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Climate and Labour

AN ENQUIRY INTO THE INFLUENCE OF
CLIMATE ON MENTAL AND PHYSICAL WORK

made by

W. BURRIDGE

D.M., M.A., (OXON), F.N.I., F.N.A.S.,

*Professor of Physiology, King George's Medical College,
Lucknow*

K I T A B I S T A N

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INTRODUCTORY

Relations between climate and labour were brought to me forcibly when, as a preliminary to closing down my bungalow before my first departure from Lucknow to the hills at the end of April, the electric current was cut off while I was still writing at my desk. Soon the sweat poured off me and, falling on to the paper, smudged what I was writing. My bearer noticed what was taking place, and, hunting out a sheet of cardboard, for such things were readily available in those days, he vigorously fanned me, and enabled me to resume my writing in relative comfort again.

That incident was the starting point of the present book. What were the differences between myself and my bearer which made me so uncomfortable in that heat, and left him still comfortable while he produced still more heat to wield the fan to cool me? Easy explanations would be that we were of different races, and that he was inured to the heat while I was not. Such explanations, it should be noted, are superficial. We want to know how men become inured to heat, and the mechanisms involved.

I have investigated these differences over a number of years through examination questions, and have been able to do so because whatever any

normal healthy person does belongs to the domain of physiology. This has allowed me to put my questions into two parts; in the first part the student is asked to give his personal observations concerning himself or others, in the second part he is asked for a physiological explanation of his observations. Any ordinary person can answer the first half, but the second half requires a knowledge of physiology which does not as a rule come direct from the text-books. Thus, everybody knows that it is painful to have his own or anybody else's finger put in the eye, but an explanation of the painful-perception requires much physiology.

The reader should therefore appreciate that when I point out that the hot weather adversely influences appetite and digestion, I do not do this as a result of questioning a dozen or so of dyspeptics, but after assessing the replies of many hundreds, even thousands, of healthy young Indian male and female medical students to questions concerning their own hot-weather experiences. Healthy young men and women in the prime of life are the chief sources of my information.

CHAPTER I

SOME INDIAN PICTURES

It is a hot day in June, and towards midday the hard-worked officer of the Public Works Department directs his car to the rest house. Having arrived there, he seeks shelter from the heat in the shade of a cool inner room. During his meal and while he takes his afternoon nap, he is further cooled by a punkha which is worked by a man seated on the hot verandah outside.

The man who sleeps indoors under the punkha, and the man who pulls it from the outside, though they may be of the same race, are yet different men. For the man in the cool inner room finds it sufficiently warm to prevent him from sleeping in comfort unless he is cooled by a fan, while the man on the hot verandah outside can find that greater heat there so comfortable that he can go to sleep while he pulls the fan.

The two men differ because of the differing rates at which they produce heat within their bodies, and in the rates at which they lose it. To carry on the day's work in India, especially in the hot weather, it is obviously desirable that the vast majority of its inhabitants should be in the same condition as the

man who is so comfortable on a hot verandah that he can go to sleep there while he pulls the fan. Unfortunately, however, this capacity to be comfortable on a hot verandah automatically carries with it other qualities which many earnest reformers would like to abolish or remove. Still more unfortunate is it that the very earnestness of the reformer automatically carries with it that state of mind which makes its possessor look ill at any suggestion that he both wants to eat his cake and keep it.

Our next picture is taken from a railway journey made between Lucknow and Agra on a hot day late in April. The journey was from 10 a.m., to 6 p.m., approximately. Before the train reached Etawah the compartment had become so hot that the fan merely made things hotter by blowing down the hotter air from the roof of the compartment. Accordingly the fan was helped by resorting to water cooling as well.

At Etawah I got out to see how people without fans were faring in the heat, and therefore took a look at the third-class carriages. As a class their occupants seemed quite comfortable, but here and there was an individual who appeared to be distinctly uncomfortable. The uncomfortable traveller was always fat, and so I tentatively reached the conclusion that fat men should not travel third class in hot weather. The conclusion I still believe to hold good. After all the man whose income allows him to get fat ought to travel second class at least.

CHAPTER II

THE FAT MAN'S HOT-WEATHER TROUBLES

When a heat wave reaches England, cartoonists are apt to depict the chief sufferer as the fat man, who may be represented as wiping sweat from off his brow, or as seated in his office with an ice-bag on his head. Hence it did not surprise me to find that the uncomfortable passengers in 3rd class compartments were the fat ones. Considering how much hotter the plains of India are than the warm spots of England it was, however, reasonable to believe that in India fat men should be much more uncomfortable than their counterparts in England. To find out just how uncomfortable they can be I made investigations through the medium of examinations. At many written and oral examinations of medical students they were asked to give an account of the disabilities of fat men in hot weather, and how those disabilities arose. The first part of the question tested their powers of observation, the second part tested their capacity to apply their knowledge of physics to the problems presented by a living organism adapting itself to its environment.

Students seemed almost to vie with one another in giving lurid descriptions of the tortures suffered

by fat men in hot weather; indeed, after reading them, I felt that Dante and the old moralists had left something out of their infernos! Every one of them had a fat friend or relative who was prostrated in the hot weather. According to them the fat man in hot weather can only lie on his back, and sweat, and pant, and grumble about the heat. Even the exertion of fanning himself may be too much labour.

That is his condition. Its cause is a matter of mass and surface, and can be partly illustrated through hot tea or coffee.

At school we had a chess club and our weekly evening endeavours were wound up with large cups of steaming hot coffee. To those who were in a hurry to get away that hot coffee provided a hard problem in good manners until one boy noted that his mother's aunt had a niece who had been a lady-in-waiting to the Queen, and thereby had he learnt that, when the Queen found her tea too hot, she poured it from the cup to the saucer to drink. That tale clinched the matter, and none thereafter had any doubts about the propriety of pouring hot coffee into the saucer to cool it quicker. On looking back, there have been times when I have doubted that boy's tale about the Queen; nevertheless a belief in it can be a very pleasant aid to good deportment when a cup of very hot tea or coffee requires quick disposal.

A cup of tea or coffee is chiefly cooled by evaporation from the surface of the liquid presented to

the air. It is also cooled by radiation from the outside of the cup, but the former has much the greater effect. When, then, the tea is poured from cup to saucer the tea-air surface, whence evaporation takes place, is greatly increased and the consequent increased amount of evaporation provides a quicker rate of cooling.

The morning bather also provides a good example of the influence of surface. If he just rolled his wet dhoti into a bundle after his bath, he would arrive home with it still soaking wet. But if he holds one end of it while his friend holds the other, the increased surface thereby presented for evaporation enables his garment to become quite dry by the time he has gone a few hundred yards from the bathing ghat.

The surahi and khas-khas tattī also exemplify the cooling effects of evaporating liquids. The doctor's spray illustrates the point that the quicker a liquid evaporates the greater the rate of cooling. He sprays the skin over an abscess with some spirituous liquid that evaporates quickly enough to cool the skin enough to benumb the nerves over the abscess. He can then cut the skin without pain to the patient. Delicate ladies do something similar when they use the spirituous liquor known as eau-de-Cologne to cool their heated brows. Country liquor would act as efficiently and be much cheaper, though it would not be quite so aesthetic, perhaps.

In contrast with the above cooling methods, a cup of hot tea may be kept warm by placing the saucer over the cup. This action imprisons, as it were, air between the saucer and the tea, and this air quickly becomes saturated with the water vapour evaporated from the tea. When the air thus becomes saturated, evaporation no longer takes place from the tea which therefore ceases to be cooled by evaporation. The tea can only now be cooled by radiation from the surface of the cup. The marked differences in cooling times taken by tea poured into the saucer, left in the cup, and covered over in the cup, respectively, illustrate both the influence of surface on cooling time, as well as the preponderating effect of evaporation over radiation in cooling liquids.

The air around us can hold different amounts of water at different temperatures, the amounts rising as temperatures rise. Warm air can hold much more than cool air. When, then, warm air charged with moisture is cooled down, a temperature will eventually be reached at which the air is supercharged with moisture, and the supercharge is deposited as dew, fog, mist, or rain. Warm moist air, for example, may travel as such across warm plains, but, when the current of air rises to cross some mountain barrier in its path, that same air, cooled as it rises to cross the mountains, will become supercharged and the supercharge be deposited as rain.

Everybody knows, either from personal experience or the washerman's monsoon delays, that

clothes do not dry quickly when the air is moist. That is because the rate of evaporation into the air depends also on the amount of moisture already held by the air; the drier the air is the quicker is the rate of evaporation into it, and vice versa.

Now all living creatures are heat-producing machines, and we humans are not only such heat-producing machines but also we have a constant temperature, the blood-heat of our thermometers. To maintain that constant temperature we have to preserve a balance between the heat which we produce and the heat which we lose by evaporation of sweat, and by radiation, and by conduction to our surroundings. Sweat cools us by taking heat from us when it evaporates into the surrounding air. Heat is also conducted from us to the surrounding air, as well as to the air which we breathe, and to any cool object that we make warm by touching it. Our radiation is not ordinarily made apparent to our senses, but the physicists have made instruments sensitive enough to react to the heat received from distant stars, and to point one of these at a human being is almost enough to break it from over-action!

Heat is energy or motion, and is measured as the now familiar calories. Thus, when it is stated that an egg provides so many calories for the body, the statement implies that the body obtains that amount of energy when it uses up that egg. The greater part of the energy appears as heat, a lesser part as work.

The non-scientific should here appreciate that

energy has many forms which are convertible into one another. Heat is a mode of motion, and so is electricity or light, etc. When they are converted from one to the other, the conversion is so definite and regular that so many units of electricity produce so many units of heat, and vice versa. Machines are energy transformers and the householder who uses electricity has a meter to measure it. This meter is really a small electric motor wherein a small fraction of the total electricity used turns the small wheels which record on the dials. An electric lamp is a machine for transforming electrical energy into light, a toaster or electric kettle transforms it chiefly into heat, and a fan transforms it into motion.

When the temperature of things around us is higher than our blood heat we can no longer lose heat to our surroundings by conduction and radiation, we can only then thus gain heat from them. In the cold weather, for example, it is possible to keep another man's seat warm for him by sitting in it while he is temporarily away, but in the hot weather the same process would keep the seat cool for him. Once the thermometer registers blood-heat or more, the evaporation of sweat becomes our only source of heat loss. If we are unable to produce enough of sweat, or fail to produce and evaporate it fast enough, the temperature of the body rises and heat-exhaustion or heat-stroke supervenes.

There are, thus, three chief ways by which we lose the heat produced in our bodies; viz., by conduc-

tion to other objects such as the air which surrounds us, by radiation to our surroundings, and by the evaporation of sweat. In each case the cooling power is determined by the amount of surface exposed.

There was a time when to bring out these points I would ask a student under examination how he or she lay in bed in the cold and hot weather respectively, and why they adopted the different attitudes. I expected them to tell me that in the hot weather they lay stretched out to expose as much as possible of body surface to the air whereas in the cold weather they just curled up to reduce the exposed surface to the minimum. Unfortunately, a limited number of the ladies appeared to imagine that this was an unjustified enquiry into the secrets of their bed chambers, and therefore I thought it better to put the question into a different form by going to the dogs instead. But, while the problem in its first form could be answered by anybody who applied his book-learning to facts within his own personal experience, the second form required that the student should also be an ordinary observer of the world around him; yet many more students failed in the observation test than were young ladies shocked at imagined enquiries into bed chamber secrets.

Dogs lie all stretched out in summer and all curled up in winter. They cannot evaporate water from their skins because they have no sweat glands, but they can evaporate water from their air passages and muzzles, and when things grow too warm they

increase the amount of this evaporation by panting. In dogs, specially warmed up to study this process, the rate of breathing has been observed to rise to so much as 300 times per minute. Most dogs also, after a few car rides, learn the cooling effect which follows putting their muzzles into the wind. In winter, however, the dog's cold spot may need a little warming, and so he directs his nose to the fire. It is noteworthy here that fat men in hot weather may be compelled to use the dog's method of cooling by panting. There is good reason to believe, however, that such panting in humans, if prolonged, should be a precursor of heat exhaustion.

Save for increasing the rate of evaporation from the small area of his muzzle, the fan has no cooling effect on a dog. If, however, the dog had just come from a bath and still had a wet coat, the fan would cool him. Without such a wetting, however, the fan would rather make him warmer. Hence dogs in hot weather do not seek the fan, but seek some cool corner. And, after he himself has warmed that originally cool corner the poor dog has to get up and seek another, which brings us to the point concerning how fans cool us.

When the weather is hot enough for us to require the fan, it can be found, by placing a thermometer beneath the fan, that the air blown by the fan is as hot as the air anywhere else. Indeed, if the fan be an overhead one and the thermometer delicate enough, the air blown down by the fan may be found warm-

er than that near the floor. Fans do not normally cool us directly but indirectly by increasing the rate of evaporation of our sweat.

If we sit still in still air we quickly saturate with water vapour the air in our immediate neighbourhood. We cannot then evaporate more sweat. The sweating machinery, however, will keep working because the blood has reached the temperature which sets this machinery in action. Accordingly we then become bathed in perspiration.

Fans ordinarily cool us indirectly. They effect a regular replacement of the air, next to our skin and saturated with water vapour, by fresh air which is not so saturated. Our sweat can be evaporated into that fresh air and so we can be cooled. Of course, it is possible to be cooled directly by a fan which actually blows cold air, but it may be accepted that fans as ordinarily used in India never do this. In America, however, doctors have begun to use fans blowing cold air to cool people down to a body temperature much below blood heat. The patient early loses consciousness and, after being kept in cold storage for a week or more, is warmed back again to normal. Such cold treatment is claimed to be beneficial in a number of different chronic diseases.

Bearing these various points in mind we can return to our fat man who can be visualised as weighing 300 pounds whereas in his youth he had but weighed 100. His weight has trebled, but his body surface

has not; the latter may be taken as being only about double what it was.

Next imagine father with his son, a stripling and the living image of father in his youth, hurrying to catch a train on a warm day. The exercise not only makes them feel warm but actually raises the body temperature. Young men, for example, after a game of football can have body temperatures so high as 104° , but are not feverish and quickly cool down again. Our fat man, moreover, when he walks with his son does more work than the son because he carries treble the son's load in flesh. To put himself on a par with father in the matter of the amount of work done in getting to the station, the son would require to carry a load of 100 lbs., in each hand. And if the reader of this weighs so much as 150 lbs., he can get some idea of that fat man's burden by imagining himself to be hurrying to a meeting holding half a maund weight in each hand. He could reasonably expect to get hot on such a job of work.

Because he does so much more work father produces much more heat than the son. For convenience, we can imagine that father's temperature at the end of the exertion has risen 2° above normal whereas the son's has risen 1° only. Also for convenience, we can introduce a new unit of heat, and define it as the amount of heat lost when one pound of human flesh is cooled through 1° F. This implies that father has 600 surplus units of heat to dispose of while his son has 100. Both would cool off at

approximately equal rates if father's body surface were six times greater than that of his son; we have noted, however, that instead it was only just about twice as much. The father should therefore take something like thrice the time taken by his son to cool down again to normal. After which it will be realised that in hot weather a little exertion can keep a fat man uncomfortably hot for a long time. Sleek and fat men are not suited for physical work in hot climates, such work is for men of lean and hungry look. And long has that been known in India for an old Indian proverb states that in hot weather fat men should only sit at the door and watch the passers-by.

The man of lean and hungry look is best fitted for physical work on the hot plains of India. When, then, the reader next sees the semi-naked coolie showing each and every rib through his flesh he should not think of starvation, but instead of a body adapted to work in comfort in a hot climate. For a rib-show aids the dissipation of heat from the human machine just as do the flanges on the cylinder of a motor cycle. And if the reader requires further evidence on this, he should compare the body-build of coolies working in the rice-fields of the Indian plains and those of Kashmir. Concerning both places he can be told awful tales of low wages and insufficient food, especially of Kashmir, yet the Kashmir coolie looks sleek and well-fed when compared with his plains-man counterpart.

If, however, we cannot go to Kashmir to make such comparisons, we can do it on the Indian plains. All that is required is to make a motor run on a hot day in May or June, and observe the countryside. Every few miles a mixed herd of cows and buffaloes is certain to be seen feeding on the same pastures. Never will the buffalo be seen to interfere with the cow's feeding, yet the buffalo is sleek and fat while the cow reveals its ribs. And while many cows may be seen ruminating contentedly in the full heat of the midday sun rarely will the buffalo be so seen. The buffalo not only seeks the shade, but requires also her daily cooling bath. Hence, when the mixed herd goes down to the river to drink, the buffalo goes right in while the cow stands on the brink. The sleek and heavy buffalo requires water-cooling when for the thinner cow air-cooling is enough. There is much in the differing natures of these beasts that can be applied to men of different builds.

The man who now works in the fields of India and the man who now works in the fields of Kashmir have both behind them at least a hundred generations of ancestors, who have all been doing the same sort of work. While they did it, nature was also at work among them eliminating those who were unfit for this job and preserving those fit for it. The latter further reproduced their kind. These differing men in these differing places may, thus, really represent a natural selection of the best type of man for this work in those differing places. Human effort may possibly

improve on what Nature has already done, but nevertheless we should not be over-confident about the possibilities.

The lower animals of India may also have their own ways of adapting themselves to its high temperatures, but my direct observations only extend to frogs. Many years ago I described some of the effects which follow the placing into warm water of a particular muscle of the English frog that is found around Oxford. These results were attained at a temperature of 40° Centigrade or about 104° Fahrenheit. When I got to India, I tried the same experiment on Lucknow frogs, and it did not similarly come off. I next found that I had to use a temperature of 50° Centigrade to get from Lucknow frogs what I could get from Oxford frogs at 40° .

After that I studied the hot weather temperatures of the ponds from which these Lucknow frogs came. I found that English frogs would die straightway from heat-stroke if they were placed in Lucknow ponds in the hot weather.

Though these temperature-differences imply profound differences in the physico-chemical make-up of the two frogs' muscles, I could not find that they were accompanied by changes in the reactions to drugs. For, after I had found these temperature-differences, I repeated in India experiments that I had already done in Oxford and London with such drugs as alcohol and cocaine, and I obtained in India the results that I had already obtained in England. Somehow or other,

then, the Indian frog balances the one change by some other equally unknown.

It is unlikely that humans and other warm-blooded or homoiothermic animals resort to any such mechanism as do frogs for adaptation to high temperature because they keep a constant temperature. Blood-heat in Indians is the same as blood-heat in Europeans. Nevertheless, just as the Kashmiri differs from the plainsman, so must cows and other warm-blooded animals differ in different parts. The Indian cow can contentedly chew its cud in the full blaze of the afternoon sun in June whereas Thomas Hardy's cows, fed on the lush meadows that border Dorset's streams, would probably die of heat-stroke if they were suddenly transported by magic carpet from Dorset leys to the middle of the U. P. in the middle of mid-summer's day*. Cows probably have all a common origin, but there are many generations of adapting and adapted ancestors behind the present cows that feed respectively on Dorset's leys and India's plains. Even the milk yield may thus have been affected because milk-production by the cow carries with it extra heat-generation. A cow in the shade can, in fact, safely produce more heat than cows in the sun. Some day it may be found, if it has not been found already, that the same cow will yield more milk on a summer's day when it is kept in the shade than it does when allowed to roam in the sun.

*Voit's standard man similarly transported would probably meet the same fate.

CHAPTER III

THE SKIN AS A HEAT-REGULATOR

Our skin is full of blood vessels most of which are ordinarily closed or partly closed, the degree of their opening or closing depending on whether it is desirable for us to lose much or little heat to our surroundings. When it is necessary for us to lose heat to our surroundings, i.e., when we have attained a temperature above blood heat, these blood vessels are all opened up, and the skin grows warm, and then, by warming the air, etc., in contact with it, heat is taken away from the body. When the blood vessels are closed, the skin cools off and the heat lost by the body is diminished. The blood is turned on locally during blushing, or over an abscess or insect bite, and everybody is acquainted with the local warmth of the skin in such places. When we are hot enough we can blush "all over"; and when we are cold enough, we can likewise grow pale.

The skin, through its sweat glands and blood vessels, is the chief apparatus employed by the body to keep its temperature constant. Through these blood vessels the skin can act as a vast radiator, yet with a function somewhat inverse to that of an ordinary household radiator unless the latter be regarded

as an instrument for cooling off the water in the hot-water apparatus rather than as an instrument to warm a room.

Our radiator-apparatus is under the control of a thermostat or heat-regulating centre which is situated in the brain. All our organs and structures are, of course, sensitive to warmth and cold, but the heat-regulating centre is so constituted as to be the most sensitive structure in the body to changes in the temperature of the blood flowing through it. It is further so constituted that, when the temperature of the blood rises ever so little, it sends nervous messages to the skin to open up its blood vessels and if necessary, to pour sweat from the sweat glands, and to do just the opposite of this when the temperature of the blood falls below blood heat.

Our thermostat is also subject to the influence of disease processes, and so are the blood vessels of the skin. One sign of tuberculosis, for example, is to sweat heavily from a cold skin at night, the so-called cold sweats. In contrast with this, in the early stages of malaria there is not only a cold dry skin, but also that cold dry skin sends impulses to the brain which in turn set up the shivers. Yet, while the patient thus shivers apparently from cold, the clinical thermometer will show that his actual body temperature is much above the normal blood heat.

Our personal feelings of being hot or cold may thus be fallacious guides concerning whether our temperature is deviating from the normal or not.

