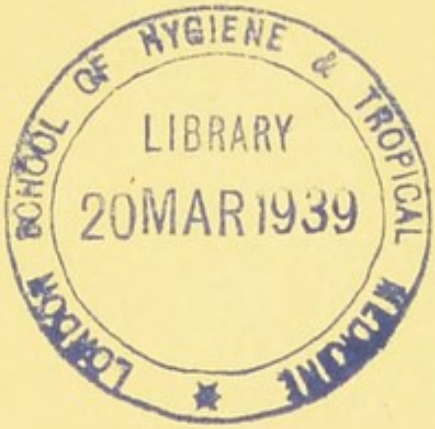
Life and health / by James Frederick Rogers.

LIFE AND HEALTH

BY

JAMES FREDERICK ROGERS, M.D.


LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE
LIBRARY
20MAR1939

LIFE AND HEALTH

4/6 Net

LIFE AND HEALTH

BY

JAMES FREDERICK ROGERS, M.D.

ASSISTANT INSTRUCTOR PHYSICAL DIAGNOSIS, YALE UNIVERSITY;
AUTHOR OF "THE BODY AT ITS BEST"
AND OTHER ESSAYS

PHILADELPHIA & LONDON
J. B. LIPPINCOTT COMPANY
1910

Published April, 1910

Printed by J. B. Lippincott Company
The Washington Square Press, Philadelphia, U.S.A.

"There is no theam more
plentiful to scan,
Than is the Glorious, goodly
frame of Man."

JOSHUA SYLVESTER.

PREFACE

MANY books have been written about the human organism,—most of them from the analytical standpoint. The body is taken to pieces, each organ described minutely, and its working as a laboratory specimen explained in detail. The student, when he has finished, has acquired a multitude of names of parts, and has learned much about what these parts can do, but he leaves the subject with a consciousness of various organs lying scattered about in the laboratory, and with little idea as to how this intricate machinery is combined and of how all the parts in the working whole are intimately related. The practical lessons which might be carried away from such a study are largely obscured by cumbersome anatomic details. It is the aim of this work to avoid this method as much as possible and to present the whole struc-

ture and function at a glance by picturing its historical unfolding. The reader will thus get a general view of the subject, the details of which he can fill in, if he is sufficiently interested, from works of another character. In so doing he will be less likely to lose sight of the whole and its unity.

Never, in all history, was there so much interest as at present in the subject of bodily welfare, but there is such diversity of theory that the average man finds himself in a "midway" of health teaching; the barker of each side-show knows just what is needed for the searcher after health, but a trial, often after payment of no mean admission fee, reveals the fact that each show was not quite all that the advertiser prophesied. So the health seeker travels from one disappointment to another. It is the supposed end of the study of physiology to enable one to understand better the laws of health, and it is only through a comprehensive view

of the history and general working of the body as a whole that we can judge of our own needs.

While the first part of this book is intended as a general picture of the body in life and health, the second part deals more explicitly with the problems of hygiene or the maintenance of life and health. After the view gained from the first part, it is believed that the second will aid the general reader to more easily choose between the true and the false—the half-truth and half-falsehood—in the multitudinous health teachings of the day.

James Frederick Rogers, M.D.

New Haven, Conn.

CONTENTS

PART I

MEANING OF HEALTH

PART II

MAINTENANCE OF HEALTH

PART I

MEANING OF HEALTH

LIFE AND HEALTH

INTRODUCTION

GROWING INTEREST IN LIFE

Interest in matters pertaining to health had its beginning far back in the dawn of human consciousness, and it has increased with our ever-increasing sensitiveness to suffering and our shrinking from premature bodily dissolution. Nor is the interest wholly a self-centred one, for it reaches deeper with the development of sympathy, and health is desired as a means toward doing and being for others:

> "If I be dear to some one else,
> Then I should be to myself more dear."

Finally, and not least, the bodily growth and health of the child appeals to us more and more, and so our interest in the cul-

tivation of health is extended to include the welfare of the coming generation.

In former days, when bodily or mental derangement was looked upon as a visitation for sin, the deity, as the source of the trouble, was propitiated accordingly. In a more skeptical time, sickness was considered more or less of a happen-so, a necessary part of existence as it was meted out to us, and even conscious errors of health were committed for the pleasure of the moment, with neither concern for the punishment which followed, nor thought of more remote consequences for self or others. More recently the growing perception of material and get-at-able agencies as the causes of sickness has aroused our inquisitiveness in this direction, and, at the same time, a new kind of conscience has grown up which looks upon preventable sickness and bodily weakness as sins of more seriousness than offence against a distant deity, and we now leave no stone unturned in our search

for that which will drive out disease and heighten health.

