Consumption and How to Prevent it.

Alex Hrdlicka

CONSUMPTION

AND

HOW TO PREVENT IT

BY

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CONSUMPTION.

CHAPTER I.

INTRODUCTION.

It is a patent fact that consumption is more destructive to human life than any other disease. Its doleful and seemingly endless march sweeps many thousands of victims to an untimely grave, yet, the perfect indifference and complacency with which we view its enormity is a surprising spectacle. The sudden ravages of yellow fever strike mortal terror into every human breast, and for the time being become the absorbing theme of the pulpit, the press, and the fireside; while millions upon millions are magnanimously poured out for the purpose of alleviating and assuaging the misery of the sufferers. But when we come to realize the fact that on the whole the fatality of this disease is far less than that of consumption, it is indeed astonishing to find that the latter scarcely receives a passing comment, much less serious notice, except from some wary

philanthropic sanitarian, who "cries out in the wilderness." For the number of deaths from yellow fever in this country for the year 1878 (which will hardly reach 20,000), when compared with the mortality of consumption, which amounted to 69,896 deaths in 1870, (and we have no reason to believe that the number is any less, rather more, this year), will show that about five times more individuals died of consumption than of yellow fever, notwithstanding that this was a very prolific year for the latter disease.

It is a very hard matter, perhaps, to account for the extreme apathy which is manifested towards the prevention of consumption, unless it is ignorance of the true nature and character of the disease, and the widespread and deeply rooted belief that, sooner or later, it is fatal to every person who is tainted by its influence. Individuals, and indeed whole families, are firmly imbued with the conviction that they are doomed to become the victims of this terrible destroyer, then give up all hope and needlessly perish. Is this not suicidal? Physicians, at least up to a very recent period, have in a great measure been unable to lessen the mortality of this formidable disease, which to a certain extent, assists in giving color to the notion that all efforts to mitigate it are futile. Medical science, however, is not so much at fault here as are those who labor under the effects

of the disease. Very often it is by expecting the impossible from medicine that causes a decline of faith in its efficacy; and in that stage of consumption in which valuable remedial aid can be rendered, the victim fails to take advantage of his opportunity and thus imperils his life to a great extent. He is thus letting the golden moment slip by, and when he is aroused to a true sense of his dangerous situation he may be beyond the limit of human aid.

That consumption is preventable is a reasonable as well as a practicable idea, and in spite of the ignorance which is displayed by the popular mind on this subject, there exists a growing feeling that such an end can be accomplished by proper precautionary measures. As evidence of this I can say that I have received many assurances from members of different consumptive families, who believe that they have been instrumental in preventing it in themselves as well as in their offspring. And I have no reason to doubt the perfect truth of this. On this subject an illustrious lay writer * has recently expressed his views on the preventability of consumption, under the title of *Thin Living and Thick Dying*, in the following words: "If any reader of this article will take General Walker's Statistical Atlas, based on the results of the Ninth Census, and turn to the

* Dr. Holland in *Scribner's Monthly*, July, 1878, p. 430.

page which represents the mortality from consumption, he will be startled to see that, over an immense area of the Northern American Territory, one-fifth of all the deaths that occur are in consequence of this fell disease. The whole of Maine and New Hampshire, the most of Vermont, Massachusetts, and Connecticut, and all of Northern New York, show that two thousand out of every ten thousand who die, owe their death to consumption; while, in very much larger areas about the great lakes, the deaths from this disease range from one thousand four hundred to two thousand in every ten thousand. If Asiatic cholera were to claim in these unfortunate regions, in a single year, as many victims as consumption does, it would be regarded as a terrible epidemic,—perhaps, as an awful visitation from heaven.

"It would be a great benefit to New England, and all the regions associated with her in this sad scourge, to know how far the dangers of their inhospitable climate can be avoided by a change in diet and regimen. Our own opinion is that consumption can be driven from New England in three generations. * * * If our physicians could only be paid for preventing disease, and could be permitted to prescribe for each family its way of living, there would be but little difficulty in routing from its stronghold that most fatal and persistent enemy of human life, which we call consumption."

Leaving it an open question as to whether knowledge is the panacea for all the evils to which flesh is heir, one thing is firmly established in my mind, and that is that before the people are in a condition to escape and avoid consumption, they must first possess a general knowledge of the laws which produce, maintain and prevent this disease, and hence these pages will be devoted to a consideration of these laws.

CHAPTER II.

GENERAL PHYSIOLOGICAL PRINCIPLES.

To obtain a clear conception of the means and methods which are essential for the prevention of consumption, it is necessary first to study and become acquainted with some of the most important principles of action which pervade the body in health, as well as with those in the disease which we have under discussion; hence the present chapter will briefly treat of the general laws of health, and the succeeding one of that morbid condition which is peculiar to consumption.

It is now a well established fact in physiology that in many respects the animal body bears a striking resemblance to any ordinary machine. It contains a material structure, the sole aim of which is the performance of work: so a machine is likewise composed of matter arranged in the most advantageous manner for the same purpose. The only dissimilarity between the two is that the body re-

pairs its own structure, while a machine does not and cannot. This analogy becomes clearer, perhaps, by using a particular machine as an illustration. The steam-engine, for example, is chiefly composed of iron, with all its parts arranged in such a manner that it can transform the greatest possible quantity of molecular motion into mechanical motion. The intense chemical affinity which exists between the molecules of carbon and hydrogen in the coal on the one hand, and those of atmospheric oxygen on the other, causes them to clash together with tremendous force, and in this way they generate a certain amount of heat-motion, which is transmitted to the molecules of water in the boiler. These expand and tend to occupy more space, and by so expanding they produce pressure on the piston which is attached to the fly wheel and set the latter in motion. Thus by the aid of machinery, we see that it is possible to derive mechanical motion from molecular motion.

The structure of the animal frame consists of nerves, muscles, blood, blood-vessels, bone, cartilage, etc. The nerves, muscles, blood, etc., are principally composed of albuminous or nitrogenous principles, while bone, cartilage, etc., are made up chiefly of inorganic principles, such as lime, soda, etc. Fat and water also enter very largely into the composition of the body, and although the former is one of

its essential elements, it can hardly be called anything else than a deposit. This then comprises the structure of the bodily machine, but to set this machine in motion, another factor is requisite, and that is *force*. This is mainly supplied in the form of substances altogether different and distinct from the albuminous and inorganic substances, which are called non-nitrogenous, because they contain little or no nitrogen. Between those substances which supply material for the structure of the body, and those which supply its moving power, there is then a marked chemical difference. The former chiefly contain nitrogen, except those of inorganic origin, while the latter contain mostly carbon and hydrogen. Now all these essential elements are conveyed to the body through the food, and we shall in the future know them under the name of nitrogenous, non-nitrogenous and inorganic foods.

Now the muscular system, which is the most extensive structure in the body, is, like the water in the steam boiler, capable of changing the molecular motion resulting from the combustion of the carbon and hydrogen of the food on the one hand, and the oxygen of the air on the other, into massive motion. As, for example, if a muscle contracts, one end of which is inserted into the upper arm and the other into the forearm, it at once changes the relative position of the bones, and thus bends the arm at

the elbow, or, in other words, produces massive or mechanical motion. The muscle in contracting performs work, and hence must expend force, and this force chiefly emanates from the oxidation of the non-nitrogenous foods. The bones then bear the same relation to the body as does the piston to the engine, mere levers by which the muscles are able to change the position of the body, or of parts of it. Not all the muscles, however, are inserted into bones, and used for the purpose of moving them, but the blood-vessels, the bowels, and many other hollow organs, are invested with muscular walls, for the purpose of diminishing and enlarging their calibre. The nervous system, which is the most important structure of the body, is composed of ganglions or cells, and threads or fibres, and it is designed to regulate and control every other structure in the body. The nerve fibres, which pervade every part of the body, constitute a system of telegraph wires, through which the brain and other important nerve centres are brought into intimate relation with the whole body. Now the nervous system bears the same relation to the muscles as does the lever of the engine to the force which is latent in the boiler, or that of the trigger to the force of the powder in the gun. It does not generate the force which the body expends, as was formerly believed, but merely liberates that which already exists. As, for ex-

ample, a nerve which is supplied to a muscle, upon being stimulated will only be capable of discharging the force in the muscle, and such a discharge or liberation of force will cause the muscle to contract. If such a contraction takes place in a muscle, the ends of which are inserted into bones, it will cause, as we have seen, a bending of the limb, and if it surrounds a blood-vessel or intestine, it will diminish or lessen the capacity of these organs.

The mouth, stomach, liver, pancreas, bowels, which principally serve to prepare the food for ready absorption by the blood; the lungs, which are the organs for the taking in of oxygen and the throwing off of carbonic acid; the kidneys, which eject a large amount of refuse matter; and the skin, which is an excretory as well as a breathing organ; all have an important bearing on the subject which we have under consideration.

CHAPTER III.

GENERAL NATURE OF CONSUMPTION.

WITHOUT entering into a discussion of the intimate nature of consumption, one thing is certain, that above all other diseases it is one which is characterized by preceding weakness in one or both lungs, very frequently associated with a feebleness of the whole body, and it is enough for my purpose if I succeed in impressing the reader with a knowledge of the tendency and general causes of the disease, so that the measures which are necessary for its prevention can be intelligently applied.

Consumption is either inherited or acquired. The influence of inheritance is currently believed to be the sole cause of consumption, but statistics, both from hospital and private practice, show that while this is true in the majority of cases, it is not absolutely true in all. The influence of these two factors, although they eventually lead to similar morbid results in the lungs, have such a peculiar mode of operation, and therefore it is necessary to give them

separate attention, and so I will at once proceed to consider the nature of that variety of the disease, or the tendency thereto, which is produced by hereditary agency.