Ordinarily, of course, the feelings of warmth or cold which we derive from our skins guide us correctly; some disease process is at work when they mislead us. Many a patient, for example, has ascribed his illness to a chill whereas the chill was instead the first sign that he had been stricken with disease. There is a similar popular misconception concerning the relations between inebriety and lunacy. For a man to take to drink is frequently one of the early signs of lunacy. He takes to drink because he is already mentally weak enough to lose control of his actions. Certifiable lunacy comes later, and could quite possibly be avoided if the man's relatives took medical advice in the early drinking stage. Immoral incontinence may likewise be the first sign of consumption in young persons, and when later the consumption becomes manifest the righteous are apt to see therein evidence of divine retribution rather than the inevitable accompaniment of a divine madness.

The skin, through its radiator apparatus and its own very structure, is our natural suit of clothes. It has a high degree of natural efficiency which is gravely diminished through the wearing of clothes. It retains its pristine efficiency in clothes-wearers only in their faces. Thus, it is on record that a Canadian Governor was once taken out to see Red Indian ice sports. He arrived on the spot well wrapped up in furs and was received by the Indian Chieftain very partly clad in a single blanket. Whereupon His Excellency asked the Chieftain if he did not feel cold

with such an uncovered body. As reply the Chieftain asked His Excellency why he did not cover up his face because of the cold. And when told that His Excellency had never been in the habit of covering his face, the Chieftain replied "Good, me all-face."

Britons should also appreciate that there was a time when the all-face with a little decoration of woad was their national costume. No vital statistics concerning those days are now available but it can be reasonably suggested that they were a hardy race who died relatively young because the efficiency of the skin as a temperature regulator decreases with age just as does the efficiency of our limbs or eye-sight. Thus, when old and young people are together, the old people shiver with the cold long before the young. We shiver when our radiator apparatus no longer suffices to keep our temperature constant. As a result every new winter becomes more trying to those who are ageing. When, then, there is a cold wave and the newspaper reporter enquires from the oldest inhabitant of the English village for comparison with previous years, the oldest inhabitant can but record that never in his life before had he felt such cold weather. The oldest inhabitant of an Indian village would correspondingly report on a heat wave.

Indian customs and clothes are more conducive to maintaining the skin as an efficient heat regulator than are their English counterparts. The man who wears his shirt outside his trousers, for example, is much more sensibly dressed for hot India than is the man

who tucks his shirt inside. The bush shirt thus goes far to increase the marching efficiency of soldiers. What we have just noted is further in accord with the tradition that the Indian student who goes to England to study passes his first winter there in relative comfort, and the second one in discomfort. The cause for the difference is that, in between those two winters, he has had time to anglicise his clothes and customs enough to reduce the efficiency of his skin, his natural suit of clothes.

It is therefore to be appreciated that sentimental people, who have been sufficiently well-clad all their lives as to have gravely reduced the efficiency of their natural suit of clothes, can devote considerable misplaced sympathy on their less well-clad fellow humans. As a striking instance of this one can quote a police-court case from Plymouth. There a couple, who believed in rearing strong healthy children, let their two children sleep naked on the lawn each night. But there came a night when it snowed heavily and the children had to be dug out of the snow next morning. This caused great stir in the neighbourhood and in due course the couple appeared in the police court. Originally angry magistrates could but subsequently discharge them because the chief items of evidence, the children, were such fine specimens of what children should be.

The reader should not, however, read in the above an argument for general nudism, he should only take therefrom enough to preserve a balanced

mind concerning the use and abuse of clothes. Yet there is still another interesting point concerning the skin as a natural suiting. Its efficiency as a protector against loss of heat is gravely diminished by soap. The unwashed Tibetan may appear somewhat odorous to the sensitive nostrils of a stranger, but, like bad breath, it is not appreciated by its propagandist, and should be deemed necessary in the climate where its possessor normally lives. Indeed, it can safely be said that none should use soap for washing if he is to make full use of his skin as a suit of clothes in cold weather. He should just go down to the river to bathe, or stand under the tap; that is all. And if this is read by anyone with a lust for slaughtering little children, he should note that he could achieve his object by starting a society that would provide every naked little child with a hot bath and plenty of soaping on the first chilly day in the cold weather. The hot bath could be recommended for warming them up, and the soap for rendering them sweet and clean, two most praiseworthy but, in the circumstances, dangerous ends.

We can finish this chapter with a few remarks on feet. The reader of this has probably been accustomed to have his feet covered with boots or shoes ever since early childhood. He has only, in fact, used his feet for standing or moving. The regularly bootless or shoeless man, however, has much more useful feet, as anyone can see who watches the skill with which things can be picked up from the

floor with the foot, or the help which his foot is to the carpenter or other workman. When one has realised how useful the foot can be to the man who does not regularly wear boots, he will get some idea of the usefulness of the skin as a suit of clothes to the man who wears little. The Englishman who has served in India, and worn English clothes, so gravely diminishes the efficiency of his skin that his life in retirement is spent in evading the draught.

CHAPTER IV

ON GOING TO THE HILLS

A chapter has just been devoted to the skin-organ because of its importance to our present discussion which deals with the question of the blood-supply to the various organs of the body. The first point to note is that none of us possesses enough blood to fill all his blood vessels; far from it. The blood vessels of every organ of the body are capable of expanding and contracting just as we noted was the case with the blood vessels of the skin. When an organ works its blood vessels expand and allow it to be filled with blood almost as a sponge; when the work is done the blood vessels contract again, squeeze the excess blood out, and allow just the quiet trickle to pass through.

The body's arrangements for blood supply are in fact somewhat similar to those of a police force in that there is enough for ordinary patrol of all organs, and a general and special reserve for contingencies. These general reserves are in the abdomen, and the special reserve is in the spleen.

This special reserve, it may be noted, was only recently discovered. A party of English physiologists journeyed to the Andes in South America to study certain problems associated with living at high alti-

tudes. A necessary preliminary, however, to finding out what changes take place in us when we go up mountains is to find out first the state of affairs before the ascent is made. Accordingly, they made daily observations on themselves while journeying out, and thereby found that, as they got near the equator, the amount of blood in their bodies seemed suddenly to increase, and when they got cool again on the other side, it seemed as suddenly to decrease. One of them, when he got home, experimented to find out how this happened, and eventually discovered that the spleen held a special reserve of blood. The ordinary reserve is in the rest of the abdomen.

Just as no government keeps a police force sufficiently large to deal with simultaneous riots and civil commotion in every town and village, so no animal body has within itself enough blood to deal with simultaneous activity in every one of its organs. Instead, things are so arranged that organs ordinarily grow active in succession. When any organ becomes active the blood taps are turned on for that particular organ, as it were, and turned off for the others. Thus, for fighting and running away, each of us has a special blood-distributing mechanism which briefly consists in greatly reducing the amount of blood in the abdomen and switching it over to the muscles instead. When the running-away mechanism is highly activated it will effect also a sudden and involuntary evacuation of the contents of the bladder and large intestine, apparently in order to lighten the load for

the runner to carry. This same mechanism operates more gently in candidates who have been called up for interview or examination, and are nervous at the prospect of being asked questions which they cannot answer. Wherefore should their waiting room always have convenient lavatory accommodation available. Some people never overcome this weakness, and there was a case of a famous surgeon for whom a special lavatory had to be built adjoining his operation theatre. Although one of the best surgeons of his day, yet each operation was for him something sufficiently terrible to 'take him short' before he started operating.

When most of the blood in the abdomen has been switched over to the muscles, digestive processes suffer because there is not then enough blood left in the digestive organs to enable them to work with full efficiency. Hence, any form of violent exercise is contra-indicated after meals, especially heavy ones.

Carking care brings the same blood distributing mechanism into part action, and thus impairs the digestive capacity of the care's possessor. His appetite also fails because that as well depends on an adequate blood supply to the stomach. Thereby does he or she in time take on the lean and hungry look. Quite possibly, indeed, it was for such an one that a little wine was once recommended for his stomach's sake. Wine thus taken would not directly influence the digestive processes, rather would it produce that calmer state of mind which permits of the proper

distribution of blood required for good digestion. Sadness of soul evoked by an unfortunate love affair can similarly influence appetite and good digestion, and the lowered nutrition thus resulting provide a fruitful soil for the seeds of consumption.

Now when the weather is hot, blood must be sent to the skin to keep our body temperature down to its normal value; otherwise we start on the journey to heat stroke. For survival, therefore, blood must be sent to the skin, and it accords with this that in hot weather the skin does obtain priority in respect of the blood supplies available. And if the skin has this priority then other organs must go short. And, if those other organs have to go short of blood then obviously their working capacity cannot be up to the normal. It is thus inferable that the brain, digestive, and muscular systems cannot function as well in the hot as they do in the cool weather.

But, after one has thus evolved a theory, it still has to stand the test of further observations, and those further observations I have made through examinations. From a single simple question I can thus obtain the combined wisdom and evidence of several hundred intelligent students. As a result I find that they have three chief complaints; viz., (1) indigestion. (2) inability to perform muscular work satisfactorily. (3) inability to carry on their studies.

One of the gems thus collected came to me over an examination number subsequently revealed to me as a charming young lady from the Lady Hardinge

Medical College, Delhi. She thus informed me that "during the long summer months to eat seems an exertion, and even to think takes all our superfluous energy." Her home was Karachi, and what she said was confirmed by others who came from Travancore, Bombay, the Central and United Provinces as well as the Punjab, Bihar and Bengal. There were even some who asserted that their minds just went blank in the heat of the summer's day. Quite apart from these last, we are safe in asserting that students on the plains of India find it difficult to pursue their studies in the hot weather. And what students have thus told me I have found confirmed by teachers, for I remember a meeting of Deans of Lucknow University at which the question of study-efficiency was raised; they were all of the opinion that little real work could be done by students in Lucknow during August and September.

This mental torpidity of hot weather is determined by the same mechanism as that which determines the same torpidity after a heavy meal, with the difference that while the blood is in the skin in the one case it is in the stomach in the other. When, for example, we feel appetite, the stomach blushes, as it were, all over. It first becomes flushed with blood and then it sweats, but the sweat is gastric juice which, like sweat, first appears as drops on the stomach surface, and then the drops grow bigger and finally run down and join together in a pool at the stomach's lowest place. A good digestion waits on appetite because the juice thus formed through appe-

tite gives the proper start to good digestion. Our stomachs 'water' just as do our mouths when the appetizing dish is set before us. It is also to be appreciated that a heavy meal towards noon on a hot day gives a co-operative combination that would leave over too little blood to work our thinking machines at anything like high pressure. Rather would we sleep the siesta, that custom of warm and balmy climates.

The hot weather disabilities are, thus, essentially bound up with our possession of too little blood to run two or three organs together at high pressure. The skin gets a primacy of blood supply because, as already noted above, the immediate survival of the individual depends on it. In the hot weather a few moments' suppression of the heat-regulating function of the skin can send the individual hurtling down the track that ends in heat-stroke, whereas, in contrast with this, depending on his age, he can depend on surviving fasting for anything from a month to a few days. Hippocrates, the father of medicine, who flourished in Greece some 2500 years ago, left behind for us the aphorism that old men stand fasting well, the young fare badly. Clinical experience since has not only confirmed this age-old aphorism but also of recent years a well-known French physician, M. Guelpa, by combining fasting with appropriate purging, has very successfully rejuvenated many aged persons and also improved their chronic complaints such as high blood-pressure, etc. It should therefore be appreciated that a carefully conducted fast is much

less dangerous to a frail old man than to one in the full vigour of youth. In addition, the frail old man can obtain considerable relief from his high blood pressure whereas the young one has probably no chronic complaint to relieve.

Another interesting discovery made by Guelpa was that fasting greatly reduces the discomforts of railway journeys in hot weather, a discovery directly applicable to Indian conditions. We would not advocate therefrom that restaurant cars should not be run in hot weather, only that due provision should be made for light and snacky meals, especially for those who are pensioners or are approaching the pensionable age.

Through fasting we have thus emphasised the great difference in danger times associated with suppression of intake of nourishment and suppression of the heat regulating function of the skin. Thinking, digestion, and movement can wait, but heat-regulation cannot. The skin must always have priority of the available blood supply in hot weather, and that priority implies less blood for thinking, digesting, and moving.

When considering this the reader should also appreciate the difference between hard, and easy or artistic thinking. Any man with enough money and a dear but dead wife can lie on his back and artistically day-dream concerning the erection of a Taj to her memory. It requires hard thinking, however, to express any such dream as plans and estimates. Hence, while it may be still possible to do the former

on a hot summer's day, real hard mental work such as the latter or the work of a student is out of the question. Also, as the psychologists well know, there are people who never get beyond artistic thinking, and such people could well imagine that the hot weather made no difference to their thinking capacity. Their ordinary thinking, in fact, may be of such poor quality that it cannot be worse!

The act of taking decisions is more exhausting to the brain than the performance of routine, and, in this connection some interesting work was done by an Italian Physiologist, Mosso. Just as it is news to most people to know that an old man can fare well on fasting whereas the young fare badly, so most people regard examination as a sort of picnic for examiners and a terrible ordeal for the examinees. The opposite is the actual case.

Mosso gave examiners and examinees certain work to do before and after an examination, and found that the examinees could do the work after their examination almost as well as they did it before the ordeal. In contrast with this, the examiners after the examination just fell to pieces, as it were. He then followed up this discovery and eventually found that the taking of decisions was the cause of the examiner's exhaustion. During an examination the conscientious examiner is regularly taking decisions on the merits of the various answers given by candidates, and thereby is he eventually exhausted. My own observations extending over many years have

also shown me that it takes the average examiner longer to think out a fresh question to ask a candidate than it does for the average candidate to give the answer. It accords with the above that many lawyers have complained to me of the mental strain associated with cross-examination and suggested that it was harder on the lawyer than on the witness. In view of this, it seems fit and proper that the higher courts should go on vacation in the hot weather, and correct at the proper season the hot-weather errors of lower courts !

Since these difficulties arise through our possession of too little blood to run two groups of organs at high pressure at one time, the obvious remedy is to seek a cooler environment. This can be done either by air-conditioning, or by going to the hills, or by going down in the earth just below the level to which the sun's heat penetrates. The first is new to India, the others have long been practised here. To go to the hills is best because there the environment is everywhere cool; the others really represent temporary makeshifts. It is, for example, more pleasant to eat in a cooled dining room than in a hot one but, to be really beneficial, the air-conditioning should extend also to the room where digestion takes place as well as to the place where one takes exercise. At the same time one should appreciate that, if a man breaks his fast in a hot room and then goes to an air-conditioned office or laboratory for work, he works under conditions satisfactory for digestion and mental

work. But if a man has to ponder and think outside as well as during office hours, he requires air-conditioning outside as well as during office hours, and that can only be obtained if he goes to the hills.

The air at high altitudes like Simla is rarefied, and every breath we take there contains less oxygen than a similar one taken on the plains. We require above, however, at least as much oxygen as we do below, and to get that same amount of oxygen out of the diluted mountain mixture we not only require to breathe deeper and faster, but also we require more and richer blood. It takes about a fortnight or so for the body to make the necessary adjustments, and until they have been made, the newcomer is short of oxygen for a part of his time. On arrival in Simla, say, from Delhi, the newcomer may find himself short of breath on climbing stairs that he could take with ease in Delhi. Next, after he has done his fortnight or so, he finds himself climbing the Simla stairs with the same ease as he climbed stairs in Delhi.

A pertinent point about this adapting stage, when the newcomer is suffering from lack of oxygen, is that it produces the same general symptoms as alcohol. In the annals of physiology there are many interesting descriptions of the effects of this lack of oxygen and in its oral traditions there are many even more, such as what the affected son said to his eminently respectable father, and what the affected inspector of mines said to the manager's daughter. The point to note about them is that each of these affected persons,

like the pufflicky sober imbibor, believed himself to be perfectly normal and rational at the time when he behaved so strangely. During the adapting stage, then, people may say and do in the hills things which they would not have done down on the plains below in similar circumstances. It is quite customary to ascribe this light-hearted feeling to the load that has been taken off the body through rarefaction of the surrounding air but the actual cause is quite different. It is further the case that different people are differently affected, and that ultimately the amount of effect will depend on the life that has been led below. Those who have led physically energetic lives below will have the reserves to meet ordinary contingencies above whereas those who have led slothful lives will not. Hence, when legislative assemblies change their meeting place from plains to hills, it should be required of the physically slothful that they should proceed to the new place of meeting at least a fortnight before the new session begins. None, however, would envy the lot of the man or committee who had to select the physically slothful! And it should always be borne in mind that the affected individuals are firmly convinced that their minds work as rationally and normally as ever they did. Their deficiencies are only revealed when some independent observer can compare the affected one's intelligence and behaviour in the two sets of conditions.

Physical endurance tests such as tennis and boxing have also to be considered. Many years ago the

adjutant of a famous British cavalry regiment lamented to me concerning the fate of their boxers who had gone to Mussoorie for a tournament. Down below he had not only seen his team trained to the pink, as he termed it, but also he had accompanied them to Mussoorie in the confident expectation that they would carry all before them. Instead of that, he had the distressing experience of seeing them fall all to pieces, as he put it.

I then learnt him something, as the psalmist puts it, concerning physical contests in the hills. None from the plains should take part in them unless he is prepared to spend at least a fortnight, preferably a month, in preliminary acclimatization to the locality where the contest will take place. Otherwise the local pahari will probably just make rings round the plainsman. In accord with this, is the comment once made to me that a certain local native, who made rings round excellent but new arrivals from the plains when the place of contest was the Happy Valley, showed a distinct difference of form when they met again at Allahabad in the cold weather.

The higher we go, the more attenuated becomes the oxygen in the air, and to everyone who goes high enough the diminished supply of oxygen eventually induces a train of symptoms to which the term mountain sickness has been applied. So far as the actual sufferer is concerned, the symptom brought prominently to his notice is either extreme nausea or actual vomiting. Whence comes the term, mountain sick-

ness. It affects the individual on his way up or on arrival at his new location, it does not affect the regular inhabitants. And, if it be on his way up, then he gets sick where the going is hardest.

The average hill-station of India is below the altitude where mountain sickness afflicts ordinary individuals, though Simla is quite high enough to be a trial to those who down below were only accustomed to lie or sit about. But two popular places of pilgrimage, Amar Nath and Badri Nath caves, are at an altitude trying to anyone straight from the plains. Pilgrims going thereto, however, do not ordinarily suffer from mountain sickness because the journey takes long enough for them to become acclimatized on the way. Yet there is on the way to Badri Nath a very steep climb which brings out mountain sickness in the overhasty, and by overhasty is implied those who do not stop long enough on the way to get acclimatized. At the foot of this climb the pilgrim is advised by the local pujaris to stop and worship for several days; otherwise he may incur the wrath of the gods when he attempts the next stage. The scientist would agree with the advice of the local pujaris, but would be diffident about accepting their explanation about the cause of the sickness which may subsequently afflict the hasty pilgrim. In the climb up the Matterhorn also, it may be noted, there is a stretch well-known for its capacity to bring out mountain-sickness in the badly acclimatized and hasty. In that part of the world, however, the sickness is known to be mountain-sickness.

The road to Amar Nath has only one real stiff climb and that is short. At its foot there are no temples, only pilgrims' rest-houses and a refreshment stall where all the food is coated with silver and gold foil. No pilgrim appears to have seen the silver and gold, yet each seems to appreciate that the prices charged accord with such being present!

In contrast with these journeys performed by road to high altitudes, airmen regularly fly to heights where lack of oxygen can affect their capacity for performance. In contrast with new-comers to hill stations, however, they cannot be permitted to undergo that insidious deterioration of judging-capacity which lack of oxygen brings in its train; they all carry an oxygen supply in cylinders, and are ordered to make use of it above 12000 feet. Moreover, they are ordered to use oxygen then because it cannot be left to their discretion or judging-capacity to decide when they need it. For, if it were left to their discretion, it would be left to something which they would insidiously yet automatically lose and high flying would become an exceedingly dangerous occupation instead of an ordinary event of aviation.

Though many in India go to the hills, few get beyond what may be termed the light-headed stage. The happenings to four scientists who travelled to the top of Pike's Peak (14,100 feet), may therefore be recounted to give the ordinary reader some idea of what can take place.

There is a railway to the top of Pike's Peak and they travelled by it. On arrival all were cheerful and for the first hour or so busied themselves with unpacking and setting up apparatus in the room which was to be their laboratory. Then a gloom settled on them all, and nothing said or done was right. They ceased to be interested in each other, and refused dinner. They went to bed miserable, and only one of them got up next day. He had a splitting headache all the day. Of the others, one was most uncomfortable for two days, one was speechlessly miserable for three days, and one had a bad week of sleeplessness, headache, and nausea. Down below, all had been hale and hearty men, and, after a fortnight above, were able to do there what they had previously been able to do below. When eventually an account of their experiences was presented to the Royal Society it led the late Sir William Bayliss to remark that "perhaps all unreasonable people are suffering from lack of oxygen in their brains."

The manager of the hotel at Pike's Peak is credited with a job requiring endless tact. Each new arrival is happy, and many, elated with the scenery, sit down to enjoy it over a cup of tea or other refreshment. Before the meal is over the early symptoms of mountain sickness come on, and even if the diner knows about mountain sickness, he has by that time become so unreasonable that he will listen to nothing about the mountain air; instead he will roundly curse the quality of the food provided, as well as

those who provide it.

