of sodium salt is easily demonstrated in infants, who are so sensitive that even a few grammes of sodium chloride produce marked fever.

"Recent work by Keller has shown that potassium does not occur within the cells in ionised form, just as sodium chloride is not ionised in the tissue fluids. Both of them remain parts of complex compounds with opposite electric charges. Investigating the biological effects of potassium, one is impressed by the functional antagonism of the potassium and calcium ions. Eppinger and his school have emphasised that in all abnormal states of cellular nutrition such as obtain in infection, intoxication, circulatory insufficiency and *even after mere exhaustion*, there is an increased exchange of electrolytes between cells and tissue fluids. Potassium and phosphorus leave cells while sodium chloride and water enter. Eppinger's group have also shown that the permeability of the cells can be influenced by various pharmaca. Excessive intake of potassium with the food acts in a similar way, apparently by increasing the potassium content in the body fluids which prevents the cells from losing potassium. Thus, feeding potassium-rich food to rats increases the potassium content of their muscle tissue. This is accompanied by decrease in oxygen consumption and carbon dioxide production. Increased sodium intake has the opposite effect."

It is furthermore an accepted fact that any substantial loss of sodium chloride is usually followed by an increase of blood sugar.

The eminent pharmacologist Starkenstein in a recent publication stresses the great importance of mineral metabolism in nutrition, and draws attention in particular to the relation between mineralisation and the work of vitamins and hormones. Let us quote again, this time from Professor Kaunitz, who says:

"From an electrostatic standpoint we can divide the nutritive substances into two great groups: the one being itself electro-negative and therefore having a tendency to get accumulated in the electro-positive tissues, and the second group, which being electro-positive is stored in the electro-negative plasma. The tissue group mainly consists of potassium, phosphorus, sugar, vitamins and hormones, etc. The plasma group contains sodium chloride, bromine, etc."

He goes on to say that the storage of glycogen, which is one of the main functions of the liver, can only take place when potassium is present. If there was a lack of oxygen, he found œdema of the liver and brain, and in cases of muscular exhaustion, he found œdema of the fatigued muscles occurring simultaneously with a loss of potassium and an increase of sodium. The loss of vitamins in the cells, Kaunitz continues, must be similar in cause to the loss of potassium, and "this may be the reason that nowadays in so many diseases connected with disturbances of biologic permeability of the tissues, symptoms of hypovitaminosis can be noticed in spite of a sufficient vitamin intake." Kaunitz also agrees that one of the greatest contributions to this problem was made by Rudolf Keller.

Based on the research work on electrostatic groups, Keller produced a special preparation, called Equilibrin, which consists of the various minerals such as potassium phosphate, calcium gluconate, magnesium oxide, copper phosphate with traces of zinc, iron and urea. This kind of preparation has the task of balancing the mineral metabolism. The amount of sodium chloride in the tissues will be decreased while the potassium group is increasing and the sugar reserves are more economically utilised.

It has further been found to activate the reserves of glycogen and phosphorus.

The effect of this preparation and similar ones is to counteract fatigue and to increase efficiency by creating the conditions that brings the vitamins into full play. Its practical results have been proved not only by the author but also by the Medical University Clinic at Vienna (Eppinger), at Prague (Nonnenbruch) and at Manila (Kaunitz). This preparation, Equilibrin, represents a new principle, and it has been discussed for the first time in Prof. Starkenstein's recent book on pharmacology, and was advocated by physiologists and eminent clinicians.

My own investigations have shown that blood-tests are a ready means of confirming its remedial and tonic qualities, which may be further demonstrated by the adrenalin curve and by testing the vitamin C content in the urine after a few days' treatment.

In many cases in which the administration of vitamin C had no effect I could prove that the simultaneous administration of Equilibrin enhanced the effectiveness of the vitamin C. To take a typical example: the urine of one patient I treated had a vitamin content of 5% which I was unable to increase higher than 7% in spite of administration of vitamin C. By adding to the first treatment with the same supply of vitamin C six tablets of Equilibrin, I increased the vitamin content to 16% in five days and afterwards to 40%. By adding further cortex hormone gland the vitamin C content was increased to 60%.

A mineral preparation based on such principles as Equilibrin owing to its stimulation of the adrenal cortex hormone, its alkalising quality, its potassium content and its regulative influence on the sodium chloride content,

would increase efficiency and resistance against infections and fatigue.

The present limitations in the supplies of cheese and milk, which are the chief vehicles of phosphorus in our diet, endangers both physical and mental efficiency. Therefore such a mineral preparation which makes up for this deficiency is a most important potential source of assistance in our war effort.

CHAPTER TEN

BALANCED DIET

WHAT is "right feeding?" Like harmony in music, proportion in architecture or logic in the expression of thoughts, our diet must be correct in proportion, harmonious in composition and logically selected; we must avoid discord, clumsiness and muddle when we eat as carefully as the artist avoids them in sound, stone and thought. It is not a question of this or that food being "good for us," but of combining the various elements of diet into a balanced and harmonious whole.

The first object in selecting our diet should be to see that we take more basic foods than acid foods; the foods containing vitamins and minerals should be in excess of those containing protein, carbohydrates and fats.

The actual kinds of food eaten must of course depend on local factors; on climate, habits of life and environment. These have always and everywhere guided the choice of the various national diets. Medical science and hygiene have influenced popular fare only in a very small degree, and only in the course of centuries has it changed appreciably. But we can point to three radical changes in the staple foods of Europe since the Middle Ages began. The first was the introduction of rye into East and Central Europe, where it displaced wheat and barley. The second was the rapid and widespread adoption of the potato almost as soon as it was brought over from America. The third was the popularisation of sugar owing to the discovery of the sugar cane.

Another extremely important factor which must on no account be overlooked, in the problem of any change in diet, is the effect of the mind on appetite and digestion. Our attitude to food changes completely with our frame of mind; a Christmas dinner is eaten with gusto by the contented father of a family, but in a man faced with ruin it is more likely to excite disgust. The relations of the digestive system to psychological stimuli have been exhaustively studied by Pavlow and his school, who have carried out a great deal of experimental investigation on this subject. From the psychological aspect, therefore, any attempt to change the popular diet, even in normal times, would be attended with difficulties, let alone at a time of stress and exhaustion. But in a time of crisis, when the greatest efficiency and effort are imperative, the difficulties must be faced, and the supreme urge of necessity should give us the will and power to surmount them at all costs.

As have been shown in previous chapters, our everyday diet is unbalanced, and our organism suffers from excess of acids and deficiency of alkalis. This weakens the effect of vitamins and minerals, and the majority of the population suffers from malnutrition. We must cure this by introducing and propagating a balanced diet, and though it is out of the question to alter the habitual fare of a whole nation a correct balance is not beyond achievement.