Since the door-opening discoveries of Darwin and Spencer, we have become interested in the origin of a thing which we may be studying. Each factor in development has left its impress, and a knowledge of the past is necessary to appreciate present structures or traits in the object before us. Especially is this true of the study of man and of those conditions of structure and function in man which we call health, for his past history not only furnishes the key to present knowledge, but also makes more possible any prophetic glimpses which we may essay. A bit of jelly-like living stuff wrought upon by air and water, by light and darkness, by wind and sun, by heat and cold,—yes, as the older seers believed, influenced in a way by electrical changes, by the phases of the moon, by the planets and other suns,—such in its beginning and changeful progress has been the history

of human existence. It is almost beyond our powers to imagine the continuous time-wrought miracle going forward through æons until man is made. We can only sketch certain stages of the process. Through it all, life and health have meant the more perfect adjustment of the increasingly-complex organism to the multitudinous external influences by which it is surrounded.

It is not at all difficult, in studying the structure of a civilized community, to see how it consists of many individuals who are more or less unlike in their work, and all more or less dependent upon each other; the laborer on the capitalist, the capitalist on the laborer, the farmer on the mechanic, the mechanic on the farmer, and the merchant and the transporter or carrier of goods dependent upon them all and a help to them all. It is easy to see that the welfare of the society depends on harmony among its individuals, and on the coördination of all its members to some

delegated controlling persons whom we call the governing portion. It is not so easy to think of the human body-mind as made up in the same way and gradually evolved in a similar manner as the social organism is being developed, and that, as social health means coöperation and mutual aid, so ill health or sickness of the individual are only other names for lack of harmony and coöperation among the millions of individuals of which the body is composed. Perhaps, if we could be possessed with manifold, microscopic vision, this insight would be more simple, for it has been only by the aid of the microscope that we have had a vision of this marvellously specialized and coördinate cluster of beings which we name the body; and it is by the aid of the microscope and the evolution key that we can trace in a rude way the origins and gradual unfolding of the more finished whole.

We can find, in different lands, groups of men in various stages of progress in

the development of society, and we can even find individuals who live apart, independent of others, and are typical of the units from which the most highly civilized society has sprung. So, by searching through the realm of animal life as it has struggled upward, we discover forms representing earlier stages of our advancing complexity of make-up and interdependent activity of parts, and, finally, by searching far enough we come upon the unit or type from which we began.

BEGINNINGS OF LIFE

The primitive animal, our distant ancestor, was a bit of life-endowed, chemically unstable, gelatinous stuff, living in, and consisting *chiefly of, water,* combined with some few elemental materials—simple substances made miracles of complexity, however, even in so simple a form of being, through life's magic touch. Even were it not so minute we would scarce recognize this object as our primal parent

and forerunner. It was without definiteness of form, but ever changing,—now one shape, now another,—a happy-go-lucky individual, a creature of a day, with little apparent definiteness of aim, and yet, with all, it showed a versatility that was prophetic. Having no limbs, it yet had the power of motion and of projecting a part of its jelly-like self for arm, leg, foot, or hand. Without mouth or stomach, it could on occasion form itself into a devouring opening which closed upon its prey, and became a stomach from which there was no escape. Having no digestive, absorptive, or excretory organs, it knew somehow certain marvellous ways of taking what it needed from the food material, and of ridding itself of what was left. With no elaborate brain nor radiating nerves, it was irritable and conscious in an indefinite way, knowing its own needs, its friends and enemies, and capable of responding to outer influences in rude fashion. Seeing without eyes, moving without muscles, eat-

ing without teeth or stomach, this bit of animal matter had the even more wonderful accomplishment of giving birth to itself again by dividing into two such bits of living substance.

Such was the first animal—a marvellous, self-sufficient Jack-of-all-trades. It got along very well without book knowledge of its physical make-up, and without conscious knowledge of the care of health, and, consequently, was innocent of sin against such laws. Any failure of its irritable, or movement, or digestive powers, however, brought it to premature destruction.