Failure to take mountain air into account also once provided a great fiasco for the town of Potosi which is at a height of some 13000 ft., in the Andes mountains. Silver mining there made a town prosperous enough to develop a bull-ring which was duly built. For its opening ceremony a well-flagged train brought bulls, toreadors, etc., to a magnificent civic reception. But, though all these things were intended to lead up to the great event of the day, the bull-fight, none took place. By bull-fight-time all fight had been taken out of bulls and fighters by the thin mountain air. However, they got their first bull-fight a fortnight later.

In all these matters the individual has to be considered as well as the height. Some individuals will experience mountain sickness at 6000 feet, but most do not, for, if such were the case, few hill-stations in India could become popular resorts. The few who do develop actual mountain sickness at these resorts probably return home at once, and complain later that the smells of Simla made them feel so sick that they could not 'stick' the place, or something of that sort. In the cases that I have met the individuals were of the feeble type who can get a sense of superiority in not being of the same standard as ordinary men. At the same time it should be generally appreciated that all, who go to Simla, or Naini Tal, are affected by the thinness of the mountain air, and that judging-capacity in particular is affected enough to prevent

the individual from appreciating his own loss. While then decision-takers and law-makers could be expected to do better work in the hills than in the plains during the hot weather, they ought all to take a fortnight's holiday on arrival in the hills and before they settle down to any real work. But we should also note the possibility that the great heat of the plains may have diminished their judging-capacity much more than the temporary loss due to thin mountain air. The increase of capacity due to cooling could thus be more than the loss produced by lack of oxygen. This would make the individual a better judge as from his first day in the hills with further improvement as time went on.

CHAPTER V

THE FUNCTIONS OF FOOD

To understand the basic principles of nutrition it is first necessary to cast aside all ideas about human beings other than that, in relation to their food, they are machines or energy transformers. The motor-car, for example, is a machine for transforming the energy provided by the combustion of petrol into motion; an electric lamp is a machine for transforming electrical energy into light and heat, and so on. The human machine transforms the energy of its food primarily into heat and motion. We admittedly do a little thinking as well, but the energy that the most intellectual of us expends on thinking is as nothing compared with what is expended on heat and motion.

Essentially we take food to provide the energy to run a living machine. And while there is a vast multitude of foodstuffs yet, when they are analysed, they are found to be made up of three classes of substances which are known as proteins, fats, and carbohydrates. The white of an egg may be looked upon as pure protein, cream and butter as unalloyed fats, and ordinary sugar as a pure carbohydrate. The energy value of these foodstuffs is

expressed as heat units or calories.

In the past there was a time when it was reasonable to believe that living structures had also at their command a special type of energy, vital energy, but, as experiments have progressed in accuracy, the sphere that can be assigned to vital energy has contracted down to what are known as the limits of experimental error. Within those limits, it is sometimes plus and some-times minus, if you consider it 'ought' to be there. But the facts of plus and minus do away with the 'ought'.

All our energy, then, is derived from the food that we eat, and that brings us to slimming and growing fat. Our energy accounts as income from foodstuffs and expenditure on heat and motion must either be or be not balanced. If they are balanced, we keep a constant weight, if they are not, we either lose or gain weight according to the unbalance; in which connection we can consider the village bania and his neighbour who works in the fields.

A number of my students have at times drawn my attention to what they have told me is the villager's belief that the bania can live on air. What the working villager knows is that he himself eats more than does the bania, yet the bania waxes fat while he himself remains lean. He therefore deduces that there is some mysterious process peculiar to banias which enables these latter to grow fat on air. Actually there is nothing mysterious about it. The bania just sits in his shop and so does little physical work. He

therefore requires less to eat than does his neighbour who works in the fields. But though he actually eats less than his neighbour, he eats more than is required for the actual physical work that he does. The difference between his energy income as food and the energy expenditure as physical work he stores as fat in his body, and, if the difference be only the equivalent of one chapatti daily, then, on the Scotch principle that many a mickle makes a muckle, one eventually gets the fat man.

The fat man's fatness does not therefore imply gluttony. It only implies that his energy intake over a number of years was greater than his energy expenditure. The fat man, as it were, has laid up a substantial balance in the bank of nutrition built up of regular daily savings.

Fatness does not increase indefinitely but goes on until a balance is struck between the extra work done by carrying the load of fat and the food intake. If a slim man weighing 60 seers, say, imagines himself to walk a couple of miles to the railway station carrying a maund of luggage he can get some idea of the extra work done by a fat man whenever he moves his body. If, then, a man has grown fat through regularly eating the equivalent of one extra chapatti each day, he will cease to grow fatter when the extra daily energy expenditure involved in carrying his load of fat is that which would be provided by one chapatti.

In Europe little children can receive moral instruction concerning the habit of squirrels to store away nuts, etc., in the autumn to live on during the lean months of winter. The little squirrel thus can be held up as an example of wise prudence. They are not, however, informed that the pig is equally prudent but in a different way. The pig in the natural state in Europe has to face the same problem as the squirrel, namely, lack of available food in winter. He stores his food reserve as fat during the autumn while the squirrel is gathering nuts. The wild pig in the autumn daily gorges himself on acorns and such like so that when winter arrives he is sleek and fat enough to provide good cooking quarry for the huntsman. As winter proceeds the pig fails to find enough food to keep him going, and then turns to his stores of fat to provide him with the extra energy required to keep him in action.

In contrast with the wild pig, the domestic pig can get full meals at all seasons. Also he still retains his capacity to store fat against leaner times, a capacity of which his owner makes proper use in due season.

Just as an extra chapatti a day, or an extra helping of rice inevitably leads to fatness, so the same deficiency inevitably leads to fading away. Deficiency, in fact, leads to slimming, and a regular daily deficiency of a mouthful of rice or a chapatti would lead to regular slimming. Indeed, if the bania and workman start out together at 100 pounds weight,

then, by the time the bania's weight has increased to 200 pounds, thanks to the extra chapatti daily, the workman will have disappeared through the equal deficiency! However, no workman has yet been seen to disappear through such deficiency and therefore it may be taken that workmen never slowly vanish as a result of food deficiency.

Much of my information on these matters has come to me through asking students to comment on the statement that "it is not possible to starve a workman and keep him regularly at work." From them I have gathered the information concerning the villager's belief concerning the capacity of the bania to grow fat on air. That was just by the way, as it were. The chief point to grasp is that every workman must get enough food to do the work that he does. If he gets more than that enough, he grows fatter; if he gets less, he grows leaner.

The first man to realise that there was a relationship between food intake and energy output was the French scientist, Lavoisier. His deduction therefrom that rich idlers required less food to eat than hard-working men was too much for those of his contemporaries who were busily engaged in spreading the revolutionary doctrines of liberty, equality, and fraternity. Literally he lost his head by the guillotine because the new republicans had no use for scientists who attempted to propagate such strange doctrines.

It now becomes of interest to consider what would happen to the agriculturalist if he were to be

given regularly more food than he now consumes. The answer to this is that he must either regularly do more work or steadily grow fatter. If the latter be considered undesirable, and it must be because fat men are not the men to hold a plough or weed a field, then he must be provided with more work. But what more work can he do? He cannot till more fields than his holding, and he cannot reap more crops than he sows, or his holding can produce. In addition, agricultural work goes on from morning till night. It seems to me, in fact, that in most Indian villages the agriculturalist cannot do more work than he does unless he takes up some subsidiary occupation, and for that he has not the spare time except possibly in the hot weather when his thoughts seem rather to turn to things of litigation.

One should therefore consider the probability that the dietary standards of the Indian agriculturalists are what they are because these must be what they are. It is quite beside the point to compare what he gets with what somebody else gets elsewhere, and then grumble at the difference. Each gets what is required where he is.

More evidence on these points is given by certain tendencies in the Punjab. Every village in the Punjab appears to have somebody who has seen more of the world as a result of Army and other service, and the influence of these men has led to a gradual improvements of the standards of village life. One of these modern improvements is the village mill run by an

oil engine. To this mill those village women, who can, send their corn to be ground instead of grinding it at home as was hitherto the rule. These women, however, have just as much to eat as they used to, but do less physical work, and so they grow fat. Indeed, from what I have heard there will soon be a new proverb current in the Punjab. It will be to the effect that "a village mill fattens village women."

It is also germane to our present point to consider what may have happened in the past in India. A man may be assumed to start out with a thousand bighas of land for himself and family. His sons inherit and divide up, as does also the next generation and so on. Eventually the holding becomes too small to provide a reasonable day's work for the members of the family, and also too small to provide them with food on what was the old scale of their ancestors. Yet there will still be balance between income and expenditure because the moderns will perform less physical work than their ancestors, and so will require less food.

What changes is the turnover and not the balance. There is, however, evidence that what we term good health is associated with a high turnover. People of low turnover tend to be listless and apathetic, and to be ready victims of disease. Pestilence and famine can then come along and so reduce numbers that the survivors can return to the old standards of existence. Such influences undoubtedly regularly acted in the

past, so regularly indeed that when Colonel Sleeman made his famous journey through Oudh he found it to be a matter of common knowledge among the peasantry that land which had temporarily reverted to jungle as a result of war, famine, or pestilence, was more productive than land which had been regularly tilled.

India has had peace for a century or so, and the census returns show that her population is increasing by leaps and bounds. Unless means be taken to increase the productivity of the soil, the pressure thereon must inevitably increase to the point where each individual must find less work to do, and compulsorily submit to diminished turnover. Nature, it should be noted, takes no account of human desires, wishes, or ideals. Relentlessly she pursues her path, and the present indications are that she will use Tuberculosis to effect her ends, because a reduced turnover favours the development of this fell disease.

At the same time one must point out that a reduced turnover can be due to many other causes than lack of food intake. Millions in India have their turnover reduced by intestinal worms, other millions have their turnover reduced as the aftermath of malaria or dysentery, and so on. The position, in fact, is that while the doctor knows of many causes for reduced turnover, the ordinary layman knows of only one, reduced intake. Consequently the layman can forthwith make a diagnosis concerning the meaning of a lean and hungry look while the

doctor suspends judgment until all the facts of the case are at his disposal. Political agitators can thus rush where doctors fear to tread. India, moreover, is not the only part of the world where hook-worms and such like flourish; they flourish also in certain Southern of the United States. The picture, "Gone with the Wind" depicts forcibly the lack of energy, initiative, and enterprise that can afflict the members of a family harbouring hook-worms.

Stress has been laid above on fatness and thinness to emphasise the point that the chief function of the food we eat is to provide the energy to do physical work. We effect also a certain amount of wear and tear of the body's machinery, as it were, when we do work, and this wear and tear can only be made good by proteins. Consequently proteins occupy a special place in nutrition. We must have them, but how much each of us 'ought' to have, no man knows. All the doctors can do is to argue about it, though there is good evidence that what the Americans call pep depends on an abundant protein intake. Mc Cay also drew attention to the point that physical fitness among the various Indian races depended on the amount of protein their customs ordinarily permitted them to consume.

Unfortunately proteins are the most expensive of the different classes of foodstuffs, and consequently, when anyone has to feed himself or other people on a limited budget, the tendency is always to provide too much of the cheapest class of foodstuffs, the carbo-

hydrates. Every head of an institution, when left to himself, automatically tends to over-feed his charges with carbohydrates. Such individuals usually now consult a doctor when drawing up their dietaries, but it was not so very long ago when such a consultation would have seemed strange.

Milk has a special place in nutrition. It is the foodstuff of young mammals and has a very high protein content because the young animal has to lay on flesh as well as to keep alive and moving. Human beings being the only adults who drink this beverage I have often asked at examinations the possibility of living on milk only during the hot weather. An Indian adult should be able to obtain enough to eat and drink from some four seers of cow's milk daily, but it would be a high protein dietary, and its high protein content would probably make him hot and bothered. So far I have not obtained any volunteers for experiments.

Milk varies from animal to animal, and is in each case adapted to the special needs of the young animal. In which connection there is on record the reply of the truthful consultant to the fashionable mother seeking medical support for her desire to feed her baby on something other than Nature had provided for it. After much bothering questioning she came to an enquiry concerning ass's milk and got the reply. Madam, there is nothing better for a young ass than asses' milk, and nothing better for a young human than its mother's milk. If you think your child is a

young ass, give it asses' milk; if he is not a young ass feed him on human milk.

Milk has not only a high protein content but also this protein varies according to the time taken by the young to develop. Thus, a rabbit's milk is just loaded with protein because young rabbits grow quickly whereas human milk has half the protein content of cow's milk because humans develop slowly. In contrast with these, the milk of a polar bear is loaded with cream because fat is so highly necessary in polar regions.

Dried milk, as is well known, is now available on the market, and about a quarter of a century ago Professor Hopkins of Cambridge took such dried milk and refined it and refined it until at last he got the purest of protein, the purest of fat and the purest possible carbohydrate from it. He then mixed these pure foodstuffs together again to form a sort of synthetic milk and fed rats on the mixture. All the rats thus fed died, but they all did well if he added a little ordinary milk to his synthetic mixture.

His experiments thus demonstrated that the maintenance of life requires more than calories; he therefore noted that fresh milk contained what he termed accessory food factors which were essential to a normal existence. About the same time another scientist, Casimir Funk, was working at the Lister Institute in London on the same subject, and he came to the conclusion that these accessory factors belonged to a class of substances termed amines by the chemists.

He therefore believed that he had discovered a special class of amines, the vital amines, and for convenience coined from the two words the word, vitamins, a word that is now on everyone's lips. His chemistry we now know not to have been as good as he thought, but the word, vitamin, remains to designate a class of substances that have opened a whole new chapter in the book of knowledge concerning nutrition.

The vitamins are many, and some day the letters of the alphabet will be used up as their tags. Each does something that was not dreamt of before it was discovered. Yet, in spite of their number and importance, they are not things about which the ordinary omnivorous citizen need worry about. They can, however, provide much trouble for the food faddist and poor.

An example of a food faddist I will take the man who was the only case of scurvy that had turned up at a certain large London hospital over thirty years. He had religiously adopted the advice of his friends concerning what was bad for this and bad for that. He conscientiously practised their combined wisdom and so restricted his range of foodstuffs that he developed scurvy. A somewhat similar event took place in Lucknow, but in this case the man took the conjoined advice of a number of doctors. In defence of the doctors, however, it has to be pointed out that they never met in consultation. The patient had enough money to consult one doctor after another concerning what was bad for this and bad for that and

eventually got what he paid for. Incidentally he lost his hair in the process but ascribed this to his increasing wisdom.

It is a digression from vitamins but the reader should appreciate that there is a class of well-to-do individuals in India whose sole claim to any importance is a book of prescriptions from different doctors. They know of many things to complain about, and by harping on any one of them to a particular doctor they can obtain a prescription different from that obtained from another when they harped on something else. They thereby obtain a sense of superiority by the supposed possession of some mysterious malady which is so extraordinary that no doctor can properly diagnose or prescribe for it. They are believed not to take any of the medicine prescribed for them, for, if they did, they might well be cured and then become just ordinary people. In contrast with these, was the recent case of a young man who contracted a definite disease and had enough money to consult a dozen different doctors. Each prescribed the same medicine but prescribed it under its many differing trade names. This young man was so anxious to get well again quickly that he took what each doctor had prescribed, and died from the resultant overdosing.

Returning to our vitamins again, we get all the necessary vitamins provided we eat from a wide enough range of foodstuffs; once we start restricting the range then danger can loom ahead. The food-

faddist restricts his range because he may, the poor man because he must.

In India, for example, poverty can drive a man to get too many calories from rice, and too few from other sources. His difficulties are increased if he uses polished rice from the modern mill instead of the unpolished grain prepared at home because the polishing of rice removes a most essential vitamin which is not present in the rest of the grain. A little more variety, such as an apple or orange a day, and a cup of milk, will provide few calories but much more vitamins. Religion at present is one of the chief obstacles to providing more milk, and it would be a good thing if religious leaders would re-examine their authorities to find out if veneration can really be accorded to bad cows, a bad cow being one that cannot do its duty as an efficient milk provider. Where there is the will, the pandits could surely find the way. If they could, about two thirds of the present cow population would early disappear to the benefit of the countryside, and then, with good milk-siring bulls applied to the remainder, the supply of milk would tremendously improve. Those who are acquainted with the great benefits that Coonoor has shown can be conferred on Indian children by giving them a little milk each day in addition to their usual diet can but realise that an improvement in milk supply is one of the urgent needs of India. Even now, however, tomatoes form a good and cheap source of vitamins but their red colour is a bar to

their more extended use.

Growing children, as already noted, require relatively more protein than grown-ups; they also require more minerals such as lime for the proper formation of their bones. Yet the child can have abundance of lime in its food and be unable to utilise it because of lack of a certain vitamin which is present in abundance in butter and cod liver oil. And, just as a child can have abundance of lime in its food and be unable to utilise it, so anybody can have abundance of calories presented to them and be unable to eat because of lack of appetite. Pigeons deprived of a particular vitamin will voluntarily starve in the midst of plenty ; humans deprived of it can be rendered sick at the sight of food. And even if you have the appetite it may not be possible to obtain nourishment from what is eaten because of lack of the necessary digestive ferments. We humans, for example, are capable of eating our straw hats or grass, but we cannot live on them because we lack the necessary digestive ferments to extract their nourishment. The cow and goat, however, do possess the necessary ferments. Consequently, they can wander through the streets and make a nourishing meal out of old hats and paper.

But even if you can manufacture the necessary agents, yet enjoyment of the food is a prime mover in determining that they shall be used. Thus it comes about that in King George's Medical College Lucknow students are regularly taught that a little of

what you fancy does you good.

Now, I have often lectured on and asked examination questions on vitamin-D. The recorded results of its lack are truly bad. But it is also the case that the healthiest Indians in India are the ordinary prisoners in the U. P. Jails, and they get no vitamin-D. If the facts are correct, vitamin requirements in the food vary, and this in my opinion is probably true.

Vitamin-lack or withdrawal is followed by what is known as a deficiency disease. The signs and symptoms of these diseases, however, cannot be caused by the substance which is deficient or missing, but by what is left behind, a point that is almost regularly forgotten or neglected.

The state of the body before the vitamin was withdrawn was the resultant of a large number of interacting forces of which the withdrawn vitamin was one. When, then, one of these forces is withdrawn, the other forces regroup, and the different modes of working of the various organs of the body which they subsequently maintain provide the signs and symptoms characteristic of a particular deficiency disease. All the other vitamins must therefore be held responsible, at least in part, for the signs and symptoms which follow the withdrawal of one of them.

An analogy from apples may make this point clearer. An apple hangs from a tree because of a balance between the pull or force exerted by the twig

to which it is attached, and the pull due to gravity. Before Newton's time apples fell from trees because of a deficiency of support; after his time they were actively pulled to the earth by gravity. Most writers on deficiency diseases appear to me to think along pre-Newtonian lines in that they ascribe to deficiency of support what is really caused by the action of the regrouped remaining forces. Thus, the body has at least two types of bone formation, the one type is formed with the help of vitamin-D, the other is formed without it. This latter we call rickety, and it is certainly less preferable to the other, but tastes and fashions can differ.

Rickety children develop a sort of natural rosary on the chest, and such a phenomenon could quite possibly be held to be a mark of divine favour conferred on them through their involuntary austerities. Human beings can imagine such ideas, and, if they did, they would take good care that their children took well-watered and skimmed milk, and plain margarine instead of butter. The children could then reasonably be expected to develop a natural rosary on their chests. Fortunately, as things are, parents would be sent to jail if they deliberately fed their children to develop it.

This anti-rachitic vitamin, as vitamin-D is called, can be developed in the skin under the influence of the sun from certain precursors present in many other articles of diet than milk and butter. In consequence, little children, who run about naked in the

sun, can manufacture this vitamin for themselves whereas, little children, who wear clothes and do not see much of the sun either because they are deliberately kept away from it by their parents or because they live in regions where there is little sun to be seen, require to be given this vitamin already manufactured for them. Naked little Indian children who run about in the sun can thus flourish and wax strong on dietaries that would leave their English brethren rickety weaklings.

Vitamin-D has been the subject of much investigation because of its social importance in connection with the development of rickety children in certain parts of Europe. Rickety children are not considered to be desirable young citizens, and consequently many welfare authorities, both public and private, have devoted attention to them. We therefore know much more about it than many of the other vitamins.

What vitamin-D does teach us is that you cannot assume that the requirements of vitamin—this and vitamin—that are the same for Indian conditions as for English. With the aid of European and American results you can pull to pieces, as it were, any Indian dietary, but the pulling to pieces will always depend on assuming that what has been found essential and desirable in one part of the world is essential and desirable in another. Vitamin-D teaches us that the argument is based on false premises. There is a long road to be travelled before we know what is essential and desirable under Indian conditions. The prisoners

in the U. P., jails do not get many substances in amounts which you can 'prove' from American and European figures to be essential, and which also people outside the jails get. Yet they are the healthiest Indians in India.

This fact, however, is not to be considered as a recommendation of their dietary to the reader who has access to more palatable and savoury food. For such an one its consumption would be an austerity rather than act of enjoyment. And even if its consumption gave him a further twenty years of expectation of life against his present nineteen, say, there is little point in exchanging nineteen years of eating pleasantness for twenty years of austerity. And prisoners, after all, must be held to have deserved a little austerity.

Before closing this chapter one may point out that the fact that Indian children do not require the same amounts of milk and butter as do English children is not an argument for giving Indian children no milk at all. Naked little children who run about naked do not require milk and butter to protect them from rickets, and there, so far as we know, the non-requirements end. Milk and butter, however, are useful for many other things than protection against rickets, and the experiments already mentioned as done from Coonoor show us the desirability that all little Indian children should at least get some milk. Here again Indian customs may help, for it is no uncommon sight to see the child of three or four years

squatting down to get some milk from mother. Some day we may find that growing children daily provided with a little milk in that way flourish better than little children provided with an equal quantity of cow's milk.