This can be procured by increasing the basic foodstuffs in our regime: by adding salads, steamed vegetables and potatoes to the staple menu. Two glasses of milk daily will give us the calcium and phosphorus we require, and so will a suitable quantity of cheese. Our vitamin C requirements can be met by two oranges or three bananas a day, bananas having the additional merit of a protein and vitamin D content. Two spoonsful of

cod-liver oil will supply vitamin A, and yeast in some form or other our vitamin B. But all these means the minimising of a diet sufficient in vitamins.

The alternative and ideal solution of the problem would be the compulsory addition to the ordinary diet of the following, taken daily:

1. 900 international units of vitamin B1. Synthetics or Concentrates are to be used.
2. Ascorbic acid (vitamin C) in an amount equal to that of 60 mg.
3. Vitaminised sugar in large quantities, or alternatively, four spoonsful of glucose.
4. Eight tablets of equilibrin.
5. Two spoonsful of cod-liver oil.
6. Large quantities of yeast in some proprietary form.

A planned treatment of this kind might be impossible of application to the public as a whole, but there is no reason why it should not be a practicable proposition for all those engaged on essential war industries.

Among the other alternatives that suggest themselves for adoption is one that would provide for the addition to the habitual diet of sugar, brown bread, fruit, potatoes, spinach, and carrots, all prepared in the right way. This might appear less formidable but would be most difficult to supervise. But it cannot be sufficiently emphasised that the *sine qua non* remains the elimination of all salt in the tissues over and above that required for health. This can be achieved in two ways either by limiting the food taken to milk or fruit and fruit juices on one day in the week, or by taking an adequate amount of equilibrin every day.

Van Noorden emphasises that the question of nutrition cannot be decided by sitting round a table, but only by the result of clinical experience. It is a matter for regret that food problems are dealt with chiefly by physiologists and not by clinical experts. As Bircher-Benner said: " The research worker on nutrition who uses mice and rats as his subjects is far from being a nutritionist. To regard a physiologist as a specialist in the subject of nutrition is to commit a grave error, for a knowledge based on the study of animals alone gives no insight into the remarkable reactions of the human organism to curative foods, nor into the conditions obtaining in the human body in sickness. If we were to present the authority on veterinary physiology with ill-nourished people to cure—and these exist all around us by the million—we should soon find out how little we could rely on his skill."

Again, Sir Walter Fletcher, when he was secretary of the Medical Research Council of Great Britain, declared " That our present knowledge touches only the fringe of the laws governing nutrition and of the processes by which unbelievably small changes of quantity in a food constituent often affect the condition of the human body. Even the discoveries that led to our cures for scurvy, beri-beri, dental caries and rickets give us but a glimpse of the immense possibilities that offer themselves for raising the standard of health and preventing illness. But human institutions have lagged so far behind the astonishing strides in science that even at this day, at any rate in Great Britain, the medical student receives no adequate or systematic instruction in matters of nutrition as part of his training. He must content himself with what may be described as little more than gossip. The loss that this means to the community is immeasurable."

In the ways above described, it is possible to give the people a harmonised and therefore balanced diet. But such a diet, while adequate in normal times, would be inadequate in war-time if maximum production and maximum powers of resistance to infection are demanded. That is to say that even by adding to our ordinary diet such elements as secure balance, we could never achieve it. As Sir John Orr says, in his book, *Food, Health and Income*, half the people of Great Britain suffer from deficiency of minerals and vitamins and therefore are in a condition of malnutrition. To quote a passage from this book: "The diet of half the population of England was found to provide a level of vitamin B1 consumption lower than which the League of Nations' technical commission regarded as necessary for adult men in peace time; that level was 300 international units per day." And if this was the case in peace, what of war time?

Extraordinary times demand extraordinary measures. These will be discussed in a later chapter on methods for increasing efficiency by nutrition. But here we should like to draw attention to an article published in the *Journal of the American Association*, which states " that when white flour and sugar provide 50 per cent. of the calories, as is the case in England and America, selection of a diet that can be called good, in the sense that is satisfies more than the minimal requirements of vitamin B1 and calcium, is almost impossible — *except for an expert.*" One would expect the people of such countries as England and the United States to be properly fed in peace time. The above quotation shows us that they are not, and that it is not possible to eliminate old-established errors by a " proper feeding " scheme to secure war-time efficiency.

CHAPTER ELEVEN

DIETETICS IN MODERN THERAPY

SINCE dietetics first became an object of scientific study, the ever-increasing fund of knowledge accumulated in relation to the effects of various foods and nutritive substances on the human organism, and of the relation between food and health, has revolutionised our ideas on the subject.

To most people the word *dietetics* implies nothing more than a limitation of the kinds and quantities of foods taken. But the Greek word *diaitia* has a far wider connotation, covering the habits, methods and order of life. Dietetics therefore in its proper meaning is the art and science of healthy living.

Nutrition is the process by which the food consumed by the body is made use of for its growth and maintenance, and for the provision of the energy required by the organs in order that they may carry out their natural functions, as well as of that needed for external activities. It is therefore not an isolated process operating independently, but is inextricably bound up with all the vital processes, such as the generation of heat in the body, the glandular functions, growth, propagation, the work of the muscles, the brain and the emotions.

Nutrition and the expenditure of energy are the first concern of dietetics, but we must not overlook the psychological side of the subject, which is of fundamental importance in its study

Dietetics must therefore concern itself with the quality and amount of nutritive elements taken, including the supply of water, air and light, so that the qualities and effects of each article of diet, and their interplay as component elements of our food, must be considered with as much care as the correct preparation of foods for the table.

The nutritional requirements of the healthy or diseased body must be determined both biologically and psychologically. The biological diagnosis must determine the amount of energy present or needed, and for this the amount of nutritive elements and energy, and the efficiency of the organism as a whole, not only that of the individual organs, is the determining factor. The psychological diagnosis comprises observations of the customary diet, the prejudices of the patient, his perverse tastes, sub-conscious reactions, appetite, greediness and dietary inhibitions.

Both the biological and psychological aspects are frequently complicated by toxic conditions and morbid factors which influence the case and make diagnosis far more difficult; they must, however, on no account be ignored. Energy requirements are also profoundly affected by the prevalent climatic conditions, environment, occupation, temperament, and also by mental reactions such as happiness and depression and physical pain and temperature.