Through some touch of Nature's magic wand, two of these primitive beings became stuck together, or, in process of reproduction, did not become completely separated, and went floating about as one, in their watery element. Then, later, four, and even more, clustered together, thus forming a composite creature which was, in a sense, what we call a "higher"

animal. The members of this composite soon began to lose their individuality. As more and more individuals clustered and the composite grew larger, the individuals became subject to differing conditions, since those on the outside of the group came in contact with the outside world, while those within were protected by those without. Only the outer ones, buffeted by the currents of the surrounding medium, could come in contact with the objects in that medium, and only they could apprehend food substances or harmful agents in the neighborhood. Since each individual could no longer come in contact with the food material, nor make itself into a mouth or stomach to devour that material, the several members arranged themselves so as to form a permanent opening or mouth, into which the food could be drawn. As the individuals on the outer surface of the group must, of necessity, exercise only the property of apprehending, so those on the interior

surface lining the food canal took upon themselves the special work of dissolving the food material, of absorbing it into their own structure, and of passing the ready-prepared foodstuff on to the outer protective and food-detecting cells. So began a division of labor, and, being endowed with that greatest of gifts, the power of improvement through use, each set of cells, the outer and the inner, became more and more proficient in the work it found itself best placed to do.

Division of labor, just as in society, brought with it increasing dependence of the laborers of one kind upon those of another, and failure of one set to perform their appointed task meant destruction to all, while imperfect performance of such special work meant debility and—what it still means in the most highly developed animal—ill health or sickness. So those organisms in which the various individuals and groups did their special work in a superior way prospered, and could even

afford sufficient nutriment for growth and the addition of other individuals to their number.

Exercise develops structure, and difference in use makes difference in form, so that we find changes of shape slowly taking place in the individuals in the outer and inner parts of the whole group, according to the character of work they have to do. And, once started in the line of specialization, the variation in the individuals becomes greater and greater. For want of a better name, the individual animals which make up this composite animal have been called cells, since, as they become packed together, they look not unlike the cells of a honeycomb; while the group of cells all engaged in one special line of work we name an organ.

Not being able, like the primitive amœba, to make its whole body at will into a foot, certain cells arrange themselves more or less permanently into projecting portions which act to fasten the whole colony

to a spot favorable for the obtaining of food, or serve, later, as feet to propel the colony from place to place. To aid in drawing food material from the surrounding water into its permanent mouth and stomach, hair-like processes developed on certain cells which reach forth and propel currents of water toward the opening of the common food laboratory. It is but a step from these delicate, waving structures to tentacles or arms, which, in the larger animals, grasp and hold food material and more surely drag it toward its internal body-kitchen. Indeed, all animal development and specialization has been toward seeming greater and greater rudeness and violence in the obtaining of that which will furnish sustenance. With the adding of these complex means of obtaining a living has gone, also, increasing cunning in means of protection. The increasing size of the composite animal made it more subject to the buffets of the watery currents about it, and also made it more

liable to damage from other growing, grasping things of the animal world—yea, even from its own kin. The cells of the outer layer, therefore, became thickened and hardened for defence of their communal brethren within. Some of these cells, taking their function of protection very much to heart, lose the sensitiveness which was common to all, but others become more than ever sensitive, and some even come to appreciate the presence of light or of shadow, and so are able to detect more promptly objects which move in the vicinity. The organs of special sense, of seeing, hearing, and feeling, begin to dawn.

With the increasing size of the organism, some supporting structures within were needed to give shape and permanence to the group, and certain cells become stretched out into tough, elastic bands which bind the rest together. Later, others take it upon themselves to abstract from food and water some hard materials, such

as lime, which they deposit in such quantity as to give form and strength to the whole; and the foundations of the bony structures are laid.

While, in the animal made up of a few individuals, the absorbed nutriment readily soaked through from cell to cell or filtered between cells, in the more complex organism with increasing size and activity this process proved insufficient, and small tubes became fashioned as reservoirs for a more generous supply of nourishment and for the disposal of refuse from the many cells.

In such an ever-increasingly large and complex community of the interdependent, it became necessary to have a more and more elaborate and perfect means of communication between groups of cells, for the mere transmission of messages from one cell to those more remote became ever more needful for the welfare of the whole. Sense organs, even though of most simple character, must communicate with motor organs in order that they may be of benefit

to the whole organism. The knowledge of the approach of the shadow of a harmful body in the neighborhood must be reported promptly to the arms or legs in order for the latter to carry the animal out of harm's way, otherwise the legs or arms are useless; and the presence of food material detected by the organs of seeing or of feeling is likewise of no service unless the organs which reach out and draw the food toward the digestive tract can be informed of its presence. The obtaining of food supply and the escape from destructive forces are the two main objects of the whole complex animal make-up, and, to perfect the adjustment of parts to these ends, certain members of the community were set aside for duty in conveying messages between organs. The primitive, common sensitiveness, communicated slowly from molecule to adjacent molecule of a cell, or from cell to cell, is replaced by especially sensitive individual cells which reach out long arms, and, clasping

hands, pass messages from part to part with a speed and exactness impossible to any but specialists, just as the passing of news items from mouth to mouth has been replaced by the use of the telegraph and telephone.