Whenever I have enquired about it, the invariable reply has been that this custom is due to poverty. This explanation I doubt because milk does not arise in a maternal breast by subtle transfer from Heaven. Milk is manufactured by a breast from materials present in the blood which passes through it, and, when milk is thus manufactured, work is done at the cost of other food materials. We know nothing of breast efficiency in the work which it does, we only know that it cannot be 100%. The mother will therefore always consume more energy in producing the milk than she can deliver to the child in the milk. If, then, the child can consume the same food as mother, the process is more expensive than to feed the child directly. But, unless the parents own a cow or cows, milk from mother will on an average be cheaper than milk from a cow, and be more beneficial. Yet it is quite possible that neither economics nor child welfare are responsible. Breast-feeding is pleasant to mothers, and to some it may be sufficiently more pleasing than average that they just won't wean the child, and the child gets benefit by accident and not design.

CHAPTER VI

ON EATING

Not so very long ago I sat me down in the shade of a Kashmir garden to eat a half-pound or so, may be more, of lusciously ripe white-heart cherries plucked straight from the tree, and I enjoyed myself so much that I took forward to equally pleasurable repetitions of such eating when cherry-ripe times come again. But, after sweets may come sorrows, and, as I sat, I reflected on what then seemed to me to be the specially sad case of Mr. Gladstone, reputed to take sixteen bites at each and every cherry that he ate. I therefore got up, plucked more cherries from the trees, and sat down again, this time to give them sixteen bites apiece, but I soon found that most of the pleasure that I had previously got from their eating was lost in the task of accurate counting. So I gave up the counting and resumed the previous full pleasure obtained from undistracted eating. There was also the point that, unless that statesman's jaws moved much faster than did mine when eating, he could not have consumed many cherries at an ordinary single sitting.

Before assuming that Mr. Gladstone's method of eating cherries was a sort of secret penance, en-

dured because he had once laid his woodman's axe on someone else's treasured cherry tree, and carried out by forswearing himself, both quantitatively and qualitatively, from the pleasures of cherry-eating, it is as well to point out that there is something to be said, even if it be not much, for his methods. He faithfully carried out the doctrine, which is impressed on all, who are properly brought up, of chewing one's food enough before swallowing it. For that doctrine there is sound scientific evidence which we can briefly examine.

It was less than some two centuries ago when the first exact experiments were made of the nature of digestion, and they concerned the events which take place in the stomach. The experiments revealed that meat, which is ordinarily insoluble in water, is changed by gastric digestion into a water-soluble form. If such were the whole case, then, any form of meat which was soluble in water seemed obviously pre-digested and eminently suited for invalids; the soluble protein, gelatine, which can be extracted from meat and is soluble in water, was therefore held to be the ideal invalid's food.

All the best physicians then started feeding their patients with gelatine instead of ordinary meat, but the results did not accord with reasonable expectations if that theory concerning digestion were correct. The French Academy of Sciences next took the matter in hand, and they attempted to decide the issue by feeding pigs on gelatine and gelatine only. All the pigs

died, and, as one result of their dying, the reputation of gelatine fell from that of being an ideal foodstuff to that of a poison. We know now that neither reputation is deserved and that the experiment of the Academy of Sciences was the first demonstrating that different proteins may have what are now called different biological values.

Doctors next learnt to make what is termed artificial gastric juice, or to obtain gastric juice direct from animals, and to mix this juice with various foodstuffs in glass jars and watch the process of digestion. One can thus watch meat 'disappear' when it is placed in gastric juice just as one can watch sugar 'disappear' when it is placed in water. Among many other results it was thereby found that meat in chunks 'disappeared' more slowly than did meat which was finely minced, and, that different foodstuffs 'disappeared,' or were dissolved, at different rates.

These experiments with meat in chunks and minced provide a scientific backing for chewing food thoroughly. This seeming disappearance of meat placed in gastric juice is effected by ferments or enzymes dissolved in the juice itself. In effect, gastric juice is a mixture of ferments each of which is automatically, or chemically, attracted to the foodstuff which it is keyed to act on. They act on foodstuffs from the surface inwards, and erode them away. And since, the distance from the surface to the interior is less in a small particle than in a large one, small particles are eroded away and therefore digested

quicker than are large ones.

When we chew our food, we mince it up, as it were; and the more we chew it, the smaller the particles into which we reduce it. And the smaller the particles, the quicker will the digestive juices subsequently reduce them to the condition which fits them for assimilation by the body. If, then, a good digestion is synonymous with quick digestion, the more our food is chewed, the quicker and better will it be subsequently digested. But there is the 'if'; quick is certainly not synonymous with complete, for big chunks are digested away as completely as the smaller ones, the time is longer that is all. Moreover, if quick is synonymous with good as regards digestion the ideal pabulum would always be foodstuffs that had been finely minced or ground to a pulp. Yet such are rather for the toothless.

Dogs, wolves, and other carnivores are living refutations of the theory that quick digestion is synonymous with good digestion, and I well remember the unexpected consternation that I once caused when I put a question on digestion in two parts. In the first part students were asked to explain the influence of chewing on digestive processes, and they did it well; in the second part they were asked about the possible benefits that could arise from eating a meal hastily, as do dogs and other carnivores. Most of the students did the second part badly, some even complaining about being expected to know any-

thing at all about the habits of such disgusting animals as dogs. Incidentally I may point out that all students who did well by the first part were passed, the second part was put in to enable me to give extra credit to those students who could do a little thinking as well as memorise the contents of their textbooks.

The natural dog is a hunter who co-operates with his pack in the hunt, and becomes the enemy of all his fellows after the quarry has been brought down. As a relic of the latter, it is still always difficult to persuade two dogs to eat amicably from the same plate.

The quicker the natural dog could fill his stomach, the more likely was he to get his stomach full. The dog who loitered to chew would probably find nothing left to chew before his stomach was half full. He would thus eventually weaken and possibly starve, while his bolting brothers waxed strong. The dogs who bolted their food thus became the strongest of the pack and the begetters of its progeny. Natural selection then determined that bolting dogs should survive, wax strong, and leave descendants. As a further relic of this past, one good meal a day is adequate for any dog.

Now, there is no doubt that dogs can digest their food as well as can humans. Indeed, much of our modern knowledge of the processes of digestion is derived from observations made on dogs. They therefore teach us that bolting food is as con-

sistent with its complete digestion as is its thorough chewing. The differences provided by bolting and chewing, respectively, are time-differences and not completion-differences. How then does it come about that so much stress is laid on chewing as essential to good digestion? The answer is that we tend to be creatures of habit.

In the first place, what is ordinarily termed digestion, applies only to events which take place in the stomach. Actually however, the stomach but partly digests food. Its digestive acts are purely preparatory to the more elaborate and complete processes of digestion and assimilation which take place in the intestines. The stomach is further the digestive organ whose state ordinarily obtrudes itself upon our consciousness. We feel appetite, for example, when the stomach blushes, as it were, and we feel hungry when it is empty and motile. We likewise feel full when it is full, and empty when it is empty; yet that which made us feel full when it was in the stomach gives no corresponding feeling when it has progressed on to the intestines. Rather do we then feel the urge to start filling the stomach again.

Consider next the case of the man who over many years has eaten one meal at 9 a.m., say, and the next meal at 1 p.m. If he is to get full enjoyment out of and desire for his second meal, the first meal's food and its chewing must be adapted to gastric digestion and emptying before 1 p.m. Otherwise he will not be ready for the second meal.

Experience, known scientifically as the method of trial and error, teaches him what he can eat and how he must eat it so as to have a stomach ready for the further reception of food at 1 p.m.

The day may come, however, when the breakfast has to be bolted instead of being chewed in the normal manner. Should that happen, his breakfast can remain so much longer in his stomach that at 1 p.m., he cannot feel his usual readiness to eat. He consequently experiences what for him is a striking example of the evil effect on digestion of a hastily eaten meal. A dozen of such instances and he can but be convinced of the essential relationships between hasty meals and indigestion. Actually, of course, he should postpone for an hour or so the time of the second meal, but the households are few that can stand such an alteration of routine.

Alternately, an appetiser could be taken before the second meal, appetisers being mixtures that can stimulate the stomach to blushing as well as to empty itself. An appetiser taken in such circumstances would be highly beneficial to the taker's comfort, but, if the taker did not realise how its benefits arose, a real benefit thus once given could well lead him to the regular consumption of appetisers. It is possible, in fact, to become an appetiser-addict just as one can become addicted to cocaine.

Appetite is not the same as hunger, and good cooks are people who can rouse appetite in those who are never really hungry. So are good waiters and

other table-servants who know how to lay out a dining-table properly.

Those who turn up to a meal, which they do not really need, require to have their appetites coaxed, and the coaxing is done by the manner in which the table is laid out for the meal, and the garnishings of the food itself. Few, for example, can eat potatoes and enjoy them without something added to them of more appetising flavour. Yet, if potatoes were chewed long enough, they would become sweet to the taste. They are few, however, possibly none, who are prepared to keep chewed potatoes in their mouths long enough for ptyalin, the salivary ferment which changes starch to sugar, to produce enough sugar from the potatoes' starch to give them a sweet taste before being swallowed. That process is for chewers of the cud. We humans prefer to have them 'sauced' in some way or other. But there is no better sauce than hunger, and hungry men require neither sauce nor garnishings to be able to eat their food with relish.

Now, there are unfortunate humans who, as a result of disease, accident, or design, cannot swallow. Their end is slow starvation unless food can be introduced into the stomach, and so they go to the surgeon who can make an artificial opening through the abdominal wall into the organ. Such people fare badly if pulped or minced food, quite adequate in quantity and quality, is directly poured into their stomachs; they fare well if they are first allowed

to chew their food, and then allowed to blow it into their stomach through a flexible tube.

Just as it takes two to make a quarrel, so it takes two factors to make a digestion, viz., material for digestion, and a digestive juice to digest it. The digestive juices of our stomachs are poured out in response to the gratification of our appetites, and also to tickling of the stomach wall itself by special substances added to the food. So far as the latter are concerned the trust of Europeans is placed in the soup, and the trust of Indians in condiments such as pepper. There is, for example no special caloric value in Bovril and meat extracts, such as are most soups, but they are powerful aids to digestion through their capacity to stimulate appetite by their taste, and to stimulate the stomach glands directly when they get down to them.

Since hunger is the best and most efficient sauce, those who approach their meals when hungry do not require the same eating technique as those who eat primarily because another meal time has come round. For the former the eating is a stomach-filling process, for the latter it is a ceremony to be carried out in due and proper form. The former possessing the better sauce, can further bolt his food when the latter must carefully chew.

The machinery of children's bodies runs at a faster pace than that of their parents. They can therefore be hungry at a time-interval which permits their parents to develop only an appetite through careful

eating. Children can thus gobble their food and do well in conditions where their parents would get 'indigestion.' One may wonder, indeed if those among us who eat 'properly' do so because of example and precept, or whether, as we grew older, we adapted our chewing habits to lessening hunger and reliance on appetite. Probably both influences have been at work. One would, however, point out to anxious parents that children's gobbling is not likely to have the same evil effects on children as it would have on their parents. In contrast with children who grow up to receive several meals a day and are thus given the opportunity to acquire the habit of thorough chewing, those who grow up to fewer meals a day can still do well on gobbling in adult life.

The great point to note is that there are no rigid rules for eating. We have eating habits which vary from nation to nation, and in the same nation from time to time. The stomach adapts or trains itself to our habits, just as our muscles adapt or train themselves to our daily meed of exercise. And, just as the man who does his hour's tennis daily becomes adapted to his hour's tennis, but would probably be laid out after six hours' solid play, so also our stomachs can reveal signs of strain if we overwork them. Adaptation, moreover, is always for regularity; there can be no adaptation to irregularity. The reader of this has probably been given by his habits adaptation between his eating and digestion. Any sufficient divergence from his habits automatically carries

with it a penalty, but he should appreciate that divergences which give him penalties may constitute normality for others. One man's road to good digestion is another man's road to painful indigestion. None should therefore assume that his particular mode of eating is the only one to good digestion. Instead he should appreciate that there is a long period of special training behind his habits, and that the other man may have been equally long and efficiently trained to different habits.

Attention may now be given to the significance of the adjective, sufficient, when used with divergence above. Old men and women cannot with safety climb stairs two or three at a time, heart-failure would probably their lot if they attempted it. The young can do these things with impunity. The middle-aged likewise give up strenuous athletics, such also are for the young.

In connection with all functions of the body there are the two complementary factors of field of response and reserve. The young have large fields of response and corresponding reserves, in the aged both are contracted. These differences enable the young to run with speed as well as walk slowly, and the aged only to walk slowly. These differences of field of response exemplified by walking and running have their counterparts in digestion. There is, however, the difference that old people tend to imagine that their eating habits represent the ripe fruits of experience and wisdom, instead of adaptation to a

gradually contracting field of response for digestion. It would be as rational for the young to follow their grandparents' precepts and example in regard to their eating as it would be to copy them accurately in such feats of athletics as going up and down stairs. Sixteen counted bites at a cherry are for the aged who have a contracted field of digestion, and have already taken some direct stimulant to their digestive glands such as soup; such eating habits do not constitute wisdom for the young and those of middle age who have wider fields of digestive response.

CHAPTER VII

SOME ERRORS CONCERNING VOIT

For some years before 1875 Professor Voit was enquiring from German workmen concerning what they ate, and how much of it they ate. He summed up his enquiries in terms of the man, his food, and his work, and presented his results to the Public Health Congress which met at Munich in 1875. Out of them he deduced an average man who did average work and ate an average amount of food. His average man weighed 67 kilograms or 147 lbs., he worked as a mason or carpenter, and the caloric value of the food he ate was 3055 calories. Men who did heavier work, such as that of a blacksmith, took 3370 calories.

Expressed in grams and calories this average man ate daily.

Proteins	..	..	118	grams	or	484	calories,
Fats	..	..	56	„	or	521	„
Carbohydrates	..	..	500	„	or	2050	„
Total							3055

It is to Voit's everlasting credit that he was the first in this particular field of work. Unfortunately, also, because he was first in the field, his results have attained that antiquity which confers sanctity. I

have encountered hundreds of medical students who believed that they had but to quote Voit's dietary, and they had said all that was necessary concerning human nutrition. And, if medical students believe this about Voit's dietary, one can expect the error to be widespread. Accordingly, one would like to emphasise the points that Voit's dietary represents the first and not the last words on dietaries, and that there are no 'oughts' in it. It does not tell us what people ought to receive, it only tells us what a limited class of German workmen took some 70 years ago from the foodstuffs that were then available for them.

A quarter of a century later Atwater in America found that the workmen whose food intake he investigated were taking 3500 calories, and so got more food than the Germans investigated by Voit. The extra amount may be taken as equivalent to nine ordinary Indian fowl's eggs. But we should not deduce from this that the workmen investigated by Voit were relatively starved. It may rather have been that Atwater's subjects were bigger built and did more work than did Voit's. Voit's average man weighed 147 pounds, but American figures give an average man as weighing 170 pounds. The British Medical Association in 1933 accepted 3400 calories as the desirable average for England.

Investigations, similar to those conducted in Europe and America by Voit and others, have also been made in India and they reveal figures entirely different from those of Voit or Atwater. The aver-

age Indian standard of nutrition lies in the neighbourhood of two thousand calories. And these Indian figures have the same degree of validity as those of Voit or Atwater. None of these dietaries reveals to us what ought to be received, they only reveal to us what particular groups of people were receiving in some particular locality at some particular time. If, however, one does not know the origin and significance of Voit's scale of diet, he can draw, as some have drawn, quite unjustified conclusions concerning the starving millions of India. With equal justification one could draw conclusions concerning the opulent overfed workmen of Europe and America. Yet the theme of the starving workman is harped upon as enthusiastically by a certain type of politician in Europe and America as it is in India. These politicians may mean well, but there is no doubt that they do not understand the significance of the facts with which they deal.

At the same time, however, there is evidence concerning how many calories men and women ought to receive. There is first of all the basal metabolism, and to expound this one can go to the motor car because it is reasonably certain that everyone who reads this is familiar with the following sequence of events in motors. The driver takes his seat, turns on the spark-switch, etc. and then sets in action the self-starter. With luck, the petrol-motor next starts functioning or idling. The ideal idling rate of the engine is that in which it just ticks over. If it

goes faster than the ticking-over speed, petrol consumption during stops is excessive.

Now, the amount of petrol consumed while keeping an engine just ticking over for 24 hours would represent the basal metabolism of that engine. Any petrol consumed beyond this is only economically employed when it is used to move the car itself. The proper adjustment of carburettors to give the minimum ticking-over speed during stops can obviously make a difference to the profits earned by any company which runs, say, stage carriages that make frequent stoppages to take up and let down passengers. The same applies to any organisation using cars likely to be kept 'idling' over relatively long periods.

The basal metabolism of a man is the amount of energy he consumes in keeping the bodily machinery just ticking over for 24 hours. In Europe and America the standard figures are 1600 calories for summer and 1800 for winter. In India, however, the standard is 1100 calories, and it does not exhibit the European and American types of variations. Thus, in Lucknow, basal metabolism is higher in May and June, the hottest months, than it is in March and April. It is lowest in September, the month of maximum mugginess.

It has been suggested on good evidence that the rate of basal metabolism is a good index of resistance to disease, especially to tuberculosis. At any rate it has been found in European Sanatorium that improvement is associated with a rise in the patient's basal

metabolism. It has also been pointed out that sanatorium treatment with its through ventilation, generally termed by the new comer a—draught, etc., provides measures likely to raise the patient's basal metabolism. It has further been pointed out that the mugginess of a Lucknow September provides the conditions favouring the growth of bugs, fleas, moths, beetles and the bacterial enemies of man, while the man himself has his defences weakened. Man thus becomes such a more suitable soil for bacterial invasion that local physicians have been known to declare that everybody catches something in Lucknow during September.

Basal metabolism has a further special interest for India. The basal metabolism of purdah women, whenever it has been examined, has always been found to be very low, for after all basal metabolism is partly an adaptation to environment. And consumption flourishes behind the purdah.

U. P. standards for well-fed men, such as are those in its jails, show that the basal metabolism of these Indian men is 9% less than that of corresponding Europeans in Europe. The basal metabolism of purdah women, however, may be so much as 30% or 40% less than European standards.

9% off 1600 does not bring us down to 1100. The extra calories are determined by the differences of weight.* The Indian workman in the U. P. seldom weighs as much as 120 lbs., usually he is nearer 100.

*An approximation to the basal metabolism is obtained by multiplying the weight by 11.

goes faster than the ticking-over speed, petrol consumption during stops is excessive.

Now, the amount of petrol consumed while keeping an engine just ticking over for 24 hours would represent the basal metabolism of that engine. Any petrol consumed beyond this is only economically employed when it is used to move the car itself. The proper adjustment of carburettors to give the minimum ticking-over speed during stops can obviously make a difference to the profits earned by any company which runs, say, stage carriages that make frequent stoppages to take up and let down passengers. The same applies to any organisation using cars likely to be kept 'idling' over relatively long periods.

The basal metabolism of a man is the amount of energy he consumes in keeping the bodily machinery just ticking over for 24 hours. In Europe and America the standard figures are 1600 calories for summer and 1800 for winter. In India, however, the standard is 1100 calories, and it does not exhibit the European and American types of variations. Thus, in Lucknow, basal metabolism is higher in May and June, the hottest months, than it is in March and April. It is lowest in September, the month of maximum mugginess.

It has been suggested on good evidence that the rate of basal metabolism is a good index of resistance to disease, especially to tuberculosis. At any rate it has been found in European Sanatorium that improvement is associated with a rise in the patient's basal

metabolism. It has also been pointed out that sanatorium treatment with its through ventilation, generally termed by the new comer a—draught, etc., provides measures likely to raise the patient's basal metabolism. It has further been pointed out that the mugginess of a Lucknow September provides the conditions favouring the growth of bugs, fleas, moths, beetles and the bacterial enemies of man, while the man himself has his defences weakened. Man thus becomes such a more suitable soil for bacterial invasion that local physicians have been known to declare that everybody catches something in Lucknow during September.

Basal metabolism has a further special interest for India. The basal metabolism of purdah women, whenever it has been examined, has always been found to be very low, for after all basal metabolism is partly an adaptation to environment. And consumption flourishes behind the purdah.

U. P. standards for well-fed men, such as are those in its jails, show that the basal metabolism of these Indian men is 9% less than that of corresponding Europeans in Europe. The basal metabolism of purdah women, however, may be so much as 30% or 40% less than European standards.

9% off 1600 does not bring us down to 1100. The extra calories are determined by the differences of weight.* The Indian workman in the U. P. seldom weighs as much as 120 lbs., usually he is nearer 100.

*An approximation to the basal metabolism is obtained by multiplying the weight by 11.

Allowances for these weight differences between Indians and Europeans bring the Indian standard of basal metabolism down to 1100 calories.

The average difference from European and American standards is thus, 600 calories, or 12 country eggs, or $1\frac{1}{2}$ pints of milk, or 6 ozs. of rice, or 10 oz., of bread.

To the basal figure it is customary to add

(1) for light labour 75 calories per hour;

(2) for medium work 150 calories per hour;

(3) for heavy work more than 200 calories per hour, but these figures are for Europe and the United States. They require revision downward for India because the average Indian labourer is not such a big man as the average labourer in the United States or Europe. The manner in which this can affect our calculations can be brought out by considering the case of two coolies carrying loads up a hill. And here I will digress.