An ideal condition in any given organism is obtained when the quantity of nutriment of maximum food-value exactly meets the energy requirements indicated. A deficit is as injurious as a surplus; economy and harmony go hand in hand. The nearest approach to an ideal condition of the vital processes is of the greatest importance

for therapeutic treatment. For this end, all the forces which work together in promoting and restoring health must be mobilised.

Dietetics should be regarded as the art of guiding a patient into the best mode of life, in order that he may enjoy perfect health.

Civilised man is ignorant of what nutrition can accomplish and of its real economy. His daily diet is full of mistakes and deficiencies, and gives rise to toxic conditions and psychological disturbances. As a consequence of these deviations from the healthy norm, the vital processes diverge ever further from the ideal demanded. The factors which control the metabolic processes are overburdened, and factors are called into play which help for a time to stave off disaster. But in time morbid symptoms appear which are generally neither understood nor even observed. If observed at all they are usually treated with medicines that have no effect, while the root of the evil penetrates ever deeper. The long list of injuries becomes manifest in a variety of partial symptoms until the unmistakable signs of nutritional diseases are apparent and undeniable. Malnutritional disease frequently leads in turn to disastrous affections such as migraines, asthma, rheumatism, angina pectoris, epilepsy, gall bladder and liver troubles, dental caries and loss of teeth, and the like. Every deviation from the ideal order of life is a cause of illness. Physical deterioration, promoted by mistakes in diet and refusal to supply nutritional requirements, together with the use of nicotine, is the prime and most frequent cause of illness. The diet has as great an influence on the hormones as the hormones on the metabolic processes. The hormones are, in fact, the central regulators of metabolism.

If the functions of the endocrine glands are disturbed, we get metabolic diseases such as diabetes, gout, obesity, psoriasis, eczema and the various vascular and sexual disturbances, and then allergic conditions in all their variety. Allergy (asthma, hay fever, etc.) is always a sign of metabolic disharmony.

The task of dietetic therapy is a double one. It has to diagnose faults in nutrition and to harmonise the organic functions. If treatment is given in time—before disease appears, which means, of course, while the body is still healthy—it acts as a perfect internal prophylactic. Dietetic therapy demands therefore a combination of measures which by their interaction restore the harmony of the system.

CHAPTER TWELVE

PERIODIC DAYS OF DIET

FROM the most ancient times and among the most primitive peoples, religious systems have always ordained the observance of periodically recurrent fast days; the Catholic Church still has her days and seasons of abstinence from certain foods. This shows how early in human history the value of dietary hygiene, even though not fully understood, was recognised. And we can well imitate these ancient practices, though for very different reasons, to-day. For there is a significance in and a necessity for periodic days of special diet which give us a recurrent period of digestive rest and recreation in order to relieve the organism and free it of waste products and toxins.

Medicine, since the earliest ages, has always prescribed days of hunger on which food and drink were restricted to a minimum. They have always formed an important part of the treatment of acute digestive disturbances and feverish symptoms. Complete fasting, or the limitation of nourishment to the simplest types of liquid which are almost entirely deficient in calories, has invariably proved invaluable as a preliminary treatment for diabetes and nephritis. At the same time, it has been recognised that none of the hunger cures prescribed should be allowed to become excessively strict, as are those often resorted to in cases of obesity and various digestive troubles. Long hunger cures only produce serious disorders.

The ideal to be aimed at can be attained very simply. Periodic hunger days have been successfully prescribed for diabetes, in addition to the rigorous preliminary fast; but in this treatment a regular *change* of diet was the chief factor; not an identical regimen extended over a long period, but certain special days on which an entire change in the kinds of food taken was ordered. Short periods of food rich in protein alternated with days of a diet free from protein but rich in carbohydrate. An alternating diet of this kind produced the best results, and was introduced by van Noorden into his treatment of diabetes and other metabolic diseases. His success with diabetics led him to apply the same type of treatment to almost every case of chronic internal affection, and it was proved that if chronic patients of all kinds were given once or, in some cases, twice a week, a very strict diet of whatever foods put least strain on their digestive faculties, it was possible to allow them far greater latitude in their meals on other days.

For most sufferers from gout, for instance, one or two days a week on fruit and fruit juices is enough. On these days they take the fruit allowed in plentiful variety, with the juice every two hours, while on the remaining five days of the week they take normal meals. For the treatment of obesity the diet is restricted twice a week to food poor in calories but biologically rich, such as tomatoes, cucumbers and fresh fruit. For kidney sufferers it is better to change over for single days, or for short periods, to saltless and protein-poor food than to keep them on a special uniform regimen. It is quite unnecessary, except in particularly severe cases, to prolong a diet poor in salt for extensive periods. In most cases a preliminary treatment of eight days' strict avoidance of salt is enough.

A total regimen made up of fruit, sugar, and tea and coffee, contains not more than ½ to 1 gramme of salt. Often the effect can be seen in a few hours in the increased elimination of water; fluid which has been retained is eliminated, and inflammatory swellings subside in a very short time.

After a preliminary treatment of this kind, occasional days without sodium chloride in the food are sufficient; preferably fruit days once or twice a week, or twice in fourteen days, should be adhered to. In this manner dietary prescriptions are not only more easily carried out, as being easier for the patient to keep up, but the eventual success is greater. It was observed that the chief effect of salt-free diet is the elimination of salt from the tissues, and that this took place during the first few days. A further prolongation barely improved the situation and was of no practical value.

If it is wished to rid a patient of a surplus of sodium chloride, it is therefore necessary only to restrict him to a fruit diet on certain days, as when there is no salt added to that present in the body the existing supply is driven out.

After years of experience van Noorden applied the principle of a contrasting diet to the treatment of healthy subjects and advocated its adoption by the whole country. He christened it the zig-zag course of nutrition, and I can but endorse his conclusions from the excellent results of my own application of his theories.

In the last fifteen years I have known healthy individuals and whole families take to the alternation of diet on two days a week. The habit they formed had such an obvious effect on the health of those using it that even children and servants have voluntarily followed the example set by their elders.

To preserve physical and mental energy there seems no better way than the periodic fruit-diet day combined with rest from work. This can be done without any inconvenience during the week-ends. A Saturday and Sunday spent in resting, exercise and eating nothing but fruit is not only the best recuperative measure and the most effective means of protecting the body from illness, but it is the most efficacious curative treatment for gout, rheumatism and cardio-vascular affections. It causes a lowering of high blood pressure with all its consequent symptoms, and ameliorates fatigue, neuralgia and troubles of the liver and gall bladder, even if it does not completely cure them. Numbers of artists, writers, lawyers and doctors will testify to this, after years of regular rest-day dieting.