Many persons are laboring under that constitutional state commonly known as scrofula, which is marked by general debility. They are very apt to catch cold from the least exposure, are prone to sore throat, with, perhaps, permanent enlargement of the tonsils, swelling of the exterior glands or *kernels* in the neck, and are liable to suffer from cough and inflammation of the lungs. The debility is not so prominent as to disable them from performing ordinary physical or mental labor, nay, often their mental powers are augmented, yet when they are brought into physical contest with individuals not so predisposed, their strength is almost invariably found to be inferior. This is true from infancy, although it manifests itself more decidedly towards puberty, and manhood and womanhood. Such children have not received sufficient vital stamina from their parents, and hence they are always unequal to cope with their stronger neighbors in the severe struggle for existence. This is well attested by the fact that the greatest number of persons die from consumption between the ages of twenty and thirty years: just the period when the most rigid duties and demands begin to crowd them-

selves upon a life, whose capital, both in matter and force, could hardly stem its own tide, and probably was on a decline before. Persons of this stamp generally make a slow and tedious recovery from any incidental severe sickness, and oftentimes retain a vestige of the disease. This is especially true of the inflammatory diseases of the chest, like pneumonia, bronchitis, etc., which invariably leave the lungs in an enfeebled state, and thus gradually prepare them for the advent of consumption.

Every organ in the body seems, or has a tendency to share in this general infirmity which usually brings on a multiplicity of complications. This is especially true of the digestive organs, for a weak stomach and bowels often give rise to indigestion, if not to actual dyspepsia, and to constipation; deficient secretion of the pancreas or sweet-bread, the action of which, together with the bile, is principally confined to the preparation of fats and oils for absorption, entails an aversion to fatty foods. The fact that there are a great many persons who carefully eschew all manner of fat from their diet, even from their very childhood, is too well known to require any special notice here. This, indeed, forms such a prominent feature in the history of those who are predisposed to consumption that it has led some very eminent medical men to believe that this disease is wholly due to deficient pancreatic secretion. But whatever

influence such a want of secretion on the part of this organ may have in bringing about consumption, and no doubt it is important, it cannot be said to contribute more than its proportionate share to this predisposition.

This imperfect digestion of fat therefore greatly interferes with that full and regular supply of force which is so essential in maintaining the working condition of the body, and the stored up fat in the body is seized upon and utilized for this purpose. It is evident, however, that such a state cannot remain compatible with health, at least not for a very long time; for if the income of fat is diminished, and its consumption even the same as before, the store of fat will sooner or later become totally exhausted. Now loss of weight, which is chiefly a loss of fat, is one of the incipient signs of consumption.

But loss of force is not the only detrimental effect which follows a diminished fat supply, for fat is an essential ingredient in the composition of muscles, and so besides sustaining a loss of motive power they are at the same time also deprived of a structural element, and hence the increased muscular weakness which is so common in this disease. The heart, which is wholly a muscular organ, likewise depends upon the same source for a part of its structure, and for its motive power, also becomes embarrassed in its functions, and consequently

there is always found an impaired circulation of the blood.

Again the nervous system also shows signs of increasing debility. This manifests itself the earliest, perhaps, in those nerves called the *vaso-motor* nerves, which, as we have seen, acccompany and regulate the size of each and every artery in the whole body. The weakness of these nerves will suffer a disturbance in the balance which exists between them, and the blood-pressure in these vessels, and hence the blood-vessels become unsteady in their calibre. The slightest changes in the external temperature will greatly derange the circulation under such circumstances, and produce a feeling of cold at one time, and a hot and flushed sensation at another. This cause, in combination with that of feeble heart-power, gives rise to coldness of the extremities, as well as to that chilliness which those liable to consumption so frequently experience. A continued weakness of this portion of the nervous system will also, especially during the night when the ordinary stimuli of the day are withdrawn, relax the walls of the blood-vessels to such an extent that they allow the water of the blood to pass through them, which appears on the surface of the body in the form of sweat. This is commonly called "night sweats" and is almost constantly associated with such a depressed condition of health.

I have already said that consumption may be acquired as well as inherited, and I shall now briefly consider the possible causes of this form of the disease. This is usually induced by repeated inflammatory attacks, of one, or both lungs, or parts of them. There cannot be the least doubt that a lung after a siege of bronchitis, or pneumonia, is left in a weaker state than it was before, even in a person who does not possess any inherent tendency to consumption, and this too after every trace of the inflammation has apparently entirely disappeared. Repeated attacks of such a nature will eventually enfeeble the resisting power of the lungs to such a degree that they readily fall a prey to actual consumption.

The hereditary as well as the acquired weakness of the lungs then, will sooner or later, if unchecked, result in a peculiar deterioration of the structure of these organs, which is known as pulmonary consumption. This is no more nor less than a low and miserable variety of inflammation, with its manifold complications—an inflammation in which the recuperative power of the lungs is entirely gone, and hence they are destined to undergo premature dissolution and death.

I have thus far shown that the tendency to consumption is a state of general and special weakness; how this weakness is shared by all the organs of the

body, manifestly so by the organs of digestion, and by the nervous system; how the weakness of the stomach leads to dyspepsia; how the inefficiency of the pancreas brings on indigestion of the fatty foods; how, owing to the exclusion of the fatty foods from the body, its stored up fat is consumed in carrying on the functions of the body; how the muscular system and the heart suffer on account of the absence of this kind of food; how the nervous system, especially those nerves which preside over the blood-vessels become reduced in efficiency and thus become the indirect cause of chills and night sweats; and now in the succeeding chapters I propose to consider those influences which tend to modify and check such a tendency.

CHAPTER IV.

INFLUENCE OF FOODS.

OF all the agents which sustain the integrity of the body there are none that hold a higher place than foods. We have already learned that the foods supply all the materials which are necessary for the growth and repair of the body, as well as the force which is necessary to keep it in motion, Now while the former class, the nitrogenous and inorganic foods are indispensable to all living tissues, it is, after all, the force-producing foods which sustain the most exalted relation to the subject under consideration; for scrofula, or the predisposition to pulmonary consumption is essentially a condition in which the forces of the body begin to be squandered before the matter of the body, and hence it is imperative that these should be early and abundantly supplied.

The force-value of our foods has been actually measured, and we have thus presented to us at a glance the superiority of one food over another as a force-producer. This is accomplished by the fol-

lowing method: The mechanical value of heat which is developed in burning or oxidizing a substance has been accurately determined by Mr. Joule of Manchester, England, who discovered that the amount of heat which is required to raise one pound of water one degree Fahrenheit, will, under other circumstances, raise a one pound weight to the elevation of 772 feet, or what is the same thing, 772 pounds one foot high. He also proved the converse of this to be true, that 772 pounds falling the distance of one foot, or one pound falling the distance of 772 feet, will generate heat sufficient to raise one pound of water one degree Fahrenheit, and 772 foot-pounds is therefore called the mechanical equivalent of a unit of heat. From this important discovery the force-producing value of our most important foods has been correctly estimated by Prof. Frankland, as will be seen from the following table, in which the force value of one ounce of each substance is given in foot-tons. Thus, the force-producing value of one ounce of beef-fat (see table) when oxidized within the body is 351 foot-tons, *i. e.* the oxidation of one ounce of beef-fat will give rise to heat sufficient to raise 351 tons one foot high, or one ton 351 feet high; that of one ounce of butter is equivalent to 280.9 foot-tons, &c.

TABLE.*

Name of Substance.	Foot-tons of Energy in one oz. of each Substance
Cod Liver Oil,	353.7
Beef Fat,	351.
Butter,	280.9
Cheese,	168.5
Oatmeal,	152.
Flour,	148.5
Arrowroot,	151.3
Ground Rice,	145.3
Starch,	135.00
Yolk of Egg,	127.
Lump-Sugar,	129.5
Lean Ham (Boiled),	64.9
Lean Beef,	55.
Lean Veal,	45.3
Potatoes,	38.5
White of Egg,	22.3
Milk,	24.3

Now it is estimated that the human body at ordinary labor and in a moderate climate expends about 2,800 foot-tons of energy during twenty-four hours, which is chiefly derived from the combustion of non-nitrogenous foods. From the above table we are at once able to see which articles of diet are best calculated to supply this enormous expenditure of energy. Beef-fat, with the exception of cod-liver oil, stands at the head of the list, butter comes next, then cheese, while lean beef, ham and veal

* In the original table of Frankland's, the force-value of each food is given in kilogrametres of force, but for the sake of convenience I reduced each to its equivalent in foot-tons.—*Author.*

almost stand at the foot of the list as force-producers. There is also a marked difference in the force-producing capacity between the white and the yolk of the egg. Of course the force-producing value of our foods does not alone determine their full worth to the body, for we have already learned that the latter also requires food that will renew and build up its structures—food which contains the elements of bone, of muscle, of blood, of nerve, etc.; hence in a table of the comparative nutritive or building value of our foods, lean beef would stand at the head, and cod-liver oil, and beef-fat would be next to worthless by themselves. This shows us that neither class can supplant the place of the other.

These 2,800 foot-tons of energy are mainly consumed by the body in carrying on the functions of the brain and nerves, of the heart and blood-vessels, of the lungs, of the stomach and bowels, of the myriads of glands, in maintaining the bodily temperature and in performing muscular or manual labor. Now the tendency to weakness in those who are predisposed to consumption is mostly due to the fact that the body does not possess a sufficient amount of force wherewith to uphold these functions or processes in a normal way; and hence we see the immense importance which foods play in contributing the necessary elements under such circumstances.

CHAPTER V.

INFLUENCE OF AIR.