When I first went to Mussoorie on vacation, a period which should give a professor the leisure for original work, I packed my books into my old uniform case and thus obtained a package weighing some two maunds. When next I duly arrived at Rajpur and realised that my trunk would be carried up the mountain on the back of one man, I considered that I had done something reprehensible in not making fuller enquiries beforehand concerning the actual mode of transport. It seemed to me to be something akin to cruelty to permit any man to carry

such a heavy box up that steep mountain-side. But my musings of remorse were cut short by a commotion among the carriers, and then I found that there was something of a fight among them because each of them was anxious to have the privilege of carrying my box of books. To carry it meant a good day's work with corresponding reward. My box was really a sort of carrier's dream; it had plenty of weight without bulk, and was of a shape that fitted snugly on the carrier's back leaving both his hands free.

Just as my sympathy was misapplied over the carrier so also it was at first misapplied over people who only eat one meal a day until I met what I may term the grumbling police officer. In his lines was a score or so of policemen who would only eat one meal a day. This, of course, upset the regular routine but, as the men genuinely believed that their health and strength depended on eating one meal a day, he had to make the necessary additional arrangements to satisfy them. After all, lions and tigers are strong beasts who never take more than one meal a day, and a man who has lion as his name could well consider that he ought to follow such an example to be healthy and strong. Thus was it impressed on me that there would be other reasons than poverty which would lead a man to eat one meal a day. Consequently, before accepting one meal a day as evidence of poverty, it would be better to enquire from the single-mealer why his dietary habits are different from one's own. One meal a day certainly saves much time, and

could well be recommended where fuel, as opposed to food, is scarce. It also happens to please me to eat four times a day whereas most of my acquaintances eat five meals, but that is not evidence that they are richer than I am, or even that they eat more. At any rate I am not a thin man, and most of my five-mealing friends are much slimmer than I am.

After that we can return to our carrying and appreciate that to imagine one man to weigh 110 lbs., and another to weigh 150 lbs., and to provide each with a load of 150 lbs., to carry 3000 feet up a hillside, is really to imagine something just ordinary. When they have performed the task, the heavier man has done not less than 120,000 footpounds of useful external work more than the lighter one because each has to lift himself as well as his load up the hill. It is to be observed also that the term, useful external work, has been used above. That is because his muscles would have used up some four times that energy in performing that work. Hence the total difference comes to 480,000 footpounds. If we add to these another 20,000 footpounds because the men do not climb vertically into the air but do the equivalent of walking several miles along the level as well, we are probably on the conservative side in estimating the difference in energy expenditure at 500,000 footpounds. This is equivalent to about 170 calories, or some three to four eggs, or about $\frac{1}{2}$ pt., of milk, or about two ounces of rice, or some 3 oz., of bread.

The act of carrying these loads, however, though

it may be the work that the men are paid for does not represent their full day's work. Every yard they walk to and from the bazaar, or in any other task, not only implies that they are doing more work but also that the bigger man is doing more work than the smaller one. Every movement made by the bigger man implies a greater expenditure of energy than that of the smaller one. If we only allow 30 calories for this, so as to get a round figure, we get 200. If we add this difference to the basal metabolism difference of 600, we get 800. That is to say, it is reasonable to expect the average labourer, at least in the U. P., to do the same work as Voit's workmen on 800 less calories per diem than they took. And so he does.

But there are different kinds of work and, as already pointed out, Voit's standard man was a carpenter or mason. The agricultural labourer works harder than such men, and Voit allowed him in Europe about 3200.

It may be doubted, however, if the Indian cultivator works as hard as the European. The energy required to manage a plough in England, for example, is certainly much greater than that required to manage the Indian plough, and the same undoubtedly holds good for such operations as digging, trenching, etc. Though each would add to the difference we can put such considerations aside, and only expect to find that the average Indian labourer does his work at a cost of some 800 calories a day less than the European. That is to say, where the average European consumes

3200 calories as a land-worker the average Indian should consume 2400. The old data in the Department of Physiology Lucknow give the average consumption of U. P., cultivators as 2390 calories, which makes him as adequately fed as his European counterpart.

These Lucknow figures are old and, as already mentioned, I do not take the view that age in these figures confers sanctity. There are more modern figures carefully collected recently by that able observer, Professor Narendra Singh of Agra. He examined agriculturalists in the Agra, Meerut, Gorakhpur, and Pilibhit districts, and found that they took an average of 2500 calories. A couple of eggs per diem represents the difference between the old and new figures, but it is not to be inferred from this that egg-eating is on the increase among agriculturalists! We only infer that their standard of living has not gone down in the past thirty years. Further, we have to point out that the figures actually available give no support to the doctrine of a starving peasantry.

Prof. Narendra Singh also examined urban workers at Cawnpore and found that they consumed about 1900 calories per diem. The bloated capitalists of Cawnpore, however, could not be held responsible for starving their workmen because the actual wages paid would have permitted these workmen to consume from three to four times the amount of food they actually ate. When I first noted this great disparity between actual incomes and necessary expenditure of

these Cawnpore workmen, I imagined that they were saving against a rainy day. On enquiry, however, I was credibly informed that they were really busily engaged in paying back the costs of past festivals such as marriages, etc.

Prof. Singh also obtained some interesting results when he studied the food intake of 47 policemen at Partabgarh. Theoretically all had equal shares, but when it came to finding out what each man took the amounts varied from 1520 to 4299 calories. Admittedly only two of them took less than 2000 and only, three of them more than 4000; the points to note are that each got what he considered to be enough, and that those who took the small amounts were quite satisfied with what they got. Yet, if one found a group of people taking the amounts of food which these small-eating policemen voluntarily took when more was offered, the tendency would be to consider them to be half-starved.

Another interesting experiment on this offer and acceptance in respect of food was once made in the poor-house at Helsingfors. Five men, whose ages ranged from 54 to 79, were daily offered for a mouth 3355 calories, and daily took about 2400. The amount varied, of course. The old gentleman of 79 weighed 130 pounds, and was satisfied with 2100 calories daily, whereas the youngster of 60, who weighed 157 pounds, took 2800. Yet, if that institution had a dietary of 2800 laid down for these men, those responsible for its management could have rea-

sonably expected to be regularly reminded about Voit and his standard dietary by ill-informed critics.

Attention was previously drawn to the point that it is not possible to starve a workman and keep him at his work, and in this connection there are figures of the energy required to perform various classes of work that throw light on what is known as sweated labour. Many investigators have examined what is termed the physiological cost of work, and some of their results are now given.

					calories per hour
Seamstress	..	..	..	..	6
Typist (50 Words p.m.)	..	..	..	..	44
Seamstress (using machine)	..	..	..	..	57
Book binder (man)	..	..	..	..	81
Book binder (woman)	..	..	..	..	63
Painter	..	..	..	..	145
Carpenter	..	..	..	..	164
Sawyer	..	..	..	..	378

These figures, it should be observed, all come from Europe and America. As in the case of our hypothetical carriers they require revision downwards before being applied to the differing conditions of India. Unfortunately, we do not know by how much, we only know they do.

When we turn from work to pleasure, we find that singing takes an extra 11 to 56 calories per hour according to the softness or loudness, piano playing can vary from 40 to 188, and the cello requires more

energy than the violin. The leader of the band requires an extra 44 to 95 according to his enthusiasm.

Dancers would be held to take their pleasures sadly because a man weighing 155 pounds would require per hour 280 calories for waltzing, 335 for the fox trot, 529, for the polka, and 761 for a really hot mazurka. Dancers, however, enjoy their dancing and so from the figures given above the reader should appreciate that physical work as hard as or even harder than that of a wood-sawyer can be performed with pleasure. Even ping-pong requires 312 calories per hour.

The soldier works hard. Ordinary company drill costs an extra 228 calories per hour, and, on a route march with full equipment, the extra energy expenditure rises to 450 calories. It is, therefore, to be appreciated that much time is required to train a tailor to be a soldier. It is also to be appreciated that the soldier requires many more calories than Voit's carpenter. He gets them. Considering further what music can do in the way of making hard work pleasurable in dancing, the soldier really requires music for his marching.

Reverting now to the aphorism that "you cannot starve a workman and keep him at his work," our short table of the physical cost of labour shows that starvation would have a different significance for each type of labourer. Allowing each of them to work eight hours daily the cost to the hand-working seamstress is 48 calories or about one Indian fowl's

egg, the cost to the carpenter is 28 times this. Therefore, if an employer only paid for the actual cost of the labour, he would pay the carpenter 28 times as much as the seamstress. Actually, of course, the employer never does this any more than does the patron of a restaurant pay only for the actual cost of the food supplied. The restaurant-patron pays both for the cost of the food and its overcharges as well. These overcharges, in their turn, vary with the class of the restaurant, the cost of the band, clean linen, etc., being always in the bill.

Now, the overcharges for the British workman include his beer and 'baccy, shoes and stockings for his children, summer and winter clothes, mackintoshes and overcoats, as well as an annual holiday. These overcharges are enormous in comparison with the corresponding requirements of the Indian workman. Yet there was a time when the British workman's overcharges approximated to what at present exist in India. The changes that have taken place had their initiative neither in the Government nor in the workman; instead they generally came from members of the middle and upper classes.

Mindful of these points I occasionally suggest to my teetotal friends the one of the greatest social revolutions possible could be brought about in India by persuading the vast majority of workmen that they must each drink a bottle of country liquor every day. The bottle should be of reasonably small size and taxation would make its cost, one rupee. My view

is that, human nature being what it is, it would be easier to persuade them to do this than it would be to persuade them to take to such things as shoes and stockings or better housing for themselves and families.

These views are not accepted with enthusiasm because, if the listener keeps only three servants, it implies an addition of over 1000 rupees to his annual expenditure. He then realises that the change would not be limited to workmen but would penetrate directly into every upper household as servant's wages, and also indirectly as increased cost of everything one can buy.

In addition, as in England, the teetotal minority would generally evade the taxation placed on the majority through their drink. Hence, unless special compensatory taxation be placed on teetotallers, these will have money to spare to increase their own standard of comfort. In India, this higher standard might be asserted as more magnificent marriage ceremonies, or it might emerge as shoes and stockings for the whole family. But, however asserted, the inevitable result will be a demand on the part of the working majority to be able to conduct their ceremonies on the same scale as the minority. The demand will not be made as such directly but eventually that will be what their new demands will amount to. Also eventually, the new demand can be expected to be conceded. Its concession will further improve the lot of the teetotaller as well, and the latter will

now have still more funds at his disposal for starting a new general step-up. Incidentally those superior persons who condemn the poor for running into debt over marriages should appreciate that it does give the meek and humble the means to be the most important of persons at least once in their lifetime. Such ceremonies can, thus, be considered to be the Magnificat in earthly practice.

I appreciate that religion is a serious barrier to Indian social uplift taking place in the manner suggested. It is for earnest Indian social reformers to find some other means if they can. The present tendency is for increased pay to be transmuted into increased absenteeism rather than a change in social customs.

We have probably by now said enough to emphasise the points that while no employer of labour can pay wages on which a labourer starves, he also pays much more than the actual cost of the labour. He pays overcharges as well and those overcharges will vary according to climate and social custom. The climate of India's plains favours low overcharges while the climate of Great Britain favours high ones, and each locality gets what its climate favours.

Going back now to our table of energy expenditure on work we note that our seamstress expended six calories per hour, or about one-twelfth of the calories spent in light labour, whereas the sawyer expended 378. The actual cost of the seamstress's labour was about one Indian fowl's egg whereas

that of the sawyer was 63 times as much. If then an employer paid only for the cost of the labour, wood-sawyers would be paid 63 times as much as seamstresses but are not because of the overcharges. These latter level down the differences.

I was minded of these things when I visited the homes of what many would term the sweated labour of Lucknow. They were seamstresses engaged in the chikan work for which visitors to Lucknow pay truly fabulous sums. These women earn from two to three annas a day, a contractor provides the designs and material, the women make and fortify the holes ! The only contractor that I saw wore a Gandhi cap, and my guide had vague ideas about a Satanic Government being responsible. However, it seemed to me to be something to look up in the Abbe's book, and therefrom I found that there just had been no change in local habits in this respect for well over a century.

These women are low paid because they can be, not because they must be. In their social position, when I saw them, they could have purchased an egg for six pies, and an egg is an expensive medium for calories. Yet such would have represented the actual cost to each of them of their labour. Consequently, if one of them earned three annas a day, her profit on her outlay was some 500%.

Nothing that has just been noted should be construed into implying that I consider the state of affairs among chikan workers to be desirable. I merely point out that things are what they are because they

can be what they are. The problem to be faced here is not of a hard-hearted contractor grinding the faces of the poor, but of social conscience. I have no doubt that each contractor believes that he pays full value for the work performed for him, and that the women themselves believe that they get market rates for the work that they do. So far as I could judge all of the women were contented. Also considering their bodily size, etc., I judged that 1200 calories a day would probably meet all their food requirements. If they were fed to a standard of 2000 calories a day, they would either grow fat, or else they would require some pleasure energy-outlet. Somehow or other, it seems to me that many moons will pass before we see such women daily using up their surplus calories in the dance-hall, or on the tennis courts. Yet, unless they can be brought to believe that some such energy expenditure is necessary to their existence and so are led to demand their overcharges-cost as increased rates from the contractors, they will stay where they have already stayed for well over a century.

Though the labour of these Lucknow chikan-workers would be conventionally known as sweated labour, there could really be no worse misnomer, for such workers never work hard enough to sweat. Better would it be termed easy sitting work because it is always work which requires no special ability, and which can be performed at very small cost in energy. Also, in spite of the long hours that may be

worked, it is, in effect, a part-time home occupation. If there were some central factory in Lucknow to which those chikan workers had to walk daily to do their work, their energy requirements would go up, and with it their rate of remuneration. As things are, they do not stir abroad from their houses except on special occasions. Such habits imply a very small caloric turnover.

The reader should also appreciate that there are women in this world who have no desire to leave their homes. The first one that I met lived in a narrow side-street off the Old Kent Road, and I found out her habits as a result of enquiring from her the quickest way to get to another and nearby side street. She regretted her inability to help me, and excused herself on the ground that she "wasn't no gadabout." Although she had lived in her house nine years, she only left it for a walk on Saturday nights and that was to the junction of her street with the Old Kent Road. She liked to watch the traffic there, and also got some thrills from the throw-outs of the local pubs. As she also informed me that her husband never earned less than £5 weekly, and sometimes as much as £7, poverty did not determine her habits. She was certainly house-proud, for everything within her house was spick and span.

These Lucknow chikan-workers stay at home also, and are low paid because the physical work they do and their habits make their caloric requirements low. To see real sweated labour, one should watch coal

trimmers at work in a collier's hold. They sweat all right, and their pay is so high that Oxford and Cambridge blues are reputed to take up this work if they fail to get more 'respectable' jobs. When I watched them, my information on the spot was that most of the coal-blackened men I saw had their own cars and lived in villas in the best parts of the town. Sweating labour is well-paid.

Reverting to our table of labour costs it will be seen from it that the carpenter's energy requirements are much more than the clerk's, and therefore he should get more pay provided the overcharges approximate. In the case of clerks there is admittedly a greater pressure of candidates than there are posts available with a consequent lowering of the overcharges the clerk can demand, points well brought out by Mrs. Caleb when she investigated the family budgets of low-paid clerks in Lahore. So long as there is that pressure, the clerk will tend to be paid less than the carpenter, even though his work claims greater dignity according to present standards. Yet there are clerks and clerks, and a glance through the columns of the *Statesman's* advertisements will reveal the point that efficiency in a woman implies much heavier overcharges than the average male typist requires.

Then there were those Cawnpore workmen who took less than 2000 calories while their wages easily permitted them to take 4000. They were factory workers and in factories all heavy work is done by machines. I have visited many factories and in none

of them have I ever seen the worker make such energetic body movements as does the leader of the band when he leads with enthusiasm. Rather would one put the factory worker's movements among the sweet and low. Fifty calories per hour would easily be enough for the actual physical work they do. Giving him a ten hour day he would probably expend less than 500 calories on his actual labour. What he requires he gets.

If, after going through the material so far given in this chapter, the reader has begun to appreciate that there is no universal dietary scale or anything of that sort, he will have started some way on the path to rational thinking in these matters. So far as the United Provinces are concerned Professor Narendra Singh of Agra is the authority to be consulted when one wants information about local dietaries, not Professor Voit. Professor Singh's figures are as valid for the U. P., now as were Professor Voit's for the Munich of 70 years ago.

It is also necessary to draw attention to the point that the figures for the U. P., are not universal to India. I have, for example, only allowed 9% off for basal metabolism. Sokhey in Bombay examining good class and well-fed medical students found that their discount was from 10% to 25%, in Calcutta it was 14%, in Madras 12%, and in Hyderabad (Deccan) 9%. The figures thus vary from place to place, mugginess tending to give the lower figures, or higher deviations.

After all India is a subcontinent with a vast variety of races. If you want big men you have to go to the North West, the chief home of what have so far been designated as the martial races of India. And just as no contractor yet appears to have volunteered to give more pay to chikan workers, so no financial department has yet volunteered to give the funds to give more food to soldiers. Eventually, however, the soldier like other workers must get the calories required, and he works hard. Indian troops in Barracks get approximately 3400 calories, and on field service 3800. British troops get 200 calories more in each case. The reader can safely wager his last shirt and his last pair of boots on the point that these differences represent the hard facts of the case in respect of men who have to be capable of the hardest of human endurance. These two groups of men approach each other in build and stature, and in the work they do; so does their caloric intake.

Differences of caloric intake indicate differences in the work done and in those who do it. Hence whenever we find such differences we should look for differences in the work done and in the men who do it, for every labourer who regularly works must regularly receive enough calories to do his work. In addition the worker should be able to work in comfort, and physical work in hot countries can only be done comfortably by men with low turnover.

CHAPTER VIII

WORK AND EFFICIENCY

Much talk is expended on what is termed the efficiency of labour and it seems worth while to spend a little time on it here as well. At the outset it may be pointed out that there are two considerations involved, there is first the physiological point of view which concerns itself solely with the man as a transformer of energy; there is next what may be termed the Gradgrind view which solely concerns itself with the degree of profit than can be extracted from the individual man. We shall consider the man's mechanical efficiency first.

Mechanical efficiency is the ratio between the energy which one gets from a machine as useful work and the energy which is put into it as fuel. In a railway engine, for example, energy is put into the machine as coal, and useful work obtained from it as traction of a train. It would be a wonderful railway engine that had a mechanical efficiency of ten per cent. That is to say, for every unit of energy given off by the engine as work, nine units of energy at least are lost up its chimney as hot air.

Man has not yet constructed any machine which approaches muscle in efficiency, for the mechanical

efficiency of muscle is some twenty five per cent. For every hundred calories of energy put into a muscle as food we can thus get back the equivalent of twenty five as work; the rest is transformed into heat.

Now it occurred to me that if the Indian workman has been starved for centuries, then one adaptation to that state could be a higher mechanical efficiency of his muscles as compared with his European counterpart. If that were the case, then his food would go further as work.

Under the auspices of the Indian Research Fund Association a young research worker examined in my laboratory the mechanical efficiency of all sorts and conditions of Indian labourers, but never could he find that the muscles of labourers in India differed from the muscles of men elsewhere. In many respects this research was disappointing. The young man and his subjects worked daily, yet the only results were columns of figures which just told us that Indian muscles were the same as human muscles in Europe or America. If any difference had been found, he would have got an important result, but, as it turned out, nothing of the kind could be recorded. In fact, the young man got nothing to publish except columns of figures, and I never had the heart to offer them even to the Research Fund Association itself. All that could be conveniently done was to quote the result.

The efficiency which employers and economists talk about is of a different type. Thus, when I was a

boy at school, the local council started a new sewage scheme whose progress I watched with school-boy interest. Certain of the public watched it with different interest. They were ratepayers who knew the estimated cost of the scheme, and what it meant as increased rates on the houses they occupied. Their comments were loud, and could be heard by the stranger without eaves-dropping. From them I learnt that there was a stroke, known as the council stroke, and that it wasted the ratepayer's money. It wasted money because the timing of the stroke by the workman's pick-axe was too slow; also he did not hit hard enough. Every one of those ratepayers appeared to believe that he could hit twice as fast and twice as hard as did those workmen. Probably each of them could, but not for long. Fatigue would step in and upset their calculations.

Muscles and all other organs are subject to a state known as fatigue which may be defined as a state of diminished functional capacity consequent on the previous performance of work, and which may be considered to be the consequence of recovery failing to keep pace with breakdown. In certain respects muscles are comparable to electric batteries in that they hold a store of energy ready for discharge. When a muscle works, it loses part of this stored energy, and, directly after such loss has taken place, processes for re-charging are set into action, but these latter take longer than the former. For each energy-discharge from a muscle there is, thus, some parti-

cular rest pause during which recovery or re-charging processes can restore its original charge. Obviously also the greater the energy discharge, the longer will it take to recharge.

Mosso, who has already been mentioned, invented a machine, the ergograph, with which one can measure the recuperation times required when the muscles of the middle finger perform different acts. Workmen, however, do not need this machine; instead they find from experience what strength to put into a stroke, and what rest to take between strokes to enable their muscles and nerves to be fully recharged with energy between their acts.