We know how difficult it is to persuade a diabetic, or a sufferer from some other metabolic disease, to adopt a stricter diet. But how easy to connect so appropriate a bill of fare with his week-end! And when a permanent and regular change of diet is impossible in view of the ordinary habits of life, we can always advise a contrasted diet on regular days, in order to relieve all the functions of the body and rid it of toxins, while at the same time providing it with abundance of alkalis and potassium. This dietetic hygiene could with the greatest benefit be extended to schools and institutions.

Periodic days of fruit diet provide the one easy and practical method of clearing sodium chloride from the tissues, combating acidosis and regulating metabolism, so that the balance lost by indulgence in an habitually ill-assorted bill of fare can be restored. It is a system which at the same time rests and tones up the organs. It provides the body with its best defence against infection, increases its power of resistance, and relieves the bowels

of waste matter, thus counteracting the ill-effects of chronic constipation.

In conclusion I give a specimen menu for the fruit diet day.

Breakfast. 2 cups of tea with sugar and lemon (no milk, as milk contains protein) or black coffee. 2 oranges, or 1 grapefruit, *or* 3 oranges, with sugar, 1 apple, 1 banana.

Every two hours. The juice of 2 oranges and 1 grapefruit, *or* 3 oranges, with sugar.

Lunch and supper time. 2 or 3 cups of tea or coffee without milk.

During the day. 15 to 20 oranges, 4 to 6 bananas, plenty of figs and dates.

When hungry. In addition to fruit juices, black bread and honey.

Such large quantities of fruit as are given above are of course not obtainable at the present time; but an equivalent quantity of vitamin C could be substituted, if only this were manufactured in sufficient quantities.

To those who object to such revolutionary recommendations as are made in this chapter, I can only reply in the words of William James, who says: "There are three stages in the history of every medical discovery. When it is first announced people say that it is not true. Then, a little later, when its truth has been borne in on them, so that it can be no longer denied, they say that it is not important. After that, if its importance becomes sufficiently obvious, they say, anyhow, it is not new."

Therefore, I would say with John Hunter:

"Don't think, try."

CHAPTER THIRTEEN

EPIDEMICS

THE gravest dangers in any war are starvation and infectious diseases. These contribute more to the final result than the bloodiest and most decisive victories in the field. Clearly, we must now discuss the influence of nutrition and epidemics.

The experience of the last war has been dealt with in the previous chapter and the serious effects of our ignorance at that time have been reviewed. How, we must now inquire, will recent discoveries help us to combat the epidemics of this war?

To understand properly the scope of the problem before us we must take into account all those factors which will enable us to resist infection. We know that our resistance can be strengthened or weakened: we must therefore take whatever measures are available to minimise the factors which weaken and to increase those which strengthen it.

States of exhaustion, mental disturbance in the form of depression, fatigue of mind and body, lessen resistance fully as much as lack of vitamins, sugar and potassium, and excess of salt and proteins.

We must bear in mind that the entire population is now called upon to increase its power of resistance to the uttermost, while, on the other hand, the conditions inherent in warfare of the character now being waged tend to diminish this power. In the first place, there is

the black-out, with long hours spent in shelters; in the second place, the general condition of malnutrition brought about by lack of minerals and vitamins.

THE BLACK-OUT

Not only does the lack of light influence our state of mind—we know that we are inclined to be cheerful on a sunny day and depressed amid fog and rain—but states of depression and anxiety can in many cases be cured by light treatment. Now that we know how far our mental processes are controlled by metabolism, these things are recognised and understood. It can be demonstrated that an exclusive diet of animal protein, that is to say, of meat only, leads to a number of psychic disturbances in the form of cramp, attacks of fear and depression and even epilepsy. Conclusive experiments establishing this have been carried out on animals and human beings.

The cause of depression can be found in a lack of oxygen. The provision of oxygen, on the other hand, increases all the metabolic processes through augmented combustion. In this way fear and depression can be alleviated, even removed. As we know, the articles composing our diet must be decomposed by combustion before we can assimilate them, and combustion is oxidisation. We know also that the skin, owing to its own metabolism, is of the greatest importance for all metabolic processes. The influence of light, in the form of sunlight and ultra-violet radiation, on the transformation and utilisation of vitamins depends on this specific skin metabolism.

It is recognised that our susceptibility to light and darkness depends solely on the storage of vitamin A, to such an extent that night blindness, for instance, is due to

lack of it. The effects of vitamin A and vitamin D on the system are also regulated by light; without light vitamin D cannot be formed. This is all the more significant if we consider that resistance to infection depends chiefly on our reserves of vitamin A, and owing to the black-out our resistance to infection is weakened.

The conclusion to be drawn from these considerations is twofold. The black-out affects our state of mind and our reserve of vitamin A. Decrease of vitamin A, combined with a depressed state of mind, automatically diminishes resistance to infection. In addition we must take into consideration the exhaustion due to increased effort in working, difficulties of communication and transport, disturbed nights and the general mental strain imposed on us by present conditions of life. In short, the black-out is lowering our resistance to infection and increasing our latent receptivity to epidemics, and this latent state will be activated by the conditions of prolonged sojourning in shelters.

We must, therefore, fortify our defence mechanism against infection, and in so doing we shall automatically fortify it against epidemics. But what measures will effectively prevent epidemics, and how can the people be protected against infectious diseases in spite of present conditions? Can this be done by means of food? We shall find that it can.

Food rich in vitamins A, B and C provides the system with a defence against germs, and stress must be laid not only on the large quantities of vitamins to be taken but equally on their proper and effective employment. This matter has been dealt with in the chapter devoted to vitamins and their utilisation.

As already mentioned, a diet which acidifies the system will lead to infection, while an alkalised diet will

strengthen the defences against it. But the kernel of the whole problem is that resistance to infection is decreased by salt, and defence against it increased by potassium. Proteins have the same effect on the system as salt. We must therefore reduce the salt and protein content of the tissues and increase their supply of calcium, potassium, sugar and vitamins.

Just as we can treat infectious diseases by an unsalted diet of fruit and vegetables, so we can prevent them by the same methods. This fact is of particular importance in this country. The prevalence of the common cold and of rheumatism are not due, as is so widely supposed, to climatic conditions, but in great part to the lack of vitamin and mineral reserves in such a high proportion of the population. As Sir John Orr has pointed out, it is a fact that the majority of the population is undermineralised and devitaminised.

Epidemics must tend to decrease production in factories, and may perhaps lead to a complete standstill. There is an even more dangerous possibility: that of a complete collapse of morale. It is common knowledge that every infectious illness, even a slight bout of influenza, leads to a state of depression. It is this lowering of mental resistance, such as would affect the entire population during and after a widespread epidemic, which would be perfectly capable of weakening the morale of the country and leading to universal defeatism. And the cure is simple. It is vitamin C and B1 in large doses.