AIR is as essential to life as food. In fact life can be continued for a number of days without any food; while a total exclusion of air from the body for a few minutes only will suffice to arrest its vital machinery. This, although a popular comparison between the relative value of food and of air, is obviously defective and unfair, for the air immediately on its entrance into the body is applied to its allotted duty, and therefore none is stored up. On the other hand the body requires some time in the preparation of the food before it is fitted for its final destination, and hence there is always some reserve material on hand. Even after this store is absolutely exhausted it is well known that the body is capable of consuming its own tissues for sustenance; therefore it is evident that were the total supply of food as abruptly cut off as in the case of air, the body would likewise come to a sudden standstill. The most essential part of the air is the oxygen

which constitutes about one-fifth of its bulk. I have already stated that before the non-nitrogenous foods can manifest their latent energy they must combine with oxygen, which enters the body through the lungs. Now in this work of oxidation or combustion, beside preparing the useless material in the body for various ends, about thirty ounces of oxygen are consumed by an adult during every twenty-four hours. The chemical union in the body between the oxygen on the one hand, and the carbon and the hydrogen of the non-nitrogenous foods on the other, results in the production of carbonic acid and watery vapor which are chiefly thrown off by the lungs.

The bad effect of impure air, or air deficient in oxygen on those who are inclined to become consumptive has been proven to be very great. Although no place or climate in the world is totally free from this disease, there is yet a marked difference in regard to its degree of prevalence in various localities. Places in which is found a pure and dry atmosphere bear a very favorable contrast in this respect to those where the air is less pure and more humid. This comparative exemption not only holds true as far as the masses are concerned, but also of individuals who even reside in the same locality, provided there are present different climatic or atmospheric conditions. Thus, if other things are the

same, those individuals who breathe the purest air are less liable to this disease than those who are deprived of this privilege and duty.

Continued breathing in a limited atmosphere will exhaust all its life-giving properties. This, as we have already seen, is due to a diminution of its oxygen, and at the same time saturating it with carbonic acid, water, and other exhalations. Hammond found that a mouse in a closely confined space was able to live only forty-five minutes. Two hundred and sixty out of the three hundred Austrian prisoners, who were confined in the "Black Hole" at Calcutta, only lived eight hours. Whatever the deleterious effects of carbonic acid and other bodily exhalations may be on the function of breathing, and undoubtedly they are weighty, I am convinced that heretofore physicians have fallen into the manifest error of attributing too much to the supposed influence of these poisons, and have, in a great measure, lost sight of the most important factor in the problem, viz: the deficient supply of oxygen. For it has been proven by experiment that animals can live in an atmosphere rich in carbonic acid, provided they receive a requisite supply of oxygen at the same time. And again we know that carbonic acid is an essential ingredient of the blood in its healthy state, and hence its effects cannot be so exceedingly fatal as we are accustomed to assume. On

the other hand it is beyond the power of any person to account for all the morbid effects which the body sustains from breathing an unhealthful atmosphere on the score of carbonic acid poisoning, or that of other bodily exhalations; for such effects (as I shall endeavor to show) bear no legitimate relation whatever to the poisonous influence of these latter agents.

The great importance of foods in relation to life has been discussed in the preceding chapter, and I have also stated in the beginning of the present chapter that oxygen is as essential as food in this respect. Oxygen not only forms an indispensable part of every organ in the body, but its separate presence is also necessary to insure bodily action. The chemical union between it, and the carbon and hydrogen of the food, gives rise to energy, and the latter on the one hand supplies the body with power to perform its functions, and on the other hand with heat to keep up its normal temperature. We can thus readily perceive that a deficient amount of this vital gas must necessarily entail great inconvenience and injury on the body, and the reason becomes intelligible to us why such persons "soon become pale and partially lose their appetite, and after a time decline in muscular strength and spirits." Why "the aëration and nutrition of the blood seem to be interfered with," and why "the general tone of the

system falls below par." * * * * And why "such persons do appear to furnish a most undue percentage of phthisical (consumptive) cases*"

Such is but the inevitable result, for if bad or insufficient food is so potent in enfeebling the body, and thus aggravating the tendency to consumption, surely a deficient supply of oxygen will bring about a similar state of things, for food and air are of equal importance to life.

The air, then, is consumed by the body, its oxygen is exhausted, and in place of this it receives the bodily exhalations; hence in order to keep the air in a pure and healthy condition, it becomes necessary to keep it in constant motion—to allow the fresh air to come in contact with the body, and abduct the foul air from it—and this leads me to the significant subject of ventilation. It is estimated that each adult person requires about 3,000 cubic feet of fresh air per hour. This amount is readily secured in the open air where the latter is in perpetual motion, and it is also a comparative easy matter to thoroughly ventilate a house during the summer season, when the doors and windows remain open most of the time; but in winter, when these inlets and outlets are closed up, ventilation becomes a question of great difficulty.

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*The whole quotation is from Parker's "Practical Hygiene," p. 122.

In order, therefore, to supply 3,000 cubic feet of fresh air to an adult person occupying a room twelve feet square and ten feet in height, it is necessary to change the whole volume of air in the room twice in one hour; for two persons inhabiting the same room, four times in the same time, and so on. This, in most instances, is accomplished by heating the air in the room, and thus making it lighter. The unequal pressure produced in this way between the air in the room and that on the outside, causes the outer air to flow into the room through properly provided inlets, and forces the warmer and useless air out of the room through places of egress.

It is not alone for the purpose of ventilation that the air of an apartment must needs be warmed, but warmed air is also of great value in preserving the healthy temperature of the body. The body in a healthy and comfortable condition is nearly always higher in temperature than the surrounding medium of air, hence there is a constant loss of heat from its surface. If this heat-loss should become too great, on account of the depressed atmospheric temperature, it is obvious that the body will suffer to a very marked degree. It is for this reason that the ventilation and warming of houses are so intimately connected, and that it is impossible to consider one without the other.

Again, in order to have good and healthful venti-

lation in a room or in a dwelling, it is essential to introduce the air in such a manner that no perceptible draught be produced. By not properly guarding against a too rapid flow of air through an apartment, the air in it grows cold, and exposes the occupants to a source of "colds." Especially is this precaution of great value to those who are liable to consumption, for, as already stated, such persons are extremely susceptible to the slightest changes in the surrounding temperature.

For the complete ventilation of a dwelling then, pure air must be admitted from the outside in such a manner as to cause no perceptible draught, be warm, and made to escape. Whenever the air cannot be warmed previous to its ingress, it ought not by any means to be let in near the floor. If this were done, the cold air, by virtue of its greater weight, would remain near the floor, and by being thus unequally distributed would expose different portions of the body to an uneven temperature, and be a prolific source of evil. When properly admitted above, it diffuses over the room, descends to the floor, becomes warmed, and breathed rises again, and makes its exit at the appointed place. My remarks here pertain rather to the ventilation of dwelling houses than to that of public buildings, where many varied artificial contrivances are necessary for this purpose. Where no special facilities exist for

ventilation, as is the case with most of the dwellings constructed at present, the best plan for purifying the air is by lowering the windows from the top. To distribute the air efficiently througout a room a light board, or strip of zinc, should be fastened along the whole length of the upper sash in an oblique position, which will conduct the air upwards, cause it to strike the ceiling, spread and grow warm, partially at least, before it falls on the inmates. Under these circumstances, the lowered top window will also answer for a reasonably good outlet for the foul air. Of course it is assumed here that the ordinary coal or wood stove is employed for heating.

It is beyond dispute that the open fire place, or the old-fashioned fire-hearth is by far superior to any other mode of ventilation and warming. The cold air being admitted in the upper part of the room, either through lowered windows, arranged in the manner indicated above, or through other appliances such as cold air tubes, etc., is warmed, heated and taken up the chimney by the draught created by the fire. In this way as long as the fire is kept up good, thorough ventilation as well as good warming can always be assured. Stoves are now manufactured with open grates, which in a great measure answer the purpose of a low grate fire, where the latter cannot be secured.

Another very common mode of ventilating and warming houses consists in heating the air by means of a furnace before its admission into the building. The air should be obtained pure and uncontaminated from the outside. Very frequently, however, no better air is supplied than that afforded by the cellar in which the furnace is stationed. Now cellar air is not the most healthful air in the world for this purpose; for, besides being unexposed to the vivifying influence of sun-light, it is liable to contain germs of poison which are given off by the animal and vegetable matter usually stored within its walls. Even when the air is taken from the outside great care is needful to obtain it from a source which is undefiled by emanations from sewers, drain pipes, or from undrained surfaces. Means of egress for the foul air thus warmed should be provided near or at the ceiling.

Again it is of primary importance that the air should have its moisture restored which it loses through the process of heating. For if the air is introduced too dry it absorbs the moisture of the mouth, throat and lungs, irritates those organs and predisposes them to inflammation. To obviate this the air after being heated must be exposed to a reservoir of water provided in the furnace, which supplies the requisite amount of moisture. Whenever this provision is not made, a pan or shallow

vessel of water should invariably be placed on or near the register.

The temperature of a room ought to range from 60 to 70 degrees Fahrenheit, according to the comfort and feelings of the occupants.

CHAPTER VI.

INFLUENCE OF SOILS.

THE soil not only produces the food of man, but also exerts an enduring influence on his health. The form of the surface, the nature of its composition, the character and inclination of the underlying rocks, are all elements of vast importance in determining the welfare or misery of mankind. Soil-dampness is now proven to be one of the most prolific causes of disease, and especially of that malady which we have under consideration. Dr. Henry I. Bowditch in his excellent paper on *The chief causes of consumption in New England*, illustrates most forcibly the close connection between consumption and soil-dampness, and its comparative absence where the air is more free from moisture. The facts which he has collected in proof of this point are many; but, perhaps, the most noted example is that of the town of Greenland, New Hampshire, which contains about seven hundred and twenty residents, very nearly equally divided, according to the nature

of the soil, into three districts. The first is a high, dry and sandy soil; the second is more moist, and the third is composed of low marshes. During a period of ten years three persons died of consumption in the first, five in the second, and ten in the third district. Prof. Parkes* in commenting on the connection between diseases and soil-moisture, uses the following language: "In some way which is not clear, a moist soil produces an unfavorable effect on the lungs; at least in a number of English towns, which have been sewered, and in which the ground has been rendered much dryer, Buchanan has shown that there has been a diminution in the number of deaths from phthisis (consumption). Dr. Bowditch of Boston (U. S.), and Dr. Middleton of Salisbury, noticed the same fact some years ago. Buchanan's evidence is very strong as to the fact of the connection, but the nature of the link between the two conditions of drying of soil and lessening of certain pulmonary diseases is unknown. It is curious how counter the observations run to the old and erroneous view, that in malarious—and therefore wet—places there is less phthisis (consumption)." Now since air- and soil-moisture are such fruitful sources of consumption it may well repay us to inquire into the mode of action of these causes in pro-

* "Practical Hygiene," p. 331.

ducing consumption, and if the effort to establish the exact relation, or "the nature of the link" between the cause and effect in this case is successful it is certain that the necessary protective measures can be intelligently, if not more effectually applied.