After all, when the workman has done his day's work, he can reasonably expect to be fit to walk home several miles if need be, and then to be sufficiently fresh to be able to indulge in a mild game of tennis, cricket, football or anything else that takes his fancy. He should not be expected to go to bed immediately after reaching home because he is so utterly exhausted by the work which he has already done that he can do no more. Indeed, the ability or non-ability to be able to indulge in pleasurable work or recreation, after the day's necessary toil has been done, eventually constitutes the differences between working and slaving..

At the same time it is necessary to point out that the amount of physical exertion customarily undergone by a workman after his day's work is an important factor determining his caloric requirements, and

so also the overcharges for which employers must pay. It is not, therefore, to any employer's advantage to encourage his employees to take up regular athletics requiring many calories. Even regular and universal ping-pong, with its 300 calories per hour, could well be barred ! Rather should the employee be encouraged to sit or lie around after his day's work has been done, not that this requires encouraging at present in India. The reader should, however, appreciate that any employer who did encourage regular and universal athletics among his employees must as inevitably pay for the additional caloric cost of the athletics as he already must for their regular labour.

In consonance with this is the war advice advertised to the farmers of England to see to the correct feeding of their cows. A properly fed cow receives a basic ration, which permits her to live and have her being, and a supplementary ration on which she produces milk. Farmers are therefore urged to watch the cow's milk output and adjust the supplementary ration accordingly. As the cow dries, the supplementary should be decreased.

In the old days the feeding of cows was the farmer's private concern. He was the sole loser if he fed a full milk-producing ration as well as the basic ration to a cow that had gone dry. Now that there is a war on and fodder is scarce because ships are required for other purposes, it becomes a matter of national concern that the food of every cow should be adjusted to its actual needs. So also now is the

distribution of milk in England. As a result many grown-ups, who previously were able to obtain as much as they wanted, find cause to grumble at its scarcity, while many children, who previously did not obtain as much as they needed, even if they got any at all, now get milk in adequate quantities. A ban on ice-cream is one of the means to that same end. Ice-cream implies too much milk to grown-ups.

The rationing of food for horses is also based on the useful work they do. When the day's work is done horses are expected to stay in their stables or paddocks; they are not expected to visit one another or take an evening stroll or anything of that sort ! At the same time it should be appreciated that high-stepping horses are not produced by allowing them to feed on green pastures, such horses must have their oats. Also, when they get too much oats, they not only sweat unduly, but also tend to be unruly if the amount of work provided for them is not equivalent to their caloric intake. Indeed, if a well-fed horse cannot get his daily exercise in the open, he can well do his daily dozen in his stable and kick his stall to pieces in the process !

The high stepping horse of the private carriage requires more calories than the horse of the ordinary cab that plies for hire. So do men who hold themselves erect require more calories than men who slouch. To stand at attention, for example, requires 30 more calories per hour than standing at ease.

And certain recent alterations in dress and mode of carrying equipment have so eased the soldier's work that a division of 15000 men actually requires daily a thousand less loaves of standard Army bread.

Labour-saving devices do not, however, always meet with the approval of those for whom they are intended. When I first came to Lucknow I found the menial staff expending much time and labour in carrying a succession of bottles from one room to another. To lighten their labour I had a trolley constructed so that they could take all the bottles in one journey. They did not use the trolley for long, and when I enquired the reason I was told that they found the mental strain too much. They could deal with one bottle at a time but twenty bottles puzzled them beyond performance. They therefore preferred walking to and fro.

This particular episode, however, does not clash with the general rule that every workman has at his disposal the experience which has taught him just how hard he may hit and just how long he must rest between hits so as to enable him to carry on hour after hour. Any enthusiastic onlooker of average physical strength could probably do more of the same work in five minutes than the regular workman does in ten, but that onlooker would probably find more than five minutes of rest were required after his five minutes piece of work, whereas the workman has to carry on regularly hour after hour.

A good supply of blood is one of the first essen-

tials to any organ of the body for re-charging it with energy after it has used energy in work. For such re-charging a working muscle becomes flushed with blood just as does a hot skin or a blushing cheek. But, if much blood be in the skin because of a rise of external temperature, then, as we noted in an earlier chapter, there will not be enough blood left over for efficient re-charging of the muscle. The muscle will still get re-charged, of course; the difference will be that re-charging will take a longer time.

But a blood-flooded skin only interferes with the quantity of blood available for recuperative processes; the quality of the blood is also of the utmost importance. Any process which can alter the quantity or quality of the blood available or both will change this recuperation time. Thus it comes about that hookworm infection, malaria, tuberculosis, anaemia, etc., all play their part, through their actions on the blood, in increasing recuperation time. Sufferers from these and many other conditions rife in India must therefore take longer rest pauses between strokes, as well as feebler strokes, when they work, as compared with their more healthy fellow-men.

Now every man has his own stroke and rest-pause in the rate at which he ordinarily walks when left to himself. There are also many people who take their regular exercise as a walk. These will complain that their walk is fatiguing during the hot weather and rains. That is because, when much blood is in the skin, longer rest pauses are required between

each muscular stroke in the walking. Hot weather walking should therefore be with slow and solemn tread. The pace of walking, however, is not only an ingrained habit of each of us, but also not the least source of the pleasures of walking is that one has not to consider the act itself. While we walk, we can enjoy scenery, carry on a conversation, and so on. None of these things would be possible if we had to watch each step. If, then, a man attempted to change his rate of step to meet the exigencies of the hot weather, his daily exercise would lose much of its charm. Moreover, there is also the point that even if he did start out intending to walk slower, he would probably soon forget his intentions through attention to traffic or something else, and then his legs would revert to their old ingrained habit.

A man's ordinary rate of walking is determined by a number of factors, one of which is the length of the leg. It is more economical in energy expenditure for a long-legged man to walk with long slow steps and for the short-legged man to walk with quicker short ones. That is because, when we take a pace forward, the leg swings as a pendulum with attachment at the hips, and if its natural rate be used, there is no expenditure of energy on the swing. Armies, however, require a uniform step, and those whose natural step deviates most from this standard naturally take longest to conform to it.

In India further there is such a wide difference in the clothing of different classes that it also exerts

influence. The man who has grown up with most of his skin covered by clothes must walk in hot climates with slower tread than the man who only uses a loin cloth. The clothes interfere with the efficiency of his skin as a heat dissipator, and so also, by leaving more blood in the skin, prolong the recovery processes of the legs after each stroke. It is also the case that, when humans develop any particular habit, they deceive themselves into believing that there is some special virtue in themselves enabling them to develop the habit. Thereby does it also become evidence of deficiency or impropriety in others to have a different habit. To walk slowly can thus become evidence of superior culture, and to walk fast become evidence of an inferiority. Indeed, in a muggy climate like that of Calcutta, or Bombay, a man only needs to overclothe himself long enough to become ultimately of the conviction that no decent person ever walks abroad !

The slow and solemn tread which one can observe in clothed inhabitants of Calcutta, Bombay, and such places is really a readily available illustration of what has been misnamed as the inefficiency of Indian labour, that is as viewed by an employer or economist. These latter naturally view the most efficient labour as that labour which delivers a given volume of work in the shortest time. When, for example a man shovels earth, his output will depend on the number of strokes he takes per hour, and this number in its turn depends on the length of the rest-pause between

strokes. If the rest-pauses be increased in duration, the man makes less strokes per hour, and so delivers a smaller quantity of earth. The employer or economist will measure the workman's efficiency by this output per hour. Very seldom does walking come within their purview, but if it did and the point involved was the delivery of the goods by walking, those who walked with slow and solemn tread could but be put among the inefficient.

When we walk, we are thus also partly in the position of the workman who adjusts his strokes to his recovery capacity. None of us, for example, adopts for walking a rate that would leave us exhausted in ten minutes; our walking pace must be one that gives us the recovery to enable us to walk all day, if necessary.

But while any man left to himself adjusts his strokes to his recovery capacity, he is not left to himself in a factory. There his strokes have to conform with a machine which has no fatigue and can be speeded up. It is therefore easier to fatigue the man who tends a machine than it is to fatigue the man who digs, unless the latter be a slave who can be whipped into fatigue. But even with slaves the owners always found that it paid them better in the long run to let the slave work in his own time.

In all these things one thus finds action and reaction. The employer looks to more and more strokes per minute as his index of efficiency, the employed man tries to make his rest pauses adequate

to ward off fatigue. When the man works as an individual, even though he be one of a gang, he can usually get his adequate rest-pauses. When he tends a machine, the speed of the machine should be adjusted to the man, but when many men's work depends on one machine, only an average adjustment can be made. Those for whom the machine's speed gives the worst adjustment will be prone to accidents when they tend it.

Fatigue, it should also be realised, is not localised to the muscles which actually perform the work; there is general fatigue in addition. Just as exhaustion in examiner's was revealed by their capacity to work the muscles of their middle finger, so can it be similarly revealed when a person has done cycling or dancing. A muscle that has worked gives off something to the blood passing through it, and this something, whatever it may be, then passes to all other organs of the body and makes them tired as well.

What has just been said concerning muscles applies also to the brain, for all physical activity depends on co-ordinated acts of muscle and brain. The brain initiates a muscular act and while the act is being performed the muscles send to the brain messages which carry information concerning the performance. The part of the brain concerned in a particular muscular performance and the muscles themselves are thus enabled to work together as a co-ordinated unit. A muscular act is, in fact, performed similarly to the advance of an attacking army. At headquarters

in the brain plans are first made and then the signal to start is given. Once the start has been made a regular succession of messages comes back from the acting unit reporting how the act is progressing. On an average those messages report all's well, but, if they do not, the act is modified in accord with their reports.

Mosso, through his ergograph, showed that in the muscle-brain combination the brain was the more easily fatigued part of the combine; the brain, in fact, is the seat of normal fatigue. When muscles appear to our senses to be so utterly tired that they cannot be induced to exert themselves at all, they are actually capable of being excited by electric shocks to as great a degree of exertion as they were when they appeared to our senses to be fresh.

The brain requires its rest-pauses after activity just as do muscles, and it may be that the rest-pauses of work are determined by the rest-pauses required by the brain rather than those required by the muscles. But whether the rest-pauses are required by brain or muscle makes no difference to the point that they are lengthened when the amount of blood available for the working organ is diminished.

Probably the greatest continuous muscular exertion undergone by any animal is that performed by migrating birds. Many observations have been made on their brains and they all reveal a marked decrease in the amount of blood in the brain at the end of the flight. This decrease so gravely inter-

feres with their normal capacity to act quickly enough to avoid ordinary dangers that trappers reap a rich and easy harvest of birds at those places where they regularly finish their flight. Tired motorists may also be placed in circumstances where the split-second of slowness brought on by fatigue can make the difference between just avoiding and failure to avoid a crash.

We may finish this chapter with a few remarks on training. We are all trained for what we do, and, if we want to do anything different, we require a period of different training to fit us for the new work. Thus, people who just sit all day have been trained by habit to sit all day, and people who walk all day have been similarly trained to walk all day. And just as the man who regularly sits all day would require a period of training before he could regularly walk all day, so also the man who walks all day would require a period of training before he could comfortably sit all day.

When we first take up some new type of work we do it clumsily and at relatively great cost in calories. Thus, the reader of this will probably find that he can only move his ears by making massive movements of his face and scalp. If, however, he is prepared to sit in front of a mirror for some weeks' practice, he would probably find himself eventually able to move his ears without accompanying grimaces. That is to say, through practice, a particular muscular movement, that required to move the ears, is done

with much less energy expenditure than was the case when the movement was first attempted. Repetition-movements thus eventually become cheap movements.

The cheapest movements we can make, in the sense of the best return for the calories expended, are those involved in walking because we are all so well-trained in these movements. It is, in fact, the worst slimming exercise that can be attempted unless a good steep hill is in the daily programme. The same considerations apply to any regular daily exercise performed for slimming or to keep the weight down. Irregular unaccustomed exercise is the real slimming exercise, so much so that machines have been constructed in which fat patients are made to perform all sorts of unaccustomed movements which, because they are unusual, are made so uneconomically in calories that the performer loses weight. In accord with this is the fact that when people start on a course of training involving increased energy expenditure, they first lose weight.

CHAPTER IX

WORK AND DRUGS

Though it really belongs to efficiency, the question of drugs can better be considered separately because more than efficiency is concerned. This study can be begun by noting the observations made many years ago on typesetters in the office of the *London Times*. The tests concerned beer, and were made by allowing the men to take beer with their meals only on alternate days. The men's reports were all in favour of the beer days. They felt that the beer eased and made their work more pleasant, it also enabled them to work harder and do more. The observers who watched them, however, found that, on the days the men had their beer, they actually did less work, and made more mistakes than on the beerless days.

Before the facts are considered one should ask oneself "who wants to be a typesetter?" It is most unlikely that any of the observers would like to be; they would almost certainly prefer the watching and examination of typesetter's work to doing it themselves. Yet, on the basis of such observations, any employer who put his profits first would insist on regular beerless midday meals; if, however, he put his

workmen's happiness first, he would insist on their getting their beer every day, even though it meant employing several type-setters more.

The vast majority of human beings are working men to whom efficiency means very little. The people who do all the talk about efficiency are those workmen's employers or their henchmen, not the workmen themselves. Workmen work because they must, not because they may. Men, who take up physical work because they may are called sportsmen, and they like their work, but it is a very limited class of people who find their work so interesting that they can make it their play. For the vast majority of men work is just work with various derogatory adjectival additions.

What reader of this book wants to be a sweeper? The answer will surely be none. Yet sweeping must be done. The work of sweepers could possibly be dignified if they could be fired with enthusiasm as the foundations of Public Health, but successful firing with such an ideal would imply radical changes in their social status, and their own social outlook.

And who wants to work in paddy fields balancing himself with two sticks and churning up hour after hour the soil with his feet beneath the water to the proper consistency for rice-growing? The answer surely will be that none would do this for pleasure; it is hard monotonous work that somebody must do.

One could thus go on for hour after hour enumerating work that must be done but which few

would volunteer to do because of the pleasure it afforded them. Very superior persons might find it interesting to puddle a paddy field for five or ten minutes just to know what it feels like and all that sort of thing, but they would not like to have to do it for hour after hour just because they must. Hundreds of millions of the population of this world have to do such work, and to them efficiency can only mean to get more work out of them for the same pay.

Keeness for the workman's efficiency is really part and parcel of the cult of the Almighty Dollar, and every employer seems automatically driven to worship at its shrine. No master, for instance, would continue to employ a bearer whose rest pauses were so long that he was always late. And unless there are special reasons, such as length of service and growing age, the employer must first look for reasonable efficiency in those whom he employs. But where workmen and employers come into conference over work and wages, the tendency is for the average workman's standard to be offered and accepted by employers rather than that of the highly efficient. Any apostle of efficiency can cavil at such settlements, but the bystander should appreciate that they indicate that to workmen higher efficiency implies getting more work out of them for the same pay. It is not possible to give every workman a high standard of overcharges, and get high efficiency from each of them.

The vast majority of the workmen of this world,

however, do not work in factories, they work on the land where efficiency matters little so long as the workers are small-holders. Efficiency on the land is only for the man who farms many acres. Such an one can consider the difference in cost to him of employing ordinary labour and using machines, and the machine will win. A milking machine, for example, will get less milk out of a cow than a skilled human touch. But when you own a hundred cows the value of the extra milk produced by the human touch is so much less than the differential cost of machine and hand milking that the prudent man must use the machine.

• It is also the case that a good threshing machine will thresh in one day as much corn as can the villagers of an average Indian village in a week. But so far as the small-holder is concerned the traditional mode of threshing, as opposed to the machine, implies no out-of-pocket expenditure. His bullocks would be just idle if they were not treading out the corn, and so also would he and his family be idle if they were not in attendance. His manner of threshing does not imply additional expenditure to him whereas to hire a machine would. Unless, then, the Indian agriculturist is to have his mode of life altered as rapidly and efficiently as the Kulaks of Russia had their mode of life altered, agriculture in India is not for mechanising just yet. Until Provincial Governments in India are prepared to consider uprooting the traditional village life of India and under a five or ten year plan institute collective farms with

mechanised procedure, Indian villagers at the proper season will continue to spend hour after hour puddling the soil of the paddy fields with their feet. Their actual labour cannot be lightened, it can be made to appear lighter to the doers if they be drugged, and the convenient drug available in India is opium.

There was a time when I would probably have held up my hands in horror at the bare suggestion of giving workmen opium. But there also came a time when the 'family' ship made a voyage to the Far East, and for that purpose a Chinese crew was shipped. The captain reported a most successful voyage, and that the crew behaved splendidly so long as they got their opium. Without it, they were unhappy seamen, who found the work hard and uncomfortable; with it, the work seemed easy and pleasant to them. He expressed himself as ready to go anywhere in future with a Chinese crew so long as the men could get their opium.

Before the reader also holds up his hands in horror at the idea of using opium to make the day's task seem lighter, he should carefully examine his conscience concerning whether he would like to do the work of a seaman or even an agriculturalist. It is all very well to talk of the dignity of labour and how ennobling work is, but there are many tasks in agriculture which are little more than one nasty job after another. It is not possible to lighten this labour, but it can be made to seem easier to the doer if he just takes a little opium. The drug may deceive its

taker, but he is happier through this deceit, and his happiness is what matters. Here may well also be remembered the recent striking case of the prominent Indian politician who wrote laudatory articles on the virtues of Nera, a non-alcoholic drink which he declared to be not only grateful and comforting but also to have been the great support to him in the heavy work he did. Nera, he declared, was the foundation of his efforts. Going down to details he gave accounts of the amounts taken which fired toddy-drawer's curiosity, and they went to him in a body to find out how he managed to get so much. Then the truth came out, he only imagined he was drinking Nera, really he was taking toddy.

Toddy thus obtained a wonderful testimonial from an observer biased against it. Doubtless when he found out the truth he gave up his daily tonic dose of sustainer and, if he did, he probably entered on a period of pessimism from which he may still be suffering because advanced age is against the change implied in recuperation. Much trouble may have accrued to India through a pessimism thus generated and sustained.

Cocaine is another drug the very name of which may only evoke visions of doping parties and so on, in those who do not know much about it. Originally its sole use was to enable the mountain carriers of South America to do their hard work without fatigue. They took it by chewing the leaves of the plant that produces it, such leaves being indeed

their pan leaves, and they thus took it in such small quantities that they only got benefit from it. This benefit, it may be mentioned, was no matter of deceit, it was a real benefit as many laboratory experiments have proved. The original users of cocaine moreover could get no surfeit of cocaine from their manner of taking it any more than could a man get a surfeit of sugar by eating sugar-cane. The ills of a surfeit of cocaine arose when the modern chemists extracted it from the leaves and produced it in pure form. The hill-carriers of India would be greatly benefited if at their various termini they could find the leaves of the coca plant available for their chewing just as they can now find pan leaves. Indeed, some day some enterprising chemist may be able to extract from pan leaves as dangerous a drug as is cocaine when taken improperly. The millions who may now be deriving benefit from this possible drug because they take it in proper dosage may then be able to become hopeless pan-addicts, and pan-addiction be put into the same category as cocaine-addiction !

Now all who take these drugs take them because they derive some benefit or pleasure from the taking, and ultimately the arguments against them come down to efficiency. The vast majority, of those who take them do so with benefit to themselves. Those British type-setters found their work eased by beer even though they made a few more mistakes, the Andes' carriers did their work better through cocaine with benefit both to themselves and their employers, the Indian

agriculturalist used to have his labour lightened by opium, I may be a sentimentalist but every time I see men puddling rice-fields I consider how terribly unfair it is that a very small minority of efficiency-enthusiasts in another continent, men and women who have never done a hard day's physical toil in all their lives, should be able to deprive those men of something which would ease their arduous daily toil.

Drug takers, who use their drugs dangerously, should be dealt with as motor-drivers who drive dangerously. Any man, who takes alcohol or opium in amounts which are sufficient to render him unfit for carrying out the proper duties of his station in life, should be placed under restraint and compelled to undergo a course of treatment until he is once more fit to take his station again, irrespective of what that station might be. Legislation could thus go a long way towards preventing the abuse of useful things by persons unfit to use them. Our feelings would no longer be harrowed by tales of men who spent so much on drink that they neglected their wives and children. Before the man could get to that stage of neglect, he would be put under treatment. After all, it would be as reasonable to abolish motoring because a few motorists drive recklessly as it is to introduce prohibition because a small minority of men employ useful drugs dangerously.

Those people who look askance at the bare mention of drugs should also learn that all of us have our own manufactories of drugs within us, and that a nor-

mal existence depends on a regular daily doping from them. Some people even go further and without their personal knowledge maintain little breweries in their insides. Such people, it should be noted, find sweets specially sustaining. In fact, they cannot do without them because they are the source of the alcohol which they regularly make and become accustomed to need. Apart from such special cases, however, our ductless glands, as our drug-manufactories are called, are the things that make us what we are, and variations in their activity determine variations in our activities and out-look. The most striking and immediately apparent differences are those of the ductless glands mediating sex which are responsible for men thinking and acting differently from women, and vice versa.

The reader of this may be a person aflame with enthusiasm concerning the iniquity of allowing hard-worked labourers to take a little opium to ease the strain. He may even feel that he is inspired from above in these respects. Yet the removal of his thyroid gland, which weighs less than two ounces, would leave him without enthusiasm for anything or any belief in his inspiration. He would not become a drivelling idiot, he would just be careless of everything; that is all, but it would be enough.

We are all drug-addicts taking our regular daily doses as they come to us straight from our own factories. If any one factory ceases to work hard enough, or works improperly, the bodily economy is profoundly

upset. So many different abnormal states can thereby arise that large volumes are written about them to enable doctors to understand and identify these different abnormal states when they meet them. It is not impossible also, that some of the many drug-addicts among us were first driven to the use of their dope by some temporary failure in one of their own drug-manufactories.