The average diet is poor in vitamins and minerals, but rich in proteins, fats and salt. In order to ensure a diet containing adequate vitamins it might be suggested that the British housewife should revolutionise her marketing. But this would be impractical, impossible and ineffective.

A preceding chapter has discussed why it is out of the question to attempt to increase our vitamin reserves in a short time by a dietary New Deal. A mere alteration of the usual bill of fare would not, in fact, achieve much towards overcoming the danger of infection.

Abnormal conditions call for abnormal measures. We are facing new and dangerous conditions, and we must take the necessary precautions. But these precautions must conform to the highest standard of knowledge. We must supplement a diet rich in vitamins with large quantities of the particular vitamins needed to ward off epidemics. We must become vitamin hoarders, and open a current account of minerals in our system, upon which we can draw at need to buy off infection. We must fight against receptivity to infection while we learn to increase our resistance.

The factors which increase a predisposition to infection are: physical and mental fatigue, acidosis of the system from excess of protein and salt, lack of vitamins A, B and C, deficiency of sugar, potassium, calcium and phosphorus. Therefore all the vitamins, minerals and sugar must be administered in sufficiently large quantities, and the symptoms of acidosis and lassitude must be removed. Only then can we prevent the spread of infection. We shall see later how far mental and physical exhaustion are bound up with chemical processes and how the supply of certain minerals and vitamins can affect them.

The full value of vitamins depends in the first place on a correct balance in the supply of minerals in the system. The balance of vitamins and minerals is regulated by the adrenal cortex hormone. Lack of this hormone makes for a complete breakdown of the potential tensions in the tissues. In other words, weakness of adrenal cortex activity is linked up with low blood pressure caused by

a loss of sugar in the blood, a disturbed mineral balance, and interference with the work of the vitamins. It must be remembered that the adrenal cortex gland is the central organ, the storehouse of vitamins C and B. deficiency in this hormone produces acidity of the tissue. Acidosis, therefore, tends to immobilise the vitamins in their fight against infection and opens the way for the activity of disease germs.

HORMONES, VITAMINS AND MINERALS

To administer adrenal cortex hormone is as important for the prevention of infection as is an ample supply of calcium and potassium. Salt must be banished from the system. Large quantities of sugar must be consumed in order to augment oxidisation, increase blood pressure, strengthen the vascular system and neutralise disease-germ toxins. Sugar, in fact, if only it were not deprived of its most valuable mineral contents by so-called refinement, would be the most effective protection possible against infection.

An ample supply of vitamins A, B and C is indispensable. Vitamin A protects against infection and fortifies the mucous membranes; vitamin C preserves the tissues against inflammation caused by infection; vitamin B guards the nervous system against all the consequences of infection: we know that diphtheria, typhoid, influenza, and other infections can lead to neuritis and even neuro-paralysis.

It has been proved in recent years that by taking adrenal cortex hormone combined with large quantities of vitamin C, diphtheria infection could be avoided, and the damage done to the system by diphtheria toxin cured. Children fed with high doses of this vitamin are immune from this infection.

CHAPTER FOURTEEN

FATIGUE AND EFFICIENCY

FATIGUE is a chemical process in which an accretion of lactic acid accumulates in the muscles, while sodium chloride is retained and phosphorus rejected. Fatigue is also accompanied by a decrease in the blood-sugar—the cause of the athlete's craving for sweet things, as has already been mentioned.

We know to-day that insomnia is frequently due to a shortage of blood-sugar and an accumulation of acids. The administration of sugar is therefore an effective remedy for sleeplessness and the mental exhaustion which goes with it.

During the war of 1914-18, von Embden, after hundreds of comparative tests of the working capacity of soldiers in the German army, found that muscular fatigue was caused by a deficiency in potassium and phosphorus. He made a quantitative investigation of the effect of phosphorus and proved its value for counteracting fatigue. At the same time Urbeanu, the Rumanian Food Controller, drew attention to the nutritive quality of potassium. Following on these discoveries it has been experimentally proved that a surplus of sodium chloride with a shortage of potassium in the tissues leads to exhaustion, weakness, decreased efficiency and lowered resistance both to infection and to mental stimuli. But the fact of greatest importance is that, corresponding to this shortage of potassium, there is a similar lack of gly-

cogen, phosphorus, and copper, and a breakdown of the electro-potentials, while conversely we know that maximum efficiency is connected with an increase of electro-potentials by means of phosphorus, potassium and vitamins. Again, modern dietetic research shows that the importance of a fruit and vegetable diet lies in the potassium food of this kind contains, just as much as in its alkalising effect on the tissues. Increase of potassium is accompanied by increase of phosphorus, calcium and glycogen.

In order to understand these facts we must realise that the close connexion between both mental and physical capacity and the functions of the hormones is now generally recognised. For example, a deficiency in the adrenal cortex hormone causes a weakening of the muscular system, and mental fatigue or failure to concentrate is due to the inadequate functioning of the pituitary hormone. We have also discovered that the hormone functions depend on vitamin metabolism. A lack of vitamin B, for instance, not only decreases nervous resistance, but affects the adrenal cortex system, while a lack of vitamin A lowers resistance to infection and leads to hyperfunctioning of the thyroid; the consequences being, as often as not, thyroid intoxication with all its attendant symptoms which make the patient irritable, easily tired and, above all, lacking in mental balance. Taking all these factors into account, we can understand the complexity of the process of recuperation. But though this problem is by no means a single one, we know that the crux of the matter lies in the adjustment of mineral metabolism, known as transmineralisation. An alteration in the mineralisation in the tissues produces an immediate effect upon the whole metabolism of the vitamins, and hence the functions of the hormones.

Recovery, therefore, does not depend solely on rest and sleep, but can be assisted by normalising the vitamin and mineral metabolism. This shows once more the importance of a correct diet. It is true that sunlight and fresh air promote recovery, but the administration of vitamins by means of a correctly selected regimen is possibly of equal importance. Van Noorden has clinically proved that it is possible, by prescribing a saltless, vegetarian diet during a rest cure, to promote resistance to fatigue and bring about complete recovery in the shortest possible time. During the rest period the decomposed products of metabolism were eliminated from the tissue, together with the sodium chloride, while the tissues absorbed phosphorus, potassium and glycogen, and the organism rid itself of the poison. This led to an increase of vitamins and normal glycogen metabolism which gives free play to the beneficent effects of sunlight.