Atmospheric air is not confined above the surface of the earth, but it extends deep into its structure, where it becomes soil air. In this condition it is very rich in carbonic acid, and poor in oxygen. Nearly all rocks contain air, some as high as thirty per cent., and loose soil as much as six times its own volume. This underground air is in a continual upward circulation, which is determined by the daily changes of temperature, amount of rainfall, etc.

The soil likewise contains a large amount of water, which exists as soil-moisture and soil-water—the moisture occupies the upper strata of soil, and is really nothing but a sort of evaporation of the underlying water. Same as in the case of soil-air, the surface-heat, winds, etc., facilitate its ascension to the surface. The level of the soil-water varies from complete exposure at the surface down to many hundred feet at different points. This depends upon the amount of rain, permeability of the soil, etc., and whenever it rises it displaces and forces out the superincumbent air. Almost all soils also contain a certain amount of animal and vegetable matter.

Thus we find in the soil moist air loaded with car-

bonic acid, watery vapour, or, at least, water in a very fine state of division, animal and vegetable matter. We have also observed that the heat of the sun, winds and rain, have the power of bringing these substances out of the soil upon the earth's surface, and thus cause them to intermix with the atmospheric air. From the constant operation of at least one, and at times, and in some places, all three of these agents, we must at once conclude that soil-exhalation is going on more or less all the time.

On investigation I think the reason will appear why these various agents of the soil have such a telling influence on health and life. In the first place it is essential for the body, in order to possess full and unimpeded activity, to throw off a large amount of foul and used-up material through the lungs and skin. Especially is this true of the latter organ, for when the skin is coated over with some impervious substance, death takes place in a very short time. Death under such circumstances is, no doubt, on the one hand, due to the fact that the material which ought to be thrown off is retained in the blood, and becomes a source of poisoning; and, on the other, by abolishing the function of skin-breathing. It is well proven that the blood absorbs some oxygen from the air, and discharges some carbonic acid through the skin. The amount of ex-

cretion from the latter organ alone amounts to nearly two pounds in twenty-four hours, and consists of carbonic acid, watery vapor, and animal refuse. Now the quantity of matter excreted, as well as the velocity with which it passes through the skin in a given time is, if other things are the same, in exact proportion to the amount of resistance which must be overcome on the outside of the body; that is, if the outside pressure is small in comparison to that on the inside of the skin, its passage is rapid, and if this difference is less marked, it is diminished. And it is a noted fact that moisture causes a heaviness of the air, which exerts a greater pressure on the outside of the body than air without moisture, and thus becomes a direct obstruction to the lungs and skin in the discharge of their respective duties. The truth of this is well exemplified in the invalid whose feeble functions are still further depressed by a close and damp atmosphere, and invigorated by an opposite condition. This difference of feeling is to a greater or less degree experienced by the hale and hearty, and even animals, as every horseman well knows, cannot perform as much work in sultry as in fair weather.

In the second place the body suffers greater injury when the moisture is cold, than it does from simple moisture alone. This effect upon the body is of a different nature from the foregoing, and is

brought about in the following manner: The body, in order to maintain its functions in a healthy state, must absolutely possess a uniform standard of temperature (about 99½ degrees of Fahrenheit's thermometer). Now moisture, which is nothing else than finely divided water, at any rate is a great absorber of heat, and if from any cause it becomes cool, this property of absorption is intensified, and so it quickly seizes upon the heat of the body, and deprives it of one of its most essential elements. Cold soil-moisture is generally produced in localities which are in a great measure shielded from the rays of the sun, as in swamps, marshes, lowlands, etc., and after it diffuses into the atmosphere above, it renders the latter cold and unhealthful. This difference of atmospheric temperature is very strikingly shown to a person who is travelling over a tract of undulatory country after sunset, and especially if the depressions of the surface are covered wholly or partly with marshes, or contain a stream of water. It will be experienced that the elevations are almost invariably dry and warm, and that the lowlands are cold, damp and disagreeable.

Now the reason that persons who are predisposed to scrofula, are more apt to feel the effects of external cold than others who are stronger, lies in the fact that their heat-producing power is enfeebled to a similar degree with the other bodily functions,

and they are therefore just able to generate that amount of heat which is necessary to carry on the bodily operations, and very little, if any more; hence such individuals can but illy afford to lose much heat, and it is very clear, if they come in contact with a medium like cold damp air which rapidly abstracts the bodily heat, and if such a condition continues for any great length of time, that they must suffer grave injury.

Cold air-moisture may however bring about the feeling of coldness or chilliness in a manner somewhat different from the above. That system of nerves (the vaso-motor) which presides over and regulates the size of the blood-vessels throughout the body, is, as I have already remarked, also in an enervated state, and hence is readily disturbed by changes in the surrounding temperature. For we well know that cold through these nerves has the power of contracting blood-vessels, and since the blood-vessels of the external parts, or surface of the body, are more exposed to changes in atmospheric temperature than those inside, it is evident that the former will readily contract when brought in contact with cold, and drive the blood into the interior parts of the body. The exterior parts of the body are thus without a due supply of blood and heat, which gives rise to a sensation of coldness or chilliness, while the interior of the body contains more than

its complement of blood and heat, and thus, consequently, produces a feeling of internal fever. In a short time the body tends to restore its former balance in the circulation of the blood, but very often, especially if the disturbance has been severe, the blood in distributing itself from the interior to the exterior parts of the body, owing to the feeble restraint offered by the blood-vessels, overbounds its normal limits and engorges the superficial vessels, thereby causing a hot skin which is usually relieved by a process of free and profuse sweating. By exposing the body to excessive changes of atmospheric temperature, we are enabled to perceive how by a series of such oscillations of the blood from the exterior to the interior, then back again, it is possible to produce some such morbid state of the body as "chills and fever.*"

This also makes clear to us how soil-moisture, besides hindering free exhalation, and wasting bodily heat, can produce serious internal disorders by driving the blood from the surface to the inner organs, thus giving rise to engorgement and torpidity of the liver, stomach, bowels and lungs, conditions which are invariably associated with chills and fever.

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* This theory of the production and development of "chills and fever," or fever and ague, through the agency of temperature changes is not new, but has been very ably and logically set forth by Dr. J. R. Black of Newark, Ohio, as far back as 1867. See vol. 18 of *Transactions of American Med. Association.*—Author.

It is manifest, then, that everybody, and especially those persons who are predisposed to consumption, ought to realize the fact that it is impossible to withstand the deleterious influence of such a locality for a very long period, and that one of the most pressing questions with them is, how to avoid these evil causes.

The principal soils which are selected for habitation, in civilized countries at least, are the sandy or gravelly, and the clayey. The former of which is loose and porous, and readily frees itself of excessive moisture by filtration and evaporation, while the latter of which is very dense and compact, prevents the water from soaking through it, and retains it within its meshes for a very long time. It is evident, since most water is derived from rain-fall, that the chief aim in counteracting the production of soil-moisture lies in the first place in endeavoring to limit as far as possible the accumulation of water in the soil, and in the second place in exhausting or diminishing that in the soil. The first of these indications is generally fulfilled by paving the surface, and by conducting the water into streams through well-appointed channels. Paving prevents absorption of water by the soil, and also interferes with the evaporation of moisture. All sloping surfaces naturally drain themselves. The second is accomplished by deep underground channels which lead the water

and moisture to more permeable strata of soil or rock. Sometimes an impervious stratum of soil is underlaid by one of sand, and whenever this is the case, drainage is effected by cutting a number of small perpendicular openings through to the sand stratum, and afterwards filling them up with gravel or sand—thus allowing the water to filter through to the sandy soil below.*

A prolific cause of dampness in dwellings, and one which in a great many instances is wholly unexpected, are cellars. Every precaution must be taken to make them dry: the walls and floor ought to be well paved, and drained with good outlets, or with perpendicular holes sunk into the ground floor, and these filled with sand and gravel.

Rivers and streams, by loading the atmosphere with moisture and by a continuous drainage of its heat, tend to make the regions through which they flow, cold, damp, and unhealthful. Stationary bodies of water, which are store-houses of heat, give out their warmth to their surroundings, and thus have a tendency to equalize the temperature, and produce a more healthful impression.

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* For a more thorough consideration of the important subject of drainage I would refer the reader to the following standard authorities: *Manual of Practical Hygiene*, by E. A. Parkes; *Sanitary Engineering*, by Baldwin Latham.

CHAPTER VII.

INFLUENCE OF CLOTHING.

THE intelligent farmer is well aware that by affording warm shelter to his live stock in winter he not only protects the life and health of his animals from the immediate inclemency of the season, but that he also saves in food by this operation. He knows that in some way he is enabled to feed less hay, oats, and corn by such a wise provision. The cause which renders this economy possible is not very far to seek: for the bodily heat is derived from the food which the animal takes in, and a cold and unprotected stable deprives the body of a greater amount of heat, and of more food in consequence, than one under opposite conditions.