Just as those who ordinarily ride may look with something akin to contempt on those who ordinarily walk, so those who work only on drugs of their own manufacture can see something wrong in all those who take also drugs from foreign sources. Once, however, one knows that each and all of us are regularly making use of our own makes of drugs, it becomes difficult to assign some special dose of original sin, wickedness, or wrong-doing, to those who take also drugs they do not manufacture themselves. I appreciate also that this drug position is unfortunately marred by pre-conceived notions arising from visions of opium dens, cocaine-sniffing parties, and so on. I should therefore make it clear that I am entirely opposed to cocaine sniffing parties, and all that sort of thing. I do, however, consider it unfortunate that a one-sided view derived from such visions plus gradgrind-efficiency ideas should be employed to refuse ease to type-setters, mountain-carriers, paddy field puddlers, and workmen of any other kind. These stony-hearted people would very cheerfully deprive soldiers in front line trenches of their rum as well as workmen of their beer or opium.

CHAPTER X

ON MIND AND BODY

Once a year I preach what I call my annual sermon to newcomers to the study of medicine. I point out to them that they will in due course learn enough to be able to do the equivalent of teaching their grandmothers the art of sucking eggs, but at the same time I advise them not to attempt such instruction because of the likelihood of trouble arising within the family circle. As an example of these possibilities I point out that none, who had not studied anatomy, could possibly know what precisely he was talking about when he used the simple word, mouth. As anatomists they might well prefer the term, oral cavity, which would convey definite ideas to them, for they would be expected to know its boundaries in all directions, above, below, front, back, and sides, and enumerate its contents from any one boundary to the other. The word, throat, is another example of a word in common use which has such an indefinite meaning that the term, sore throat, implies so many conditions to the doctor, that he has to examine the tonsils, phalanx, larynx, oesophagus and so on, to find out what actually is sore.

Likewise I inform them that if they went back to

their parents and told them that they neither saw with their eyes, nor heard with their ears, their parents could well believe, unless they were doctors, that too much learning had made their sons mad. Yet their statements would be true for what we receive with our eyes is visual stimulation that is capable of sending nerve impulses up the optic nerves to the brain. Only in the brain does it become seeing. A man may thus have perfect eyes and yet be unable to see because of some break in the connecting links between eyes and brain. In its turn the brain is a body-organ just as much as is the stomach, but with the difference that it is the organ provided to us to do our thinking. The brain is the organ of man, and our mental activities ultimately depend on the activities of the brain.

As everyone knows, strong sensations, such as are the noises of nearby bomb explosions, require our urgent attention, and the changes they give rise to in the brain are adjusted to their strength. They also leave their similarly adjusted memories behind. It is satisfying to many to believe that memories belong to the soul, but the scientific evidence is that they depend on persisting changes set up in the brain. After which it may become appreciated that we do not know what things are, we only know what we believe them to be, and that which we believe anything to be is determined for each of us by the nature of the processes taking place in our organs of mind or brains and mediating to us our ideas of that particular thing or concept. If, then, we believe that certain things

are good and that certain other things are bad, our beliefs imply that certain activities of the brain mediate to us the idea of goodness and that certain other activities mediate to us the idea of badness. But, as we are born to believe in the existence of realities external to us and corresponding to our brain's activities, as well as in the truth of what these activities reveal to us, we project the evil or goodness to things outside us and act accordingly. The reader will appreciate these points better, perhaps, if he would consider his personal attitude towards the eating of beef on a Friday, and compare his attitude with that of men of different faiths.

Our conceptions of the world in which we live thus ultimately depend on the differing types of activity which can take place in one of the organs of the body. This organ not only requires an adequate blood supply but also is exceptionally dependent thereon as may be evidenced from garotting. In this act the assailant came from behind and pressed his fingers skilfully on that part of the neck which is just over the carotid arteries which take blood to the brain, and thus diminished the blood supply to that organ. Directly after the pressure had been applied, the victim fell unconscious and all his valuables were looted before he came to again. In Spain garotting was the official method of execution, the executioner being directed to keep up the pressure for one minute.

Considering that the brain has two other large arteries supplying it with blood besides the carotids,

garotting gives impressive evidence of the high degree of dependence of the brain's activities on an adequate blood supply. It thus seems possible that those students who reported to me that their minds just went blank when the weather was really hot had so much of their blood in their skins that the amount of blood left over to work their brains was nearly as low as it temporarily is in garotted persons. Here also it may be noted that anaemic persons would be more likely to suffer from this disability than the full-blooded. It is further my experience that Indian students, especially the ladies, who read from morn to eve and long into the night for examination purposes do become anaemic. Indeed, more students appear to me to do badly through lack of sleep and overwork than from non-prosecution of studies.

The quantity and quality of the blood available determines the brain's capacity to do its normal work. The drugs, alcohol, cocaine, and opium alter the manner of its working. Inasmuch as these drugs are taken to provide a rosier outlook on life they must at least be able to stimulate and strengthen those processes on which our ideas of goodness are based, as well as to depress and weaken those that mediate badness. Their ability to change the brain's activities that ordinarily mediate badness into those that can give us the feeling of goodness constitutes, in fact, one of the chief objections to their use. In my book on Alcohol and Anaesthesia, however, it has been shown that alcohol in this is a very efficient revealer

and to die on the same evening instead. The constipated, however, have despair.

This belief in the truth of the pictures presented to us by the activities of our brains, coupled with the rule that we are born to believe in the existence of external realities corresponding to those same brain-activities, leads bad workmen to complain of their tools. And all who live long enough become bad workmen in the end, some earlier than their fellows. The times change and we fail to keep pace with them. We are outstripped because we have become bad workmen, and, because we have become bad workmen, we complain of the increased pace of modern life, the tools we must use. When we reach Utopia it may well be that senior members of services will not be put on pension when they reach a particular age such as 55, but as from the day when they are first heard to declare that their particular service is going to the dogs, or something of that sort. A statement of such character is reticent testimony that its maker is now unfit to cope with change and progress.

Here also one should note that, while everyone eventually realises that his eyes and legs are not so efficient as they used to be, few realise the same in respect of taste and smell. To cope with a master's failing taste, the cook is therefore ordered to use more and more of pepper and other spices, but all in vain. The cook does not exist who can at one and the same time prepare food to suit his ageing master's failing palate, and that of the younger genera-

tion, any more than can an oculist prepare a single lens to suit two different eyes. The master may thus be led to discharge a blameless cook, and to engage a new one who can but prove equally helpless. Finally, after a succession of such changes, the unwilling owner of the failing sense resigns himself to mournful musings on the lack of taste in modern foods, and the degeneracy of the whole race of cooks.

Old people are bad workers apt to project their personal failings on to the world around them. The chronically sick are also bad workmen who, if they are religious enough, resign themselves to the will of God, and, if they are not, they may become politicians. A striking example of this last was the late Philip Snowden. He was quite an ordinary young man until he met with the cycling accident that left him disabled and ever in pain on movement for the rest of his life. It was also the case that when he first became a bad physical workman with abundance of time to read instead of doing, the literature of discontent suited his disposition rather than such devotional works as the lamentations of Job. Had he read the latter type of literature he might well have become a Bishop instead of a Cabinet Minister. His pain-wracked body gave him that twisted mind which prevented him from being just even to a Liberal Government, and left him, as his chief joy that of communicating his discontent to as many others as possible.

So far as my own enquiries are concerned, and

they have been many, chronic tuberculosis and diabetes are of importance in Indian politics. Sufferers from these diseases are apt to under performance in the tasks actually assigned to them, and prone to complain about the much bigger things they could really do, if such they could only get to do. When they make such complaints, it is to be observed, they can be credited with full honesty in making them, but, when giving them this credit, one should also enquire concerning the possibility that the grumbler suffers from some chronic complaint such as diabetes, which impairs the working of his brain and leads him to complain of his tools.

The brain works by burning or oxidising sugar, and we have already noted that men's brains work unreasonably at high altitudes where there is not enough oxygen for normal efficiency in the body's oxidation of sugar. When, however, the body burns sugar, it does so by a much more complicated method than that of putting the sugar on a hot spot in presence of oxygen. Many factors are involved, but out of them we can only consider oxygen and insulin. A hormone known as insulin is essential to the proper oxidation of sugar. Its manufactory is the pancreas, and diabetics cannot oxidise sugar satisfactorily because of lack of insulin consequent on some form of pancreatic disease or damage.

The reader should therefore appreciate that the diabetic's brain is subject to the same stress as that of a man on a high mountain. He should also appreciate

that the one will be as oblivious to his failings as the other. Diabetics, for example, are apt to complain of muscular weakness and not of brain weakness. The doctor knows, however, that the brain fails before muscle and to the doctor a complaint concerning muscular weakness is thus evidence of brain weakness. The reader will grasp this point better perhaps, if he would consider his own personal deductions when he has been tired out by muscular exercise. So far as the phenomena which he thus meets are concerned, they are perfectly convincing to him that his muscles cannot readily move. Yet, when the ergograph of Mosso is used to analyse the phenomena in an objective manner, the regular findings are that the muscles can move quite well, and that it is the brain which is actually tired. Consequently, when patients complain of muscular weakness, the knowing doctor realises there is instead a brain-weakness. Tired muscles primarily imply tired brains, the tired brain cannot move untired muscle.

Diabetics can lead a more normal life if they take insulin, but, as compared with the normal, it is a life of ups and downs. A hundred subcutaneous injections of insulin, for example, could be given daily, but it would be an awful life to lead ! Yet the pancreas easily does as much naturally, for it will send extra insulin into the blood stream to cope with such an additional muscular effort as that of turning round in bed during sleep. Nothing like that can be done artificially. All that one can thus do reasonably is

to give a couple or so of injections daily. After each of such injections there will circulate in the patient's blood more insulin than he actually then needs, and before each injection there will be less than he requires. Only at some short time between any two injections will the patient have in his blood just the amount of insulin that is actually necessary. Realising this, doctors have expended much time in trying to make insulin-compounds which would act like insulin towards sugar, but yet be more slowly absorbed from the site of injection than is insulin. Their efforts have effected much improvement, but nevertheless they can never attain to the standards which normals possess. The body's insulin manufactories make and store insulin just as muscles store energy for their work. Immediately after the factory has recorded a call for insulin, it discharges the proper amount into the blood and then proceeds to manufacture more insulin until the depleted stock has been made good. The factory is, thus, always ready to supply just what is needed.

The diabetic who is kept going by insulin injections is thereby also subject to fluctuations of mental efficiency which are beyond his own perception. In office, as already pointed out, he is apt to under performance and prone to complain of how much he would have done if he only had the chance; in opposition he is the critic. Unfortunately, however, he can be discontented with so many things that those who have to deal with his complaints can be hard put

to it to distinguish the corn from the chaff, or to find the precious stone among the many pebbles on the beach.

Another important point concerning diabetes is that one of its earliest symptoms in men is impotence. This is something that a man can view with equanimity as it gradually develops with increasing age, but when it rapidly develops in a man who believes himself otherwise to be in the prime of life, it not only gives him a jaundiced outlook on the world but also makes him so suspicious of that world that he can suspect the existence of deep laid plots and plans where there is none.

This attention has been given to diabetes because it is sufficiently prevalent in India among its upper classes to permit its psychological manifestations to affect public life. The diabetic has an internal disharmony of the body which affects the workings of his organ of mind, and, because he must believe in the existence of external realities corresponding to his own disharmony, he projects that disharmony into the world around him and may thus quite honestly become the critical politician who never knows exactly what he wants and always wants something different from what he gets. Which brings us to the point that there are two kinds of reformers; there are men whose minds have been warped by some disease or mental injury, and there are the technical experts. The former class tends to gravitate to politics, the latter provide the schemes which the former tend to mar.

Reformers are persons who are not in tune with their environment, and the reliable reformers are technical experts. There are few Indian villages, for example, to which an intelligent and energetic doctor would find himself attuned. He would want a pure water supply, proper sanitation, and all that sort of thing. An engineer would want pucca roads in the village itself, and one to the nearest main road, and so on. Still another would have the urge to develop humus production.

The ordinary villager is a deeply religious man attuned to his environment by his religion. For him, God's will, working in mysterious fashion, determines all things. Educated people, who may be so imbued with the idea of natural laws as to regard these as ordinary common sense should appreciate that to simple people who do not know anything about these natural laws science can appear as irreligion. Also by simple people I do not mean Indian villagers only. My own grandfather for example, though a regular church-goer, was yet regarded as an Atheist by certain people because he was known to hold the opinion that there was a relationship between dirt and disease, and a certain fire which had an extremely adverse effect on the family fortunes is traditionally ascribed to arson based on religious enthusiasm. That was a century or so ago in England.

What is common sense to a man brought up in one environment can be folly or irreligion to one who has been differently trained. Indeed, at the pre-

sent stage of general scientific culture in India, a Director of Public Health, after he has carefully selected the suitable site to set up a vaccine institute, could well sleep for one night under a tree on the site to receive the requisite vision from the Goddess of small pox concerning Her approval of the site and the material to be manufactured thereon. The deeply religious would then accept vaccination as readily as the scientific. I quite appreciate that it would be difficult to find the Director of Public Health who would find it consistent with the dignity of his office to have such a vision, yet, *in apologia*, I would point out that a Director of Public Health has to deal with practical facts where politicians deal with words and theories. The suggested practice would combine two ideologies, and would be comparable with the common formula or group of words which opposing politicians seek in conference.

Science and religion come into conflict in India whenever one deals with such matters as sanitation and public health. Science may be able to command unconditional surrender, but a negotiated peace at this stage might be more prudent.

While religion thus attunes a man's mind to high infant mortality and so on, his metabolic turnover may also be at work to help him in the same direction. In which connexion attention can be drawn to certain Christian doctrines of non-resistance.

The Christian doctrines of non-resistance have been authoritatively declared to be comprehensible

only to those who have done much prayer and fasting. This declaration is undoubtedly correct, for we are all in training for what we do, and much prayer and fasting will eventually train the mind and body to do nothing. The ordinary Christian, however, has to do a day's work, and that implies a metabolic turnover which can be too high to attune mind and body to do nothing. Whence has come much difference between Christian precept and practice, a difference that must prevail so long as Christians regularly eat enough to do a day's physical work of ordinary worldly standards.

Many Christians find the do-nothing doctrine of Satyagraha comparable with their own ideals of non-resistance. This is a doctrine which can only seem comprehensible and practical to one who just sits and talks, or sits and thinks, and just takes enough food to maintain him at sitting and thinking without growing corpulent. It is incompatible with eating enough to do a hard day's work and doing it. The vast majority of men, however, have to do a day's work, and when that doctrine is presented to their minds a sort of round table conference takes place therein, and the common formula that emerges has more energy in it than to do nothing. Working men are thus liable to interpret non-resistance in their own particular fashions. Moreover, it is useless to look forward to a sort of millennium where the doctrine will prevail; the vast majority of men have to do a day's physical work to live, and, so long as they thus work, their

practice of the doctrine will be more energetic than the energy expenditure required for sitting and thinking.

Consistent with the capacity of abstinence and meditation to train the mind to Nirvanic doctrines of being and doing nothing, the regular low metabolic turnover trains the mind to do little. Men trained to a low metabolic turnover can consequently view as insuperable obstacles what men of higher turnover can view as something within their power to remove. Men of low turnover will thus tend to micawberise, or look for Government help, amid circumstances where men of higher turnover would act.

As is well known, that eminent authority on military matters, Napoleon, gave as the fruit of his experience the dictum that an army marches on its stomach. It is not the case, however, that armies just march; instead it is the rule that the marching is the preliminary to the real work of the day, overcoming formidable obstacles in battle. Soldiers have to develop the will to go forward to overcome formidable obstacles when they meet them; it requires long training to a high nutritional turnover to develop that will and maintain it. Only a high turnover can ordinarily provide the will to overcome obstacles, no matter whether these be civil or military.

At the same time tribute must be paid to faith as a moving agent. Faith provides singleness of purpose unhampered by what are known as inhibitions. For example, if the reader of this should find himself pester-

ed by an undesirable visitor to his room, he will doubtless develop a desire for that visitor's removal. But his manner of procedure for the removal will depend on the intensity of the desire. If that desire be as strong as is a faith above reason, the visitor will be removed irrespective of consequences to the remover, the removed, or the furniture. The visitor could thus be thrown bodily through an upper-storey window on to the hard pavement beneath. Such modes of removal, however, are for madmen rather for ordinary citizens.

Madmen are commonly reputed to be of great strength; actually they are weaker than ordinary healthy men. When madmen act, they act with singleness of purpose irrespective of the consequences; when sane men forcibly remove the unwelcome visitor, the force they exert must always be tempered and lessened by their knowledge of the consequences. When the sane man acts, he will manoeuvre the visitor to the doorway, and avoid damage to the furniture on the way. And, having got to the doorway, he will not attempt to push the unwelcome visitor through the door itself, but will again manoeuvre to open the door and get his man safely through. Each such avoidance lessens the force that he can apply to the unwelcome visitor's removal.

Madmen have the further capacity of developing and losing these single-purpose ideas as easily as children can pass from tears to laughter. In contrast with them, fanatics are men of permanent single-

purpose ideas. These latter therefore tend to act permanently on one line as do madmen fitfully on many, and their manner of carrying out the purpose of their single idea can appear as mad and strange to the ordinary citizen, with his actions tempered by such considerations as damage to the furniture, etc., as do those of the madman with his ever-changing ideas.

Meditation or brooding is the basis of fanaticism. When people continually think about an idea, such as the importance of being earnest, they develop the strength of that idea in their minds just as similar regular exercise will develop and strengthen a particular group of muscles. When men thus regularly think about a virtue, the process is known as meditation, but when they think about their wrongs, the process is known as brooding. Unfortunately also, men are more prone to brood over wrongs, whether real or imaginary, than they are to meditate on some abstract virtue. Hence also it comes about that communities in which meditation is practised can produce many more men aflame with imaginary grievances than they can produce saints aflame for differing virtues. We should finally note that no man who has meditated on a particular idea or scheme long enough can correctly appraise the probable results of putting that scheme or idea into action. Any community, in fact, would be far better off with its meditators in a home. That is not to say that no good can come from meditation, much can. The proper me-

thod would be for the mediator to commit his ideas to writing in the home and then send it through a secretariat for opinions. Any action on it should be taken by an outside independent authority.

CHAPTER XI

PROBLEMS FOR THE FUTURE

The Principal of King George's Medical College Lucknow has the duty of making annual recommendations to a freeships committee for students' freeships. The recommendations are based on the investigations of Indian Officers in charge of the hostels, and they make special enquiries concerning whether applicants use fans or not. If a student uses a fan he is considered to have money to spare for a non-essential. Consequently, when other things seem equal, the use or non-use of a fan can decide the issue, the non-user getting the freeship.

This fan-criterion is correct because it is obvious that for the vast majority of the population of India a fan must be a non-essential even in the hottest weather. This implies that they must be able to lose the heat generated in their bodies as fast as it is generated even in that hottest weather. From what has been given above it can be appreciated that there will be two ways of achieving this end, viz., a low rate of production of heat within the body, and a type of body that facilitates heat loss.

Considering the rate of production first, there was no evidence that Indian muscles work more

efficiently than muscles of other races. Therefore, to keep heat production down, they cannot be allowed to do so much work as could be done in a cooler climate, also they must work at a slower rate. As compared with the workers of cooler climates, a feebler stroke with longer rest pauses must early become an ingrained habit for Indian workmen.

When next we consider the body form, the best heat-dissipator will be that which provides the maximum surface for weight. In animals this is best attained when there are all skin and bones. The thorax, which plainly shows each and every rib, may not be as much the more efficient heat dissipator as is the motor cycle's flanged cylinder better than the plain cylinder's form, but yet it will be a better heat dissipator than a thorax rounded out with fat. And an abdomen that recedes, while it may have no greater surface than one that protrudes, has a much smaller quantity of heat behind it to be dissipated, for, as already pointed out in connection with the fat father and thin son, the amount of heat to be dissipated depends on the individual's weight.

There is also the question of size; short men are better heat dissipators than the tall. Hence, just as in India the Punjabi is on the average a bigger man than the Madrasi, so also in Europe the Russian is on an average larger than the Italian.

There is finally diet to be considered and here proteins require special consideration. They exert on heat production what is known as a specific dynamic

action which is another way of saying that in a normal healthy adult all protein that has been absorbed from the food can be accounted for as having been metabolised or used up with consequent heat production in the body within 24 hours. The healthy adult cannot store protein, he stores fat.

This peculiar action of protein is actually a matter of common knowledge, for all persons seem to know that meat is heating to the body. Prudent meat-eaters, in consequence, eat less meat in hot weather than they do in the cold. Since vegetarian diet is a low protein diet it thus may be held to be peculiarly suited to hot-weather conditions. Certain foodstuffs, such as salads, are believed to be cooling in the hot weather, but it may rather be that these are really foodstuffs containing few calories. They can fill the stomach with food of small caloric value, and thus leave their takers with less room for the foodstuffs, like meat, which have a high caloric content.