We understand to-day the relation between light and vitamin A and D metabolism. Not only is fatigue caused by a lack of the vitamin A which can cure it; it also restricts the production of vitamin A in the body and lowers resistance to infection. Ultra-violet ray apparatus should therefore be installed not only in the shelters, but in factory rest-rooms and in every place where tiring work is done in bad lighting conditions.

These considerations lead to the suggestion that workers should spend their days of leisure in fresh air and sunlight, and should be provided with a bill of fare which would ensure both bodily and mental recuperation. Country houses in the neighbourhood of factories might be taken over and used for this purpose. The running of these houses and the preparation of meals could be undertaken by women not yet recruited for national

service. It would not be difficult for them to learn to prepare the vegetables and salads necessary for the diet; it should, in fact, be an interesting occupation, for they would not only have to take care that the vitamin and nutritive value of the dishes were preserved, but also to make them as attractive, varied and palatable as possible.

The daily bill of fare should consist of fruit juices taken every two hours; for lunch and dinner, vegetables, salads, rice, potatoes and milk, without tea, coffee, or alcohol.

Not only would these days of recuperation counteract fatigue and increase resistance in general, but they would have a most beneficial effect on those allergic affections to which this nation is particularly prone, such as rheumatism, asthma and hay fever. The equipment of such rest-houses would cost next to nothing.

The treatment just outlined could, of course, be given at intervals only, and in spite of its obvious desirability, it might meet with obstacles and objections. There are, however, two questions which must be answered:

(1) Is it possible to improve the efficiency of our workers and our soldiers and render them less liable to fatigue of mind and body?

(2) Is it possible to increase resistance to infection, and to accelerate recovery after illness and operations?

Both those questions can be answered in the affirmative, for we know, not theoretically, but as the result of experiment and experience, that we can improve efficiency and counteract fatigue, and knowing this we must act upon our knowledge before it is too late.

Let us sum up our case. We are able to increase efficiency by preventing bodily and mental fatigue. At the same time we can increase resistance to infectious

diseases and mental shock by the administration of such preparations as Equilibrin, vitamins and hormones.

It is a fact that both bodily and mental fatigue are due to lack of potassium and excess of sodium, while our food on the whole is too rich in sodium and too poor in potassium.

Resistance to infection depends on the vitamin reserves in the organism, and the vitamins are dependent on balanced mineralisation. Potassium and phosphorus, in particular, increase our resistance to infectious diseases and promote recovery.

The numerous allergic affections diminish the efficiency of the worker, but they are curable by means of the administration of potassium and the elimination of sodium.

In present circumstances, a salt-free diet, combined with fruit, vegetables and the necessary vitamins, is impossible, although it is by far the most effective means of ridding the system of excess sodium chloride and its results. We must therefore make use of a preparation which, by providing an increase of potassium, has been proved successful in overcoming sodium poisoning.

We know that the outcome of the present war depends on the mental and physical resistance of the entire nation, man for man and woman for woman. We know that mental health is not only influenced but governed by the vitamins and hormones; we must therefore concentrate on their use. A preparation is in existence which fulfils all our demands in this sphere; it should be given with yeast, large amounts of vitamin B (750-1500 int. U.) and in some cases, with particular hormones in addition.

"The food question clears the way for the mind question, which then is exalted above the former, and the social question is dependent on both and conditioned by both."

M. BIRCHER-BENNER.

CHAPTER FIFTEEN

FOOD AND THE MIND

THE construction and functions of the body provide an inexhaustible and estonishing subject of contemplation, and some understanding of health and sickness is indispensable to the student of human nature. But there is another side to us no less significant than the purely physical processes of the organism; that part of us which knows, feels, observes, remembers, judges and desires, that part in which we meet with affections, instinct and emotion. We change from one physical state to another, from energy and effort to exhaustion and fatigue; even our consciousness has varying phases, vanishing in sleep and re-emerging in the experience of our dreams. In every one of us exists the longing for things known and unknown. Unceasingly we enter into fresh relations with ourselves, with the persons and things around us, with our whole world, in a complicated play of mind and emotions which is constantly evolving new permutations and combinations. And it is by our mental attitude that our place in our environment is determined, the environment of which we ourselves are a part and a function.

Friendship and hostility come into being, standards of value are formed which lead to enthusiasm or indiffer-

ence; we learn to distinguish between good and evil, creating in ourselves feelings of guilt, remorse, atonement, inspiration, intuition and imagination. And each and all of these conscious and unconscious notions are swayed by our varying impulses; the three prime impulses being the urge to eat, the urge to propagate and the urge of the ego. These three are the great factors in the development of all personality.

The three are increasingly at work in us, even though we neither recognise nor feel their presence. Impressions and conflicts take place, decisions are taken or rejected, standards of value are set up, all without our conscious knowledge; for none of these occurrences within us can be seen or measured or weighed; their field of action is the mind. But the body reveals their presence, and from the signs which the body shows we may recognise the inner, invisible processes behind.

Fear and apprehension accelerate the heart-beats; ill-humour, vexation and anxiety spoil the appetite, while happiness and contentment promote it. The stomach, the intestines and even the skin react to mental excitation, as witness the sweat of terror. If it were generally known how much we can diagnose from the skin alone, we should realise with what truth the skin has been called the mirror of the mind.

The misunderstood child, ill-treated by unperceptive teachers, trembles and begins to lie from fear, then becomes sly and secretive. Its guilty conscience makes it shy, uncommunicative, impudent and badly behaved; it loses appetite and refuses food. This state of affairs leads sooner or later to actual ill health.

Every doctor knows to what an extent mental states influence the body in all its functions; evidence of this is

to his hand daily. And though it may seem at first sight a far-fetched conclusion, even sociology is not divorced from health. Our mental condition and its physical effects actually determine our outlook on society.

In this connexion may be mentioned a particularly interesting case recorded by Bircher Benner. Mrs. S. suffered from digestive troubles and vainly sought relief for years from all kinds of medicaments. She was a youngest child; her father died young from an affection of the lungs, and her mother was a permanent invalid, incapable of working, so that the girl, while still in her teens, was obliged to manage the household. Whenever she failed to run the house to their satisfaction, her brothers would ill-treat her. The result of this unhappy and loveless life was that the overworked and mishandled young woman projected her own dissatisfaction upon the world around her.