But, in order to make this subject as lucid as possible, let us inquire a little closer into the mode in which a warm stable protects its inmates. Naturally, in a cold climate, there is a constant flow of heat from the body to its environment, and also a constant reflow of cold from the environment to the

body, and certainly if this exchange should be carried to excess the warmth of the animals would become reduced to its lowest limits; hence there must be a check somewhere to the outflow. Now it is well known that air, when locked up, or made to assume an almost stationary condition, is a very poor conductor of heat and cold. Such atmospheric quietude is exactly secured in a stable which is constructed of double or hollow walls, and this space filled in with fine straw or some other loose material. Air closed up in such a manner is warmed by the heat obtained from the animals, and is of course in a constant state of circulation from within outwards, and from without inwards, but by this arrangement the motion of the air is restricted to such a velocity that the animal does not lose enough heat to make it feel uncomfortable, or make the cold perceptible.

We are already aware that it is of primary importance for the body to be constantly immersed in air so that the abundant exhalation which is given off by the skin may be carried off, and that the aëration of the blood which takes place through this organ may be readily effected. Air in contact with the body, for even a short time, becomes warm, ascends, and is supplemented by cooler air, and as long as the temperature of the environment is very nearly the same as that of the body, the latter does not suffer much inconvenience; but if the external tem-

perature is depressed a great deal, it is evident that the influx of cold air which is brought about in this way, would soon divest the body of all its necessary warmth. Now just precisely that relation which the warm stable bears to the horse, our clothing bears to the body. Clothing is but the medium which tempers and regulates the cold air in such a manner as not to produce a sensible impression on our bodies when it lights upon them. The space between the horse and the walls of the stable, in a rough way, represents that between the skin and the clothing, and the double wall represents the clothing itself. The reason that woolen clothing affords more protection against cold than any other material is because it is loose in texture, and consequently embodies a large amount of air which, as we have seen, is a bad conductor both of heat and of cold. The cold air from the outside, as soon as it enters the garment is tangled and hemmed in on every side by the innumerable meshes of the latter, and in this way the rapidity of its inward motion is reduced to a minimum, which gives sufficient time to the body to elevate it to a temperature like its own.

The slowness or rapidity with which the various articles of clothing conduct heat, depend altogether upon the looseness or density of the fibres of which its texture is composed; or, in other words, upon the amount of air which they are capable of contain-

ing. This is well shown in wadding, or even in woollen clothing itself, for when these materials become compressed from wear and age, or from other causes, their capacity for retaining air is diminished to a marked degree, and it is also well known that in the latter state they are less fitted to resist the influence of cold on the body than in the former. Cotton, linen, and silk are more compact and contain less air than wool, and consequently are not so well adapted for conserving the heat of the body as the latter Prof. Hammond has tested the heat-conducting power of some clothing materials with the following results: He employed a vessel and noted the length of time which it required to cool from 150° Fahr. to 140° Fahr.

	MIN.	SEC.
Vessel uncovered . .	15	11
" covered with cotton shirting,	9	42
" " " linen "	7	24
" " " white flannel,	12	35
" " " dark blue woolen cloth, .	14	5
" " " light blue woolen cloth, .	13	50

From these experiments it appears that not only are woolen materials superior to cotton and linen as non-conductors of heat, but that even identical materials have different heat-conducting capacity where

their colors vary. Thus dark blue woolen cloth retains the same amount of heat longer than light blue woolen cloth, and white flannel, which is also composed of wool, is inferior in this respect to the latter. Everyone is familiar with the fact from experience that black is much warmer than light clothing, and all this difference seems to be due to the different heat absorbing power which various colors possess.

Therefore one of the chief uses of clothing is to conserve the warmth of the body in cold climates, and in cold seasons; but there are climates and seasons which are as warm, and at times warmer, than the animal body, and for this reason the same kind of clothing is not adapted to all conditions. Cotton, linen, and silk, all of which transmit heat with great facility, make the most suitable and comfortable clothing in warm weather. It is not, however, my purpose to dwell on the influence of light clothing on the body in mild climates, for I am thoroughly convinced that a greater number of people suffer from the effects of insufficient clothing in cold weather, than from being improperly clad in warm weather; for in the latter case the body has certain powers by which it can recompense itself, while in the former it has none.

Woolen clothing is not only valuable as a conservator of heat under ordinary circumstances, but

it is equally efficacious in guarding the body against too sudden changes of bodily temperature which follow protracted physical exercise. The increased heat, developed during such exercise, transforms a portion of the water of the body into vapor, moisture or perspiration, which, as we are already aware, is a great absorber of heat and thus greatly facilitates the process of cooling. It is evident, however, that when this process is carried on as actively as it is after severe labor, it would soon abstract more heat than the body can afford to lose, but just here the woolen fabric intervenes and asserts its usefulness by absorbing the moisture and re-condensing it into water, and in this way again giving back a part of the heat which was made latent, or consumed in the process of evaporation (for vapor contains more heat than water).

But under certain circumstances this very property of imbibing moisture or water which all woolen goods possess, becomes a source of danger to the wearer, for any substance which takes up moisture also has the power of retaining it, and in this condition woolen clothing instead of preserving the heat of the body as it does when dry, dissipates it. Cotton, silk and linen have less affinity for moisture and hence are not so injurious in this respect; yet all kinds of damp clothing possess a detrimental influence on health and ought to be removed with-

out delay. From this we learn the reason why damp feet are such frequent sources of colds and diseases. A large amount of blood circulates through the feet and when the latter are enveloped in damp and wet clothing they afford a ready means for abstracting the heat of the body as fast as it is carried there by the blood, and in this way produces coldness and chilliness of the whole frame. Not only is it of the highest importance to keep the feet dry, but it is equally necessary that they should be kept warm.

Again, our bed-clothing bears a most remarkable influence on health. Being warmed by the heat of the body in a way similar to ordinary clothing it is plain that the best non-conductor of heat produces the most useful bed clothing in cold weather. Yet, if other things are equal, the same clothing does not protect the body as effectually in the horizontal or lying position as in the upright; for in the former attitude nearly one half of its surface directly establishes a warm air current which leaves the body at a right angle, and in this manner gives free vent to its warmth; while in the latter position a current is produced likewise, but it moves in a line which is in contact with the body, thus surrounding the latter by a warm stratum of air. We must also take into consideration that during sleep all the functions and processes of the body are reduced in activity, and

on this account generate less heat than during the waking hours, hence this is another reason why the body should be thoroughly protected by warm clothing during sleep.

Underclothing should also be worn constantly by such persons in summer and in winter, both for the purpose of retaining the heat of the body and absorbing the perspiration or moisture which is generated during exercise. Without exception this kind of wear should be woolen in cold, and thin wool or cotton and wool, or silk in warm weather. The chest should receive extra attention and protection in very rough and inclement weather. We are now in a position to properly appreciate the immense value of good clothing to those scrofulous individuals who barely have sufficient vitality to manufacture heat enough to carry on the necessary operations of their bodies.

CHAPTER VIII.

INFLUENCE OF LIGHT.

THE action of sunlight is, perhaps, not so distinctly perceptible on animal as it is on vegetable life, yet its influence is no less certain and powerful in the former than in the latter instance. Every one knows, of course, how difficult it is to raise plants in badly lighted apartments, and how quickly they sprout forth under the stimulus, and even follow the motions of the sun; but it is not so well understood that the absence of sunlight restrains the growth and development of the animal body.

Milne Edwards, a noted French physiologist, illustrates this by the following experiments: Frog's eggs were placed in two vessels full of water, one of which was covered all over with black paper, and so protected from the rays of the sun, while the other was freely exposed to light. The eggs in the vessel to which light had unobstructed access developed regularly into tadpoles, while those in the dark ves-

sel gave rise to aborted embryos. He then, in the next place, put tadpoles under similar conditions, and found that they grew into frogs without difficulty, while those in the obscured vessel were either stunted or remained in the same condition. Prof. Hammond, of New York, extended these researches, and discovered that when undeveloped tadpoles in the dark vessel were freely exposed to sunlight they resumed growth and developed into frogs. Pursuing this same subject, the latter celebrated author says:* "Upon another occasion I took two kittens of the same litter, and when they were twenty days old weighed them accurately. One weighed eighteen ounces and the other eighteen ounces and a half. The first was placed in a box to which the light of the sun had free access, the second in a similar box, to the interior of which no light could reach. Both were fed alike, and in all other respects, save as regards the light, were kept in the same condition. At the end of the first five days, number one weighed twenty-two and a half ounces, while number two weighed but twenty and three-quarters ounces. At the end of a second period of five days, number one had attained a weight of twenty-four ounces, while number two scarcely weighed twenty-two ounces. The two animals were now placed together in the

* *Sanitarian*, vol. i, p. 59. This is an excellent monthly journal of health, and ought to find its way into every household.—*Author.*

box which was exposed to the light, and at the end of the third period of five days each weighed within a fraction of twenty-five ounces."

Now, man is a wonderfully complex being, and is surrounded by a multitude of stimulants. The highest structure of his body is the brain and nervous system, and we have many reasons for believing that sunlight is a special stimulant to this structure. This seems obvious, for the eye, through which we receive the greatest number of impressions from the external world, is so closely connected with, and in truth we may say, is a continuation of the nervous system. It is, indeed, held by some of the most distinguished men of the present time that the eye, with all its appendages, was principally generated by the influence of sunlight throughout the different stages of its evolution. This belief is confirmed by the well-known phenomenon that animals which live in total darkness, like the fishes in subterranean lakes, are devoid of eyes, as well as of the optic nerves, or the great nerves of the eyes, which transmit the light from the eyes to the brain in other animals not so conditioned.

Now if, as we have reason to believe, it is true that the nervous connection between the eye, as well as the eye itself, was brought about by the instrumentality of light, then we have evidence which indicates that sunlight is a stimulant or excitant to

the whole nervous system, for certainly if it acts on one portion, as we know it does on the eye and its nerve, it is not unreasonable to suppose that it acts on other parts also.