When all these facts have been considered, it seems possible that the state of affairs in Indian nutrition is not only what it is because it can be what it is, but also that the problems of improvement are greater than what many appear to imagine. Not the least of the troubles of India, so it appears to me, is that too many people have come to India from the West to teach, but not to learn. They teach from books that come from the West, and if they find anything here different from the standards laid down in their text-books the tendency seems to be to conclude that

the local standards are wrong. Sometimes they are. For instance, few doctors in practice have the time to study Medical History, and a man may attain to the highest positions in the Indian Medical Service without acquaintance with it. The position among Governors is naturally even worse. Consequently, few people in India know that Unani Medicine was once the officially taught medical system of all the Universities of Europe. It was also taught there in the days when heresy of every kind was a severe offence. The Professor of Medicine who taught anything that deviated from the official Unani doctrines as inevitably lost his chair as would a bishop who deviated from his doctrines lose his see. There also was never a time when Unani medicine ceased to be and Modern Scientific Medicine was born, just as there never was a time when people ceased to believe in a flat earth and a geocentric universe, and began to believe that the earth was a planet of one of many solar systems. In both cases the modern gradually left the old behind.

The researches made in Europe into Unani Medicine gradually led to its abandonment so far as the Universities were concerned, though Unani practitioners still survive in England and call themselves herbalists. But in India Unani Medicine is imagined to be peculiarly Mohammedan with the result that it comes particularly under the patronage of the University of Aligarh. There, without knowing that the work has already been done in Europe, non-medical enthusiasts have set up a research institute to bring

the system into line with modern science. Judging by European results, they will take two or three centuries to attain to what Lucknow and Agra offer today. After all, we should duly appreciate that Unani Medicine is the medicine of Shakespeare, and that there is a descent from that to modern medicine, just as there is a descent from the musket of his day to the modern high velocity rifle.

This attitude towards Unani Medicine is given to illustrate the great part that sentiment plays in determining the actions of the educated. Sentiment likewise has led Governments to deal differently with the hazards of child-bearing and colliery work.

In English colliery districts the collier's wife, who produces the annual baby, has in respect of this production an occupation some eight times more dangerous than that of her husband who has to face all the dangers of the mine. For the maternal mortality rate in colliery districts is some eight per thousand while the death-rate from colliery hazards is but one. In India the maternal mortality is nearer forty. Much of this maternal mortality can be prevented, but is not because of its lack of emotional appeal.

There are events termed colliery disasters in which as many as two or three hundred colliers can die together at the same time and place. Such events have a strong emotional appeal and they lead Governments not only to set up committees to advise them what to do about it, but also to act. Maternal deaths are never likely to have the same emotional appeal because it is

never likely that a hundred women will die together in child-birth at the same time and place. Their deaths do not make big headlines for newspapers; they are tucked away instead in the cold figures of mortality tables. Only the intellect could provide motive for taking the necessary measures to prevent these chiefly preventable maternal deaths, but the intellect does not ordinarily provide men with the urge to action, instead it provides reasons for actions taken under the urges of emotions.

The position in regard to tuberculosis is possibly worse. More people are now regularly dying from tuberculosis in the large towns of India than die from plague, small pox, cholera, and such like emotion-evoking diseases. These latter are diseases of short duration, and their victims are either dying or on the road to recovery within a week or so of seizure. And while those who die from them may not die all together at the same time and place, they can at least die in quick enough succession to give the diseases that emotional appeal that leads to action.

In contrast with them, tuberculosis attacks its victim as the insidious sequel of what originally seemed an ordinary attack of the 'flu' or something of that sort. If, then, tuberculosis and the plague each attacked one thousand people in a particular month, there is little to show in that month for the tuberculosis and much for the plague. Consequently plague gets public attention and tuberculosis does not.

Some years ago I described a short-lived epidemic of tuberculosis in frogs. The cases were tracked to a single pond on the banks of which lived a tuberculous man who did his throat-clearing into its waters. Judging by the usual sites of their tubercles, the frogs found his sputum appetising. The tuberculosis among the frogs ceased after the man died, and we got no more tuberculous frogs again until recently. Now tuberculous frogs are coming in from all sides and, what is more, frogs last year were scarce. There is not yet enough evidence, however to decide if the scarcity depended on the weather, or whether tuberculosis in killing the frogs.

Indian customs permit tuberculosis to spread with something akin to geometrical progression. While the politicians wrangle, tuberculosis goes its way unchecked, and it may eventually change the economic face of India as effectually as did the Black Death once change that of England. My own expectation is that it will be the post-war epidemic of India.

The relatively low basal metabolism of Indians is of importance here because, if a low basal metabolism implies a low resistance to tuberculosis, then all who can comfortably pass through a hot weather without a fan must be held to be specially susceptible to this disease. It would be to the general advantage of the community if all the tuberculous were segregated into colonies, but it would be an exceptionally

strong authority that could put such a procedure into practice.

Many of the tuberculous die uncomfortably, though their exits could be eased by drugs and skilled nursing, but the skilled nurses are few. There are less than 500 trained nurses, for example, for the fifty million inhabitants of the U. P. Yet a trained nurse can make all the difference between recovery and death in severe illness. Their lack thus conduces to a higher death rate, and a shortened expectation of life.

Mindful of the uncomfortable ends to which those who die from lingering diseases are liable in India, I initiated, some years ago, a scheme to establish in Lucknow an infirmary where those who now die uncomfortably could still die but have their exits eased. The scheme duly went its way to the proper Government department where it is now safely shelved.

Unani Medicine, Maternal Mortality, Tuberculosis and Nursing have been introduced here to give the general reader some idea of the tremendous obstacles to be overcome before sickness in India can be properly relieved. In these matters India has far to go before reasonable standards of relief can be attained. The remedies, it should be observed, lie in the hands of Indians themselves. The powers to deal with them are available here and now; only the will to use them is lacking.

As a striking example of what can be done in these fields by Indians themselves, I would take the case

of Dr. Mathra Das of Mogha. He has removed nearly 180000 cataracts, and proposes to retire from active work, so I understand, when he has removed two lakhs. It is doubtful if there is any Indian who has ever done so much direct good to Indians. His reward for his work is chiefly the gratitude of his patients. It is sad to reflect that, if, instead of working hard to restore the precious gifts of sight and happiness to two lakhs of humans who were previously blind and sad, he had worked equally hard to make discontented and unhappy many crores of people who were previously happy and contented, he would probably now be enjoying fame and honour as a leading politician.

By now it is possible that enough facts have been presented to enable the ordinary reader to grasp the point that there is much solid work to be done here in India concerning food. When I came to India first I confess that I was inclined to believe the awful tales that I was often told about the starving millions of India. When I got down to what may be termed the scientific evidence, however, I found that it hinged round Voit's dietary. My informants appeared to believe that the Indian workman ought to get as many calories as did Voit's workmen. But when next I examined the actual consumption by various classes I found that the well-to-do got very few more calories than the indigent poor, and that the extra could be accounted for by a consumption of sweets.

The ordinary Indian dietary is sufficiently bulky

to make difficult the task of getting many calories therefrom without unduly loading the stomach. At any rate that is my experience after having lived for many months with well-to-do Indians and eating exactly what they ate. I would add that I enjoy such feeding. The servants generally eat the same as their masters save for the sweets. My servants, moreover, ate with their servants, and I am sure that I should have heard complaints if the food provided were not enough. Never have I heard any. The bulkiness of an ordinary Indian dietary determines, I believe, the lack of any striking differences between the caloric intakes of the well-to-do and the indigent poor.

As time went on I further learnt that the people who talked about the starving millions of India did not appear to carry their precepts into practice. That is to say, I did not find that they insisted on paying their personal servants enough wages to enable them to raise their caloric intake to that of Voit's dietary. They did just like everybody else, and got their servants at the cheapest rate available, and they were able to get them cheaper than I did mine. Yet, if there were these starving masses, everybody who belongs to the servant-keeping classes ought to accept his personal share of the responsibility and act accordingly.

I incline now to the view that the starving masses* of India belong to the same order as those Russian legions who, in the last war, passed through England

*Nothing stated here applies to the special conditions set up by war-time profiteers and hoarders.

in blacked-out trains that none ever personally saw. They were only seen by your informant's mother's servant's finance's brother's boss when coming home in the early morning after a late night. These starving masses are not to be found, for example, in the U. P. because, wherever the dietary of the lowly paid countrymen has been examined there, he ate more than the highly paid mill-hand of Cawnpore who could easily have purchased twice as much as he did, but preferred not. The starving masses of the U. P., if they exist are to be found in its towns where they earn enough to buy much more food than they consume.*

• When it has become known in Lucknow that I propose to spend my vacation in Kashmir, I can be told awful tales of the starvation and poverty of the Kashmiri countryman. I have also been told that its ruler plays polo all day while his subjects starve. I have yet to see His Highness play polo though I have passed the polo ground many hundreds of times, but, during a double houseboat journey between Islamabad and Sopor with long morning and evening excursions on foot or by cycle into the country on either side, I can claim to have seen thousands of Kashmiris, either in the costume customarily used by them for working in the rice-fields or in the Kashmiri bathing costume. Both costumes, it may be mentioned, enable the doctor to assess the subject's state of nutrition at a glance. As a result I can affirm that these masses of starving Kash-

*War profiteering may have altered this.

miris which one can be told about outside Kashmir do not live in the villages of its chief valley. If they exist, they must exist in some side valley, but there is no side valley with masses of Kashmiris.

Contrasting with what the plainsman can tell you about Kashmir is what the Kashmiri who has visited the plains can tell you about the plainsman. The Kashmiri considers that the plainsman is a half-starved weakling when compared with his own sturdy well-fed countryman. It therefore seems to me likely that the tale about the starving peasantry of India may have been originated by a Kashmiri who genuinely believed that what he said was true, because it was the evidence of his own eyes. His error was pardonable, for one has to be something of a specialist to appreciate that in these matters there is much more to be considered than only the evidence of the eyes. Once the tale had been started however, misuse of Voit's dietetic scale would apparently confirm it. And, when, I say misuse I do not imply dishonesty. I have met too many medical students who had apparently been taught that Voit's dietary represented eternal wisdom in matters of human nutrition.

But though every workman in regular work must regularly receive enough calories to do his daily work, that fact should not debar us from making efforts to raise the standard of nutrition, because of the initiative and enterprise that go with high standards. A fat clerk, for example, who walks to and from his office daily is likely to show more initiative than the thin

one who does the same; that is because the former will have the larger turnover. Too often, however, the fat man is fat because his sense of dignity requires him to ride to and fro instead of walking or cycling. I feel also that, while Cawnpore mill-owners pay their mill-hands enough wages to fatten them, they would not like to see their employees grow fat. For, once the weather grew hot, fat workmen would be so pre-occupied with wiping the sweat from off their brows that they would be unable to give proper attention to their machines. Production would, thus, fall off, and many more accidents take place.

. As things are, then, one would refrain from recommending anything in the way of indiscriminate increases of caloric intake. We do not know the maximum that can be taken with safety in different occupations, and we shall not know until many carefully conducted experiments have been performed. So far as I can judge the best places for the experiments would be prisons, and the suitable subjects would be 'lifers' because of the dangers involved. The lifer could be given the alternative of being the subject of experiment for three hot weathers, say, and then being released, or of serving out his sentence in the ordinary way. The subjects would be required to do such work as is ordinarily done outside by other workmen, but also to work to a much higher dietetic scale and output. I doubt if any of them would survive the ordeal of being fed up to 3500 calories, and then being required to work those calories off at

the task of cracking stones or bricks during the hot weather in the middle of a prison courtyard, even if granted an umbrella for shade. Yet stone-breaking is done regularly by the roadside during the hot weather in India as a preliminary to road-mending. The men who ordinarily do it, however, do not use up 3500 calories daily, their usage is nearer 2000. They may further find their working site to be in the full blaze of the sun and thank the Gods if that site be under a tree, or even if they have umbrellas.

We should consequently consider the possibility that the Indian workman is what he is not only because he can be what he is but also because he must be what he is. We can therefore turn from calories to cabbages, or the grow more vegetables campaign.

After the fighting in Syria in the last war was over, I took over the Turkish military Hospital in Damascus and employed 500 Armenian refugee women as nurses, such being the only labour available. None had been trained as a nurse. I first saw these ladies massed in the great hall and then, biased by what I had heard of the interesting condition in which the Turkish soldiery had left most of the local female population, I hastily came to the conclusion that I should have to reserve at least a couple of wards for the maternity requirements of my staff. I conveyed my fears to my guide, an Armenian doctor, who was straight-way able to inform me that my diagnosis was wrong. What I saw were the effects of a vegetarian diet. All the ladies, so he informed me, had large dilated

stomachs because they had been living only on fresh vegetables, and had to eat them in great bulk to get adequate nourishment. I had mistaken the outward expressions of those large stomachs for something else. Next, having looked again, I found myself unable to conceive of any more striking argument concerning the aesthetic disabilities of such a vegetarian diet than what I saw of its effects on the female form divine.

Out of the 500, two only were of comely form, and they were of superior class with access to more concentrated food. Being graduates of Beyrout and well versed in English and French, they were absorbed into the office staff; within a week, one was engaged to my sergeant and the other engaged to my doctor guide. Those experiences in Damascus are related as a warning to food-cranks. Fresh vegetables are undoubtedly good for us as adjuncts to a diet, but, as the whole diet, they can give rise to aesthetic disabilities. There are, however, certain people in this world who would, after hearing that fresh vegetables are good, live on fresh vegetables alone instead of using them as adjuncts. Such persons, moreover, can develop that enthusiasm for their new and perfect dietary which will lead them to force it on their wives and families. They should therefore learn some thing about those ladies of Damascus.

It appears to me possible that fresh vegetables have not so far made headway in India because they would add much additional bulk to the already bulky

dietary based on food grains. Accordingly, while admitting the benefits that can be derived from a more extended consumption of tomatoes and green leafy vegetables than is now the usual case, their very bulk must determine a smaller addition of them to a dietary based on food grains than it does to a dietary based on meat. My own ordinary dietary is based on meat, and I eat with it an abundance of green foodstuffs. I have also lived for many months on a dietary based on food grains. As a result I can confidently assert that I could not conveniently eat with the latter as much green foodstuffs as I find quite convenient with the former. Also, since I do not hold myself out to be anything other than an ordinary eater, I assume that many others would find the same. So far as fresh vegetables are concerned, then, I would hold to the doctrine that a little of what you fancy does you good. One should further and duly consider the point that much of the recommendations concerning them come from regions where the basis of a diet is meat. While, then, the Indian villager can rightfully be encouraged to grow more fresh vegetables for the consumption of himself and his family, he should not be expected to grow as much of them as the English farm labourer or the continental peasant because the former has not the same amount of spare stomach-room as these latter. Moreover, when I reflect on the ladies of Damascus, I realise that a large bulky meal may alter the body's outline enough to reduce its efficiency as a heat-dissipator so that, where a

condition of touch and go is reached, the subject may go the wrong way. Heat stroke is common enough in Italy for Italian doctors to have learnt of the predisposing effects of bulky meals thereon.

Whichever way one turns, then, one comes up against the possibility that the state of bodily nutrition and dietaries in India, are not only what they are because they can be what they are but also because they must be what they are. The vast majority of the people of India must be on a standard of nutrition which enables them to pull a fan in comfort on a hot verandah on a boiling hot day.

• This myth of the starving masses of India acts also in my opinion as a barrier to the real needs of India, that of raising the standards of requirements of its working classes. If every workman of Kashmir, for example, were imbued with the belief that he, his wife, and his children must each have three 'suits' of clothes, one for immediate wear, one in reserve for 'state' occasions, and one being washed with soap, he would only accept such wages as would provide those things. The regular wearing of those clean clothes, moreover, would not only transform the appearance of every town and village of Kashmir, but also confer on the ordinary Kashmiri that sense of personal dignity which would go a long way towards producing more desires, and a further rise of wages to satisfy them.

Likewise, if every Indian workman became imbued with the idea that humans should sit on chairs

instead of on their haunches, they would only accept such wages as provided them with chairs. In turn, that would probably mean a table for meals, crockery, and so on. Also, in view of the furniture, they would require larger quarters than they now customarily get. Likewise they could reasonably be expected to require more rooms.

Lucknow University, for example, provides a single room as quarters for a menial and his family, and there are assigned to my bungalow more servants' quarters than I have servants. All my quarters are in use, however, because I allow a married servant two or more rooms according to the size of the family. Yet it was not so very long ago that these arrangements while not forbidden, came under criticism from people who could only 'see' that I used more quarters than I had servants. In other words, one room for a menial and his family was deemed enough.

This is a view with which I disagree, and I mention it to bring out the point that what should be a model employer of labour, viz., a University, accepts one room as being proper and sufficient for a menial and his family. There was a time also when I suggested the building of a block of flats for menials giving each much more accommodation than now is the rule, but the suggestion got no further, I believe, than the Vice-Chancellor. Almost could it be held that the suggestion was rudely turned down by him. At any rate he claimed that in these matters the prerogative of initiative was his only. It was

therefore not in my province to take the initiative.

No menial has yet complained to me about his quarters save on communal lines, but I have had several cases of refusal to take a superior post of menial-supervision on the score of inferior quarters. Such refusals are, I consider, hopeful, yet, until all refuse, or there is in the background some organisation, such as a trade-union, demanding better quarters, both employers and employees will be satisfied with the standard of one room for a menial and his family. It therefore seems to me that many moons will pass before anyone sees the members of a political procession shouting slogans for three furnished living rooms and a kitchen for all menials. If such were the harijan's standard of housing there would be no need to bother about temple-entry and all that sort of thing; the harijans would settle such questions themselves.

Concentration on such items as temple-entry, etc., is little more than low-turnover fiddling while neglecting the real problem to be tackled, that of raising the workman's present standard of living. Initiative in these matters cannot come from the workmen themselves because their compulsory standard of nutrition is too low for it. Judging from my own experience also, too many intellectuals have a too-low turnover to take initiative. They can only talk. Some active and well-fed Pahari will probably make the start, and the movement spread to the plains as emulation.

As things are, I know that Lucknow University

has not the funds to provide three furnished rooms and a kitchen for each of its menials, and it will be a long time before Government is likely to furnish it with the funds to do so, because Government would have to provide similar accommodation for menials in all the institutions which it supports. It implies, in fact, spending crores of rupees on what menials at present do not want, and what employers see no reason for providing. Yet, if the standards of living of the vast majority of the population of India are to be raised, start must be made in the home. And when I point that out I am not without hope of the start being made. Within living memory the Irish peasant was accustomed to share one large room with his family and domestic animals. Now he does not. The initiative for the change did not come from the peasant, it came from men of better developed social conscience and greater initiative.

Concerning social conscience I can only tread on toes for I have seen the Head of a Department of Lucknow University peel an orange, while sitting on the stone steps of a sports pavilion, and leave the pieces of peel on the steps in such positions as made matters dangerous for others. Such a dangerously unsocial act every child by the age of 7 or so has been trained in England not to do. A walk along railway platforms in India during the banana or orange seasons will show any observer that unsocial conduct is common here. Such acts in my opinion are straws which show how the wind blows. The social conscience

here requires much developing before it can think of three furnished rooms and a kitchen as the ordinary housing for a menial's family. I have no doubt also that the present average menial placed in such surroundings would muck them up in the most awful fashion, for I have seen many of Mr. Peabody's London flats. But also I have no doubt that in due course a social conscience would develop here, as it has elsewhere, and train the tenants to use their quarters decently.

Behind all these questions of social uplift is the unfortunate fact that you cannot eat your cake and keep it. • The man who is adapted to pull a punkha rope in comfort on a hot verandah on a boiling hot day must be on a standard of nutrition incompatible with the development of foresight, initiative, and enterprise, as well as the feeling of a capacity to overcome formidable obstacles. He is only thereby adapted to follow the orders of established custom or authority, and he has for ages done so. Hinduism supplies such men with a satisfying explanation of why they must do what they do. Their present leaders, however, have lost the belief that they deserve their present lot, and, once that belief permeates these masses, they will move destructively because their compulsory standard of nutrition is too low for construction.

It therefore appears to me that the climatic conditions of India unfit it for democracy. It is fitted, in fact, for Hinduism, or some similar social system. At the same time I would point out that

austerity unfits men to show that initiative and enterprise which rulers should possess. Austerity should, in fact be a bar to office. If, in addition to property qualifications, aspirants to municipal honours had to show that their metabolic turnover was high enough to give them the urge to expend energy on some form of athletics, suspensions of municipalities would become things of the past. They would then be manned by men who would neither find the collection of dues to be too formidable to tackle, nor the digging involved in proper drainage.

It seems to me, then, that Nietzsche's doctrine of a *herrenvolk* and a *heerden-volk* is a Germanised version of what has been practised for centuries in India as caste. The idea may, of course, have been an independent creation of Nietzsche's mind, yet, here in India, in my opinion, it is in practice. And when I point that out, I have no idea of condemnation in doing so. The caste system has survived in India because it is suited to local conditions.

Once the influence of metabolic turnover on modes of thought has been grasped, the history of India can appear as a succession of invasions by men of higher turnover. Natural selection then determined that the surviving descendants of each wave should be those of a turnover adapted to the climate, i.e., men who could live through the hot weather in relative comfort without a fan. Such a turnover adapted them for being conquered by a fresh wave of men of higher turnover. The present Pathans are

probably a restless race, not because of poverty, but because they have a high turnover. Poverty with low turnover makes men listless and apathetic, only with a high turnover can they become restless. Nations, like armies, march and obtain the will to go forward through their stomachs. For the vast majority of Indians that will must be lacking because the standard of nutrition must be one which enables them to work the fan, and not to go forward. And the man, who has not the capacity to go forward is a bad workman for the job should circumstances place him where progress is. He will therefore not only tend to blame his tools, but also see imaginary bogeys on his path.