One day, going out into the street, she heard the *Internationale* sung: "We struggle for the Rights of Man." The words made a deep impression, and she began to attend Communist meetings in the evenings, returned home late, and suffered further ill-treatment from her brothers. But in spite of this she continued to attend the meetings, where she found comfort and consolation. When she threatened to run away from her unhappy home, her brothers laughed at her and beat her. To save herself from this wretched situation, she married when she was twenty; her husband was a good-natured but weak and sickly man. She chose him, however, neither from love nor impulse, and her married life was a failure. She took refuge in ill-health, and became a prey to serious digestive disturbances which no medicine could cure. But when Bircher gave her unfired food

treatment, a complete metamorphosis took place. Not only did the digestive troubles disappear, but her mental condition was ameliorated. She regained confidence in herself, and ceased to be a Communist.

But at the same time we must never lose sight of the relations of the human organism to the subconscious environment. For the human organism is intimately bound up with the universe, with the cosmic rhythm and its periodic cycle; the vital processes with the interchange of day and night; for the course of our life has also its day and night. The British investigator, Sir William Roberts, points out that there is an alkaline flow which begins after midnight and a flow of acid which lasts from noon till night. It can be demonstrated that there is a natural time for sleep, and this confirms the common theory of the value of sleep before midnight. " Early to bed and early to rise " expresses the natural rhythm of our life.

A few examples will serve to show the importance of diet in this connection. For instance, a man of fifty consults his doctor about symptoms of complete exhaustion of the system. He is in a state of excessive emaciation; his stomach is relaxed, his blood-pressure is exceedingly low. Parallel with these symptoms, his mental state is one of extreme depression. As a consequence of his inability to concentrate his work has suffered severely, and his marriage has proved a failure owing to the impotence which accompanied his mental depression. He is ordered a strict diet of raw vegetables, salads and fruit, and in addition progressive walks in the open air. In two months' time a visible improvement takes place, so that the patient is absolved altogether from further treatment. Two years afterwards a completely

altered, healthy man, quite unrecognisable, comes into the consulting room. He is still following the advice originally given him, taking walks for weeks at a time, and is healthier than he has ever been in his life.

The extent to which dietetic therapy has been practised and followed in recent years is astounding. We should like here to bring to the reader's notice a case on record which points particularly to the value of such treatment.

A doctor, sixty years old, suffered from a serious inflammation of the gall bladder and was due for operation. He had suffered ever since his fortieth year from heart attacks, which had been diagnosed and treated as angina pectoris, and digestive troubles had led to an affection of his gall bladder. He was taken to a nursing home where the gall bladder was to be operated upon, but on arrival he suffered a sudden heart attack that lasted several hours, so that an operation was out of the question; his condition seemed hopeless. But at this juncture the doctor-patient himself decided upon an unfired diet and began to confine his meals to fruit and raw vegetables. At once an improvement set in, leading in a few months to a complete restoration of health. His heart trouble and all his other symptoms disappeared, and he was able to recommence his practice, more lively and healthier than ever.

Again, a woman of fifty suffered from cirrhosis of the liver, which developed into dropsy. No remedies or treatments seemed to help her, but a change to a purely fruit-and-vegetable diet brought about an improvement in a few weeks; after six weeks the dropsy has disappeared, and before long the cure was complete.

Vegetable and fruit juices are effective for the severest cases of heart failure and the resultant dropsy and other symptoms. That so simple a method should be so

effective appears even to-day to cause astonishment. The results are gained, as a matter of fact, by the complete elimination of salt, the introduction of potassium and the alkalising of the tissue, factors with which the reader has by now become familiar. The vitamins and sugar in the fruit fortify the cardiac muscle, increasing its energy and promoting normal functioning.

But the most interesting and convincing, perhaps, of all the evidence to hand is provided by Dr. Jackson, the Canadian physician, who gives us a description of his own illness and of his treatment of his patients, in his book, *How to Be Always Well.*

He had suffered from a weak heart ever since his early youth, and was constantly under medical treatment. But in spite of all the physicians and their prescriptions he became so seriously ill in his fiftieth year that a first-class specialist gave him only four months to live. His heart trouble was aggravated by glaucoma, and he could only walk a few steps on a perfectly level surface, being unable to climb stairs any longer.

At this juncture, Dr. Jackson determined to alter his mode of life completely. He adopted a purely vegetarian curative diet with abundance of raw foodstuffs, and started to practice breathing and other physical exercises naked in bed, until he was able to go through all these exercises while standing. When he found that his physical exercises were beginning to become heating, he added cold baths to the treatment. In his account of his case he emphasises that while taking sunbaths and fresh-air treatment he wore as little clothing as the law allowed. He then began to take open-air walks, and increased this form of exercise to ten or twenty miles a day. He was, in fact, completely cured.

At the age of sixty-six, Dr. Jackson was able to take part in a cycle race of 1,300 miles with a professional cyclist lasting nineteen days, in which he showed signs of greater power of endurance than the sportsman himself. In his eightieth year he could walk ten miles or more, give lectures and show all the signs of a man in full health and vigour. From his fiftieth year onwards, ever since his severe illness, he had never taken medicines nor bathed in any but cold water. His glaucoma disappeared together with the other symptoms.

This heroic doctor owed his health, which lasted until extreme old age, to his own recognition of the value of right feeding and to his perseverance in his exercises, undaunted by the seriousness of his case. It certainly demands self-discipline as well as knowledge for a man to forsake his accustomed habits of diet and to keep to the same regimen for any long period; there is nothing harder than to break off habits of eating and smoking which have been indulged in for years. That is why the clinically experienced dietetician is sceptical when a theoretical physiologist claims that he can alter the traditional diet of a whole nation, even for a short time, and even more when he imagines he will do it permanently. All plans for balanced national diet depend upon a social reorgansation, needing much time and education to carry through. The masses will not lend themselves to a change of food to order. We doctors know how difficult it is to make the patient keep up an invalid regimen to cases of diabetes and similar metabolic affections; how much resistance and how many objections have to be met and overcome.

We must therefore find another method, which is best carried out by means of periodic days of diet, which can be carried on for years. The necessity and practical

success of these dietetic holidays has been shown in greater detail in the preceding chapter. They are easy of introduction, and should be embodied in every plan of nutrition intended to improve the condition of the nation, and made part of the compulsory school curriculum without delay.

But popular enlightenment on questions of food is essential if we are to point out the dangers and harmful effects of wrong feeding to the great masses of a people. A practitioner with years of experience behind him, who has frequently made public speeches, or written articles in the papers on medical questions, knows best how this may successfully be attempted. And he knows too that the health of the people cannot be divorced from a right —that is an organised—method of diet.

CHAPTER SIXTEEN

CIVILISATION AND DIET

IN the words of the Viennese biochemist Otto von Fürth: "Just as in the past decade man has been enlightened by the discovery of those vitamins which are essential for mere physical well-being, the coming decade may be employed in the discovery of those vitamins which are necessary to cure the people of the diseases of hatred, egoism, envy and insanity, which are the roots of more evil than beri-beri, scurvy, rickets and pellagra together."