This inference that the influence of light penetrates every part of the nervous system, receives proof from the feeling which a person experiences when he emerges from a dark to a well-lighted room. His breathing and pulse become accelerated, and it really appears to infuse a new spirit of activity into every recess of his frame. The stimulating influence of sunlight on the animal economy is clearly demonstrated, at least in a negative way, by the course which is pursued among certain classes in the fattening of geese. These animals are placed in dark cellars, closely confined in boxes, and stuffed with corn and water. It is well known that one of the chief objects to be gained by the operation is the enormous development of the liver which takes place in a very short time under these circumstances. In a like manner the farmer knows that the cheapest and most expeditious mode of preparing his oxen for the butcher's knife, is by keeping them quiet in small and poorly lighted stables. Now the principle which underlies or controls the accumulation of fat in the animal body, and which is perhaps blindly carried out in the above manner, rests on the physiological truism that

bodily activity and bodily waste proceed hand in hand; *i. e.*, if the functions of the body are accelerated or retarded, a corresponding consumption or collection of fat ensues—hence, in order to save the fat and allow it to accumulate, the motion of these animals is restricted by the most rigid methods. And one of the means for the achievement of this perfect quietude is close confinement, but what interests us the most here is the fact that this end can only be successfully secured by shutting out as much sunlight as possible; thus proving substantially that sunlight has the power to quicken and invigorate the process and functions of the body. For, if sunlight transmits no impulse to vital action, then the process of fattening might be carried on equally well in light or darkness, which, as we have seen however, is not the case. Moleschott gives us still further evidence that sunlight has the capacity for promoting vital activity. For, if other things are the same, the amount of carbonic acid which is thrown off from the body in a given time is equivalent to its interior organic movements during the same time, and by experiment he found that frogs exhaled more carbonic acid in daylight than in darkness, and that the production of carbonic acid increases in proportion to the intensity of the light which is employed.

Thus then we have much reason for concluding

that sunlight by being transmitted through the eye and propagated by the manifold ramifications of the nervous system throughout the body, enhances the work of building bone, muscle, blood and brain, as well as that of force production; and hence it ranks as one of the most essential stimulants in our environment. Indeed it is well known to every intelligent practitioner of medicine that every vital act is intimately dependent on the constant and undiminished influence of the nervous system, and that the nutrition of any organ in the body is readily disturbed if the integrity of the latter becomes impaired. And if we take this view of its mode of action it appears very clear to us why it is that persons who are deprived, and those who studiously deprive themselves of sunlight, become weak, pale and debilitated. Why palpitation of the heart so frequently occurs, and why the least exertion renders them short of breath. Why they appear prematurely old, why they manifest but little recuperative power when laid low by disease, and why nervous diseases, such as asthma, epilepsy and insanity, are often aggravated by darkness and ameliorated under the influence of sunlight. A similar train of consequences would inevitably follow in other directions were any of the other essential stimulants in our environment withdrawn. For sunlight is no less a stimulant to the body, than is

our food or our air, and yet how many persons are there who take every precaution to shut the light out of their dwellings, for the simple reason that it fades the carpets and furniture, without knowing, at the same time that they are barring out health and happiness. We can thus appreciate the importance of giving that class of persons whom we have under special consideration, a free and unstinted supply of sunlight.

CHAPTER IX.

INFLUENCE OF PHYSICAL EXERCISES.

IT is a universal law in living nature that constant moderate use of any organ in the animal body stimulates its growth and development. The blacksmith's arm and the dancer's calf are common examples of the effects of such exercise on certain groups of muscles. The lungs although not muscular organs, are likewise subject to this same law, and if, as I think it can be shown, that these structures can be developed and invigorated under the influences of physical exercise, then it becomes at once apparent that the latter is a most important lever in combating the tendency to pulmonary consumption; for from what has already been said, it is evident that, if in any way the condition of these organs can be improved, or maintained at or near a healthy standard, the danger toward such a disease is altogether averted.

The lungs, as we have already remarked in previous pages, are the instruments which expose the

blood to the air, and give to it the necessary amount of oxygen to carry on the movements of the animal machine. Now muscles in motion, or during physical exercise, require more blood than they do in a state of rest, accordingly the heart, in order to meet this greater demand, accelerates its speed and distributes more blood throughout the blood-vessels of the body, but while it throws out more blood to the muscles, it also receives more in turn, and sends a greater quantity to the lungs for the purpose of oxygenation, or of being exposed to pure atmospheric air, and this very naturally entails more labor on the latter organs. It thus becomes plain how it is that general muscular exercise of the body can in an indirect manner improve the structure and functions of the lungs—how in this manner it is possible to make them stronger, increase their capacity, and enable them to resist the encroachment of disease.

The investigations of Dr. Edward Smith clearly show that physical exercise vastly increases the activity of the lungs. He found that the lungs exhale a much greater quantity of carbonic acid in bodily motion than in bodily rest. Now the amount of carbonic acid produced in the body under such circumstances, is a measure of the amount of work which is performed both by the muscles and lungs; for the former generate this substance during exercise, and the latter excrete it, and if more is generated

by the muscles and eliminated by the lungs during a given time in exercise than at rest it is direct proof that their action is enhanced under the former condition.

Dr. Smith in his experiments exhaled the following amounts of carbonic acid in various conditions of the body: *

	Carbonic Acid exhaled per minute in grains.
During sleep	4.99
Lying down and almost asleep (average of three observations)	5.91
Walking at the rate of 2 miles per hour .	18.10
Walking at the rate of 3 miles per hour .	25.83
Working at the treadmill, ascending at the rate of 28.65 feet per minute (average of three observations) . . .	44.97

That the interests of the lungs and muscles are very closely associated is markedly shown in those who are suffering from disease of the lungs, especially in the incipiency of such diseases. The muscular system of those persons at such a time is in a comparative state of health, yet they are almost wholly unable to perform any severe muscular labor: an incapacity, which is out of all proportion to the healthfulness of their muscles, and altogether inexplicable,

* From Pavy's *Food and Dietetics*, p. 107.

if we leave out of consideration the deterioration which is taking place in the lungs.

Now while it is true that the lungs become invigorated and develop under the influence of general muscular exercise, it is also true that this process can in a great measure be aided and enhanced by special exercise of the muscles which surround the chest walls, and in order to make this intelligible it is necessary to enter into a brief description of the principal anatomical structures which participate in this operation.

The walls of the chest, in the first place, are composed of curved bones, called ribs, which are loosely attached to the spinal column behind, and flexibly to the breast-bone in front. When the chest is at rest the ribs point obliquely outward and downward. In the second place every rib is bound to its neighbor by means of intervening muscles called *intercostals*, but beside these intercostal muscles the first and second ribs have three extra muscles, called the *scaleni*, which run diagonally from their front ends up and back to the spinal column in the neck, where they are inserted. And in the third place the contents of the chest are separated from those of the abdomen by a thin broad muscle which is attached along the whole lower border of the chest walls, and which, in a state of quietude, forms an arched floor to the chest, with its con-

vexity looking upwards and its concavity downwards.

Now all these muscles are partly under the control of the will, and during inspiration or inhalation the first and second ribs are elevated and fixed by the scaleni muscles, while contraction of the intercostal muscles moves all the ribs in an upward direction, and naturally from their peculiar oblique position such a tendency will cause them to rotate outwards at the same time, thus expanding the circumference of the cavity of the chest in a marked degree. But while this lateral widening is taking place, the arched floor—the diaphragm—also contracts, and assumes a flat and horizontal position, thus enlarging the cavity of the chest, in a vertical or perpendicular direction. Such a harmonious action of the muscles which surround the chest evidently produces a sort of vacuum within the cavity of the latter, and the air in the process of equalizing the pressure between the inside and outside rushes in and expands the lungs. This constitutes an act of inspiration. In expiration or exhalation all the muscles of the chest become relaxed and the elastic fibres of the lung-tissue force the air back again.

Again, we must not leave out of consideration the broad fan-shaped pectoral muscles which arise from the front of the chest on each side and are inserted into the upper portion of the arm, for whenever the

arms are extended upwards or backwards simultaneously with inspiration, the latter act is greatly facilitated.

That muscular exercise, both general and special, increases this volume of the lungs is well verified by direct and positive evidence. The ordinary capacity of the respiratory organs is about 200 cubic inches, but in those who undergo regular and persistent exercise, it is frequently the case that their capacity is improved to the extent of 50 cubic inches more, and *post mortem* examinations show that such lungs also increase in length and breadth.

Walking, running, rowing, and swimming throw a large number of muscles into action, and for this reason constitute excellent modes of general bodily exercise. While engaged in such practice no constriction should be allowed around any part of the body, for the lungs, heart, and blood-vessels must have free and uninterrupted play in their accelerated functions. Particular caution is necessary not to carry such exercise to excess, for this may lead to a rupture of the large blood-vessels and to hemorrhage from the lungs. If, during such exercise there arise any great shortness of breath, or pain in the chest, it is an indication that the lungs and heart are worked to their extreme limit, and must be taken as a fair warning to desist, or at least to slacken the speed. At first all exercise should to be very mod-

erate, and gradually intensified with the development of the strength of the muscles, until the latter are forced to their utmost physiological capacity.

To enlarge the breathing volume of the lungs by special physical exercise, the body must be erect and in fresh air, hands meet in front and gradually move backwards as far as possible simultaneous with a deep inspiration, and then forward again with each expiration. It should be done several times during each day, and its duration be limited by the setting in of fatigue. This operation can be rendered more effective by the use of dumb-bells or Indian clubs.

It is of the highest importance to keep in mind the fact that whatever the mode of physical exercise may be, it must not be compulsory, but must be performed without effort and, as it were, without consciousness. It is for this reason that hunting, fishing, bowling, dancing, etc., if not carried to abuse, are conducive to good health and good spirits, for here the excitement is so great and so charming that it makes the individual forgetful of the amount of muscular labor which he performs.

I would indeed treat this part of my subject in a very imperfect manner were I to omit saying something in regard to the influence of the exercise of the voice on the lungs. Contrary to the current opinion among the lay classes, I believe that singing, speaking, etc., when carried on in accordance

with the laws of health, are most potent factors in strengthening the respiratory organs, and in warding off the tendency to pulmonary consumption. The deep inspirations and prolonged expirations which are necessary to good singing and to good speaking, is a process which in turn gently expands and empties the lungs in a very effectual way, and which can have no other effect than that of promoting the strength and developing the capacity of these organs, if the physiological law is true, that exercise of an organ adds to its vigor. It is only when such practice is carried to excess, when the vocal organs are strained beyond their endurance, that baneful results follow. A rule which should be heeded is, never to sing or speak after the least fatigue or pain is experienced in the throat or lungs. By constant and moderate exercise, however, such weakness can in time be readily overcome.

CHAPTER X.

INFLUENCE OF DISEASE, ETC.

FROM what has been said it may be taken for granted that any cause which depresses or undermines the vitality of the body also tends to pave the way for the development of consumption, especially in those who are predisposed to it; hence it is a matter of the greatest moment to such persons to carefully guard this avenue against the invasion of this dreadful enemy.

Among the many causes of consumption "colds" occupy a very prominent rank. This is not due to any malignant character of these troubles, for they are just the reverse, but because they are usually regarded as harmless and in consequence of this are neglected. Without great care "colds" are readily acquired in any locality, especially when the body is compelled to undergo sudden and extreme changes of temperature, which generally lead to congestion and inflammation of some portion of the breathing surface. In most instances the first attack of cold

is slight and transient, perhaps confined to the nose and throat, (the throat in scrofulous subjects is extremely liable to inflammation), and disappears of its own accord in a very few days. But, however, slight it may be, its existence is conclusive evidence that the resistance of the invaded tract is impaired to a certain extent, and is less able to ward off subsequenc attacks; and as soon as the proper opportunity presents itself a second onslaught will be made more readily and more severely, and very probably extend over a larger territory than the first. In this manner the normal resistance of this surface becomes reduced from time to time, and the congestion and inflammation spread further until at last the windpipe, bronchial tubes, and the lungs themselves become involved in the destructive process. Such a process occurring in a person who is in the least prone to consumption, is an extremely dangerous one, and is liable to be fanned into activity under the least provocation at any time.

Hence it is of supreme moment that the body should be amply protected against "colds" by means of suitable clothing, and other comfortable hygienic surroundings. Heavy clothing and confinement in warm rooms, however, will not effect this, but efforts must be made to adapt the body to the prevailing climate by frequent physical exercise in the open air.

Fever and ague, or what is generally known as chills and fever, exerts a most pernicious influence on all those who are predisposed to pulmonary consumption. In the chapter on the influence of soil-moisture I have referred to the possibility of producing chills and fever by fluctuations in the atmospheric temperature. When the cold drives the blood from the skin into the interior of the body, it is very natural that those organs which are the most vascular, or in other words those which contain the largest number of blood-vessels, receive the greatest quantity of blood. Now the lungs are, so to speak, one dense mass of blood-vessels, and in the chilly stage become engorged in proportion to the severity of the attack, and remain so until it has passed off and the sweating stage follows. The common experience of those who have been subject to this disease, attests the fact of their inability to perform any severe physical labor, even after the attack of ague has subsided, on account of the great shortness of breath; which is wholly due to the great engorgement of blood in the lungs. It is needless to say that such a process puts the lungs to a severe test, and, if continued, will eventually lead to disorganization of these structures, and must certainly develop any latent tendency to consumption that may exist.

Persons of a scrofulous temperament are specially

susceptible to the cause which brings on fever and ague, for we have already learned that they are constitutionally weak; that their power of resistance to such an aggressive force is diminished; and therefore they should never inhabit a low damp soil, nor a locality subject to great and sudden changes of temperature, and always avoid sleeping on ground or cellar floors. Almost any climate, no matter how equable in temperature, or however free from dampness, will at times, as in the fall of the year for example, when the days are uncomfortably hot, and the nights excessively cold, produce a feeling of chilliness, alternating with flashes of heat, pain in the limbs and back, all of which symptoms indicate something like incipient fever and ague. This feeling of chilliness, or disturbance of the bodily temperature, is very characteristic in scrofulous individuals, and if the disorder does not manifest itself in a well defined paroxysm of fever and ague, half a grain of *quinia*, once or twice a day, will in most cases suffice to tone up the body to its usual standard. Not only is there no harm done by such small doses of *quinia* as is generally supposed, but it imparts life and vigor to every function in the body. When the perturbation amounts to a well-marked chill and fever, more definite and acurate treatment is necessary than I can lay down here, and the aid of a physician should at once be called in, who is generally

able to terminate the trouble in a short time.

INJURIOUS OCCUPATIONS.

Certain occupations like stone cutting, coal mining, scissors grinding, steel polishing, &c., are very injurious to the respiratory organs, on account of the small particles of dust which are constantly given off, are diffused, inhaled, and cause irritation. Persons who have inherited or acquired a consumptive tendency should never engage in any of these.

CHAPTER XI.

INFLUENCE OF DIGESTION.

I have already alluded to the potent influence which food exerts in keeping up the standard of health, and in this way aids in warding off the development of any latent tendency to consumption; but we have also learned that the stomach shares the common weakness of the whole body in scrofulous persons, or in those who are predisposed to consumption. Indeed, it is a fact well attested by those who have an extended experience in the treatment of consumption, that in many instances derangement of the digestive organs is a sure prelude to the battle which will take place, sooner or later, in the lungs; hence, however essential the relation which the food sustains to the body may be, it is of far greater importance to maintain the integrity and healthiness of the digestive organs. For, after all, food can only serve its useful purposes in the body after it has undergone a thorough preparation for absorption by the blood, and this is impossible if the

stomach and bowels are impaired in their functions.

Now digestion is the process which, by various mechanical and chemical operations, prepares the food for absorption by the blood, for the latter fluid is not capable of taking up anything from the stomach or bowels, unless it is in a fine state of division or attenuation. Of the mechanical contrivances, chewing comes first, the importance of which can hardly be overrated. All animal and vegetable albumen, or our nitrogenous food, must here be reduced to a fine pulp, so as to be readily acted on by the gastric juice after being swallowed. As soon as the food enters the stomach it is subjected to a series of wave-like contractions, which impart to the whole mass a sort of rotary or churning motion, while at the same time it is exposed to the chemical action of the gastric juice which oozes out of the walls of the stomach. After the mass leaves the stomach the same process is continued by the upper portion of the bowels, aided by their own secretion and that of the liver, until finally the whole mass has undergone a complete modification and the nutritive part is extracted and absorbed.

Of all the animal foods, such as beef, mutton, veal, lamb, pork, venison, poultry, game, wild-fowl, fish and shell-fish; beef and mutton are the most nutritive * and digestible, especially the former.

* I use the term nutritive food as an equivalent to constructive food, or that which builds the bodily frame.

Although beef is perhaps less readily digested than mutton, yet these two kinds of meat are vastly superior in point of digestive and nutritive value to veal and lamb. Hence the two latter must be studiously avoided in all forms of dyspepsia, and in weakness of the stomach. Pork is one of the most indigestible of meats, while venison is of comparative easy digestion. The flesh of the fowl and turkey is tender, delicate in flavor, and is better adapted for digestion than that of ducks and geese; but the flesh of game possesses superior nutritive properties to that of poultry, and is also of more easy digestion. Fishes are not as nourishing as the flesh of quadrupeds and birds, although they may be advantageously employed where the digestive power is weak and inefficient. Of all the shell-fish, oysters are the most nutritive, in fact, their value as such is very great. Contrary to the usual custom of heating or stewing oysters, they are of the greatest service when taken in a raw state. Exposure to heat coagulates the albumen, and thus in a great measure impairs their digestibility.

Essence or extract of beef comprises the elements of nitrogenous food, and is a most serviceable mode of sustaining strength and failing vitality. Eggs consist of nitrogenous, fatty and inorganic matter, hence they are capable of serving the body in the double capacity of furnishing building material, as

well as that of supplying moving force. Raw or lightly heated eggs are more readily digested than if boiled hard.

Milk can be looked upon as being the ideal food for mankind, especially in the early stage of life. Milk, like eggs, consists of nitrogenous, non-nitrogenous, and inorganic material, and so posseses all the elements which are essential to develop the animal body.

The vegetable alimentary substances which consist of the cerealia, such as wheat, oats, barley, rye, rice, etc., and the leguminosæ, such as peas, beans, lentils, etc., are rich in nitrogenous and non-nitrogenous matter, hence their great value as articles of diet.

The non-nitrogenous foods, like fat, sugar, starch, etc., will now occupy our attention in their relation to digestion, especially since their preparation previous to their introduction into the blood-current is altogether different from that of the albuminous foods. To healthy digestion it is essential that these articles of diet be retained in the mouth until they are completely moistened with saliva; for if they are deprived of the chemical change which is brought about by this fluid, their future value to the body is unquestionably limited. In the stomach these foods undergo very little or no change, but directly after leaving this organ they are brought in contact

with the secretion of the pancreas, or sweet-bread, which is the large salivary gland of the abdomen, and is to all intents a duplicate of the salivary glands of the mouth. But in those who are predisposed to consumption, this gland, as we have already seen, is very often weak and inefficient in the discharge of its duty, and if the fatty, starchy, or sugary food be swallowed without being duly mixed with saliva, under such circumstances they remain undigested, and beside being a total loss to the body as force-producers, they cause acidity and flatulence, and are very apt to produce further irritation in the stomach and bowels. Inasmuch as this kind of food is of such vast importance to the integrity of the bodily functions, great care and vigilance ought to be exercised in its thorough mastication. There can be no doubt that many troubles in the digestive organs arise simply by a neglect of such a simple precaution. A tendency to sourness of the stomach after meals, under such circumstances can frequently be corrected or counteracted by drinking half a tumblerful of milk with a tablespoonful of lime-water before each meal.