If we look back on all the subjects we have passed in review, we shall see that the average daily regimen of civilised peoples is lamentably deficient in essential nutriment, consisting, as it does, chiefly of meat, white bread, pastries, tinned foods and refined sugar, with vegetables and fruit in small amounts only, and those in a denatured state.

We remove the germ and the husk from wheat to make white flour; we demand only polished rice; we give the most valuable elements in sugar to our cattle and eat the anæmic, flavourless residue; we are gluttons for protein, which we consume in enormous quantities in our meat, cheese, eggs and milk; we take vast amounts of fat and indulge immoderately in salt, while our tinned foods are

tainted by noxious preservatives. In fact, we make every effort to rob our food of all its wholesome properties.

Our diet, therefore, starved as it is of minerals and vitamins, is unbalanced and lacking in the essential elements of nutrition. Sooner or later the results of this unnatural bill of fare will be visible, in the form of deficiency diseases and a legion of other metabolic disturbances which arise from malnutrition and weaken both resistance and efficiency.

The human body is able to adapt itself, to a large extent, to the conditions of its environment, though this adapability varies with the individual. Civilised nations have been enabled to condition themselves gradually to their defective diet, and mistakes in eating can be made with impunity so long as health safeguards our resistance. But when the tolerance of the system is strained its patience becomes exhausted, and a state supervenes which we recognise as an illness.

Illness always reveals a state of disorder in the body; the balance of the system is upset and all our processes and functions thrown into disarray. But this is not all; physical disharmony brings mental disharmony with it. Fear, depression, even epileptic attacks, are due to a disturbed condition of the mind. As I have mentioned before, it has been proved that men fed exclusively on meat and concentrated proteins betray symptoms of a disturbed mental balance. Protein poisoning produces the conditions mentioned above, together with convulsions and even total unconsciousness. Experiments made on animals have given similar results. We need not therefore be surprised to find that the disorders produced by excess protein can be cured by salt-free and unfired food.

Everyone has heard of a fatal mental affection which is chiefly found among young people. They seem to have two separate personalities, a Jekyll and a Hyde perhaps, and this splitting of the conscious functioning of the brain finally leads to madness. This disease, known as schizophrenia, was formerly incurable, but to-day it can be cured by influencing the metabolic processes, one of the most important of which is nutrition, thus showing the intimate relation between metabolism and the mind. As mentioned in the chapter on vitamins, a deficiency in vitamin B may lead to loss of memory and to confabulation. A commoner example is migraine; we all know how this condition affects the outlook and temper, making a misanthrope of the most light-hearted optimist. This it was found can be cured by means of saltless, protein-free diet, and the success of the cure has encouraged a wider application of the saltless regimen. Take again sterility in women, and the strange, tortured characters it produces. But sterility is due to lack of vitamin E, and is therefore, like other vitamin deficiencies, curable.

Schizophrenia and sterility, two serious afflictions which are both curable by diet, show how right or wrong nutrition can alter the whole life of an individual. Realising this, we can look further and see a slender bridge leading across the gulf that separates us from full comprehension of the *mental* sterility of mankind.

Years, decades and generations pass by, and no decline is seen; yet slowly, unconsciously, the collapse of health and sanity is preparing. It may be a chronic disease, it may be physical degeneracy. Chronic diseases strike at the individual and shape his particular destiny, but bodily degeneracy shapes the fate of a nation. "Man is what he eats."

Experiments on animals have provided us with evidence of the relation between the invisible decline and the visible disease. Animals fed on a badly organised diet show an interval before the appearance of the full syndromes of deficiency disease. This period McCollum calls " the twilight zone of nutritional instability."

But it is not only animals in laboratories which live in this twilight zone. We, all of us—all civilised mankind —are living in the twilight to-day, and we can see, if we look, how the whole of our culture is in decline. The diseases of civilisation are only the result of this nutritional instability. The increase of certain morbid symptoms goes hand in hand with the elaboration of civilisation and technical perfection. But these symptoms are seen not only in the physical sphere; we observe at the same time the prevalence of fatigue, lack of resistance, irresoluteness; after sleep we awake not fresh and fit, but tired. Our power of resistance, not only to infection and the common cold, but even to moral influences, is weakened, and introspection is replaced by extrospection; our mental condition is one of irritability, depression and pessimism; for disharmony in our food means disharmony in our mind, a tired mind goes hand in hand with a tired frame. And mental fatigue leads to " life fatigue," one of the most important and tragic, as it is one of the most dangerous, consequences of the twilight zone in which we live to-day.

Those, however, who have been able to see the morbid condition will change through the revival of circulation, when the sick body is given the food it craves, in fruit, green salads and unfired foods; those who have been shown how diet can heal the gravest maladies in man, will have been given to see with Karl Ludwig Schleich the

great mystery of nutrition. For nutrition is more than metabolism; it is a type and example of the great cycle of life. But it is only the man who has permitted himself to see as a patient all the results of correct nutrition in his own body, or at the sickbed as a doctor, who can fully realise the dangers of our inadequate diet. And he will know more than this, for he will look beyond the diseases to the mental symptoms of our epoch. Knowing the relation between food and mood, familiar with the twilight zone, he will see the decay of culture, the lack of enterprise, of moral fibre, of confidence in the future, and know why men are so weary—weary of resisting the onslaughts of infection, but wearier still with the fatigue of the soul.

It is the fatigue of the soul alone which can explain those historical events whose dreadful consequences we witness to-day. The doctor versed in the mysteries of biology can clearly see the cause of breakdown in our bodies. But our country is as much a living organism as our physical frame; it has a heart, a breath, a pulse. Indolence of soul in its inhabitants means an indolent national soul, a nation in decline, a defeated nation. And for the sake of all mankind, now and in the ages yet to come, that we must never be.

Correct food enables us to restore the defective circulation in every blood-vessel in the system, to reinforce our defences against infection, to revitalise the organs exhausted by fatigue. We must increase our powers, stimulate them to maximum capacity, setting vigour against indolence, energy against exhaustion, purposefulness against indecision.

We must come out of the twilight zone—out into new light, with all our powers of mind and body enhanced,

eating rightly first, then thinking rightly and acting rightly; to rescue civilisation by building up a culture, a culture founded on and glorifying liberty, belief, justice, humanity, the only true values, the sole eternal values, the values for whose preservation is bound up with our victory in the titanic struggle that is being waged to-day.

THE END