Drinking while eating, if not carried to excess, exerts a favorable influence on digestion. It hastens dissolution and absorption of the food.

During eating as well as afterwards for some time, the mind and body ought to enjoy perfect repose.

Any exercise of the mental functions, be it in distress or in work, will in proportion to its intensity, attract that nerve force away from the stomach which is necessary for digestion. Therefore in order to restrain the mind from what may be termed involuntary excursions at such times, meals should be taken in the company of pleasant and agreeable friends, with whom a light and frivolous conversation may be carried on without injury. The same freedom of both body and mind should be strictly adhered to after meals until digestion is completed. Many confirmed dyspeptics, who are suffering from nervousness, and from pain, tenderness and fulness over the whole, or back part, of the head after a little unusual mental application, can without much difficulty trace the origin of their trouble to a violation of this law of health; to too great mental activity during, or directly after meals.

But however excellent the digestive organs may be in point of capacity or efficiency, they will inevitably succumb to disorder unless they receive the constant attention and coöperation of the cook. This personage ought to possess a complete knowledge of the art and science of cooking, so as to be abundantly able to promote and enhance the digestibility of each article of food as it passes through her hands. She ought fully to understand, that variety of food, as well as embellishment of the same

when served on the table, is not only pleasing to the eye, but is also tempting to the appetite and aids digestion. With great truth may it be said that the cook holds the destiny of many a stomach in her own hand, and thus in a measure controls the lives of many millions. Now when we reflect upon the abject ignorance which is displayed in many homes on this pre-eminently important subject, we are driven to the unavoidable conclusion that the evil committed in this direction far outweighs the good.

CHAPTER XII.

INFLUENCE OF INFANT DIET.

VERY little proof is necessary to establish the fact that the safety and durability of a dwelling depend in a large measure upon the security and stability of its foundation. Precisely the same is true of the human body, for the conditions which surround it in its infancy determine, to a great extent, the weakness or robustness of the adult: This is the most critical portion of life, for here the whole frame develops with greater rapidity than during any other period of its existence, and the slightest interruption of this process manifests itself in disease. Therefore it devolves upon parents, and especially upon mothers, to allow nothing whatever to interfere with the work of laying the foundation which is to shape the physical as well as the mental destiny of their offspring, and not only strive to discharge this sacred responsibility with conscientiousness, but also with intelligence. This advice applies with emphasis to that large class of persons for

whose benefit these pages are written, for they must remember that above all others they have an inherent tendency to transmit a weakness to their children which oftentimes, with due knowledge and attention can be entirely eliminated.

Now in order to rear such a complex and delicate structure as that of an infant's body, it is obvious that the food of the child must comprise all the essential elements of its structure; hence the question of diet constitutes an all-absorbing problem in the history of an infant's life. But here nature which rises higher than the wisdom of man, steps in and embodies these necessary ingredients in the form of milk, which is the only food that is adapted to the infant's stomach, to which mothers and nurses ought strictly and unflinchingly to adhere until the early teeth have fully sprouted. The truth of the above statement, that milk is the only suitable food for infants, is shown by the disastrous consequences, which have so far attended, and ever will attend, all efforts to supplant milk with artificial diet. Upon the subject of infant feeding in relation to consumption, or to the consumptive predisposition, Prof. Loomis* utters the following decided language: "There has come to be an opinion in the profession that phthisis (consumption) is certainly to develop

* "Lectures on Diseases of the Respiratory Organs, Heart and Kidneys," page 229.

sooner or later in those who have a strong hereditary phthisical predisposition; that because the father or mother, or brother or sister has died of phthisis, that other members of the same family will have the disease; but the development of the disease in every such case depends more upon the antecedent hygienic influences under which the childhood or adult life has been passed, than upon the hereditary phthisical predisposition. These predisposing anti-hygienic influences embrace the important problem of infantile diet.

"How few infants are properly fed! How few mothers—especially among the wealthier classes—are in a condition to properly nourish their own offspring! The habit which prevails of feeding children until they are one, two or even three years of age, upon barley water, paps, sweetmeats and indigestible articles of diet, has a most pernicious influence upon the future physical development of the child, and if at the very entrance upon adult life of such children, phthisis is not induced by some local cause, it will be an exception to the rule."

When the milk of the mother becomes contaminated in consequence of disease, or fails on account of the mother's death, and a wet nurse cannot be procured, cow's milk comes next in point of usefulness; but however good and fresh the latter may be, it cannot, by any means, fill the place of moth-

er's milk. Cow's milk for this purpose must be perfectly fresh, and is prepared by mixing one part of pure water to two parts of milk with the addition of a little sugar, and given to the infant at a luke warm temperature. It is very important that the feeding bottle should be kept clean. If the milk is vomited or passed from the bowels in the form of curds some lime water should be added. Lime water, besides proving very efficacious in many of the digestive derangements to which infants are liable, also furnishes one of the principal ingredients in the structure of bone, as well as in that of the teeth.

Pregnant women, and mothers as long as they nurse their infants, are able to contribute much to the healthfulness of their offspring by partaking of the most nourishing food, such as meats, oysters, eggs, milk, etc., taking plenty of gentle exercise, and living out of doors as much as possible.

CHAPTER XIII.

INFLUENCE OF COD-LIVER OIL, FAT, BUTTER AND ALCOHOL.

I CANNOT close this interesting subject without making some special remarks on the great value of force-producing foods in supplying the energy which is stealthily and gradually wasted in those who are predisposed to consumption. By referring to *Chapter IV*, the reader will see by glancing at the table of the comparative value of foods, that cod-liver oil occupies a higher position as a force producer than beef-fat or butter. Any substance which holds as large a store of force as cod-liver oil does, must certainly be considered a very valuable agent in restoring the failing energy of the body on theoretic grounds alone, and experience also proves that there is no single remedy superior to it in the prevention of this disease. In langour, a disposition to muscular weakness, dryness of the skin, loss of weight when associated with cough and tenderness in the chest, tickling in the throat, the good effects of cod-liver oil are particularly marked. Scrofulous persons

would fare better, at any rate, if they would take the oil every spring and fall in order to protect themselves against the sudden changes of temperature incident in these seasons. Whenever the stomach does not tolerate the raw oil, an emulsion of the same may be substituted with advantage. It must always be taken on a full stomach, or directly after meals, and if it is not digested with facility, it must be retained in the mouth for a short time to be mixed with the saliva before swallowing.

Nearly all scrofulous persons possess a natural dislike for all greasy articles of food, and they almost invariably, and at times unconsciously, divest their meat of fat before they eat it. Now such persons above all others require the force which they waste in this manner, and must endeavor to conquer this pernicious habit by eating a little fat at a time, chew it well, and mix it thoroughly with the saliva.

Butter is a very prominent force-producing food, and although it does not contain as much latent energy as cod-liver oil or beef-fat, it must yet be regarded as having a very important bearing to the subject under discussion, because, in the first place, it is so universally employed by nearly all civilized communities; and, in the second place, because it is very palatable to the large majority of scrofulous people. Such persons while, as a rule, they have strong repugnance to fat, are abundantly able

to consume this article without any inconvenience, and for these reasons they ought to supply it to their bodies in unstinted quantities.

It is eminently meet that I should say a few words concerning the important relation which alcohol sustains to the body in a depressed and enervated condition. The latest investigations on alcohol bring the conviction to every intelligent and impartial mind, whatever prepossessions may exist, that if used in small quantities, and under conditions of actual necessity, it acts not only as a food by imparting energy to the body, but also materially aids the process of digestion, and so confers a power and a benefit, the value of which cannot be overestimated.

Alcohol is a double-edged instrument, powerful for great good or for great evil, and therefore requires to be used cautiously and carefully; but happily the line which marks its good from its bad effects—its food action from its intoxicating action—is so sharply defined that it cannot be mistaken. For as long as the body is capable of burning up or oxidizing all the alcohol taken in, no harmful effects do or can manifest themselves, but as soon as this limit is overstepped, unmistakable evidences of poisoning display themselves, prominent among which are flushing or sweating of the face, fulness and heat in the head, together with increased action

of the kidneys. Therefore whenever these symptoms appear, its further use must at once be discontinued.

The action of alcohol on the walls of the stomach requires to be brought into notice here, and we shall find that the same rule which governs its action in other parts of the body holds equally true here, viz: that small doses produce healthful, and large doses harmful effects. It is hardly possible that the total-abstinence people could have invented the unfounded notion that alcohol on being taken into the stomach, in whatever quantity, coagulates the albumen of that organ, and so destroys its function of digestion; since it is a fact comparatively long known that the action of alcohol on the stomach in small doses is similar to that of our ordinary food. When a small quantity of alcohol comes in contact with the pale, gastric, mucous membrane, the blood-vessels dilate, the surface attains a rosy hue, and its glands secrete a profuse quantity of gastric juice, in precisely the same manner as in the case of food. But the condition of the stomach becomes wholly changed after the introduction of larger quantities of alcohol. The rosy color of the mucous membrane fades and the secretion of gastric juice is suspended, and in this condition of things *only* does the albumen of the stomach become coagulated. This has been well observed through an opening, or fistula, into the stomach.

CHAPTER XIV.

CONCLUSION.

In summing up the considerations in the preceding pages, I think it appears conclusive that consumption, or the tendency to it which exists in many individuals, is essentially a premature dissipation of the force and matter of the body, and that improper food, bad air, deprivation of sunlight, poor clothing, want of physical exercise, disease, imperfect digestion, all accelerate this process of waste. Therefore in all our efforts at prevention the path of duty lies straight before us, and consists in conserving these two elements of the body by laying a good foundation in infancy, by preserving the organs of digestion, by eating an abundance of rich and nutritious food, such as fat, butter, meat, milk, eggs, etc., by breathing pure air, by living on dry soil, by wearing warm and comfortable clothing, by taking plenty of physical exercise, and by avoiding disease and injurious occupations.

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