We have already come a long way on the road toward the complex animal forms; the type is already outlined, but each change of surrounding conditions brings further increase of complexity in each of the organs and in their activities. Increased power of getting about uses up more energy, and, naturally, the motive organs need more food material. This necessitates increased activity of the digestive organs if the animal is to improve his condition, and the laboratory of the stomach proceeds to equip itself with special means (glands, we call them) for producing more dissolving juices, and with mechanical appliances for more thoroughly grinding its food. Also the absorbed food material must needs be carried with in-

creased rapidity and certainty to the more active organs, so a force pump, valves which make the fluid keep one course, and definite, contractile walls are added to the system of nutritive channels. In addition, oxygen must be had in larger quantities for keeping up the body energies to the new standards of activity; a system of gills is necessary, where the supply currents may be exposed to the oxygen-containing atmosphere for greater acquisition in this direction; later, emerging from his watery element he changes gills for lungs, and so becomes a dweller upon terra firma, though even yet he remains, in essential make-up, a marine creature.

The picture rudely drawn in a few minutes has taken ages for its working out. Time and manifold surroundings have accomplished this increased clustering and specialization of cells, and, throughout it all, the type has remained as at first—a feeling, eating, moving, reproducing thing.

SUMMARY

To sum up: the first animal was a delicate mite of jelly-like substance living in a watery element, and, though of such seeming simplicity, it was possessed, in a crude way, of all the powers which become specially developed in the highest animal. These several properties of feeling (or consciousness), motion, assimilation of food, and reproduction were alike possessed by all of this primitive body. With the clustering together of many of these simple animals into a permanent colony of increasing size, the same activities go on as before, no more, no less; but, from the very grouping together, certain individuals or cell members necessarily come to perform certain of the functions once done by the whole, and this doing of special work brings with it a change of form and make-up in these members. The outer cells, buffeted by the watery world, must become protective in make-up lest the whole be destroyed. The

inner protected cells exaggerate the once common digestive and absorptive powers, in order to supply nourishment to those whose business it is to protect.

Later, the quality of irritability and the power to conduct impressions from outside becomes more definite as it is localized in certain groups of cells; and rude eyes, ears, and special organs for smell, taste, and touch, with communicating nerves attached, take shape and are shadowed forth as organs—sorry organs at first, but steadily and surely changing to something better. Food channels appear as needed, and to these a pump is added; stout connecting bands for binding the parts securely make their appearance; the rudiments of bone, of cartilage, develop, while the primitive quality of movement—the power to make its whole jelly-like body flow, now this way and now that—becomes specialized in those tissues that we name muscles, which propel the body hither and thither.

All these specializations have gone forward for the end of better detecting and seizing upon food material, for making more certain the continued round of animal existence. The dim but better-than-ever-before primitive eye detects the object for food; the slow but for-the-age-perfected nerve-cells carry the message to the specialized and not-so-slow-as-formerly motor cells which propel the organized cell colony toward the object of nutritive need. Furthermore, the perfected dissolving and absorbing cells of the food canal do their work in a superior fashion, and this results in a better supply of ready-made nutrient matter—the blood stream, from which all parts can find new energy. Of necessity the most improved organs are capable of best securing the most nutriment, provided that all work in harmony, or, as we ordinarily say, in health. We shall find it is the same in the most complex of animals—man.

HEALTH AND HARMONY

A MARINE-LAND ANIMAL

Though the gulf produced between amœba and man—yes, even between amœba and star fish—is vast, yet in essence the animal make-up is much the same. We are still made of the same few elements compounded in much the same way. Each of the body cells is still of a watery nature and of jelly consistency, and depends as much on a watery, nutritive stream as did the first single-celled Jack-of-all-trades. Though walking about on dry land, we remain marine animals—a composite of marine creatures, each washed by the briny fluids of the blood stream. Indeed, we carry about with us, within our complex, myriad-creatured bodies, the types of the various forms through which we have come. Let us examine these palæozoic remains as they exist within us at the present time.

Looking about among the collection of specialized cells of the body—all of them bathed in the predigested food current which we name lymph or blood—we find, floating free in the blood channels, as our primitive speck of highly endowed living matter floated in his watery world, a creature of the same microscopic size, and endowed with the same manifold properties as our ancestral type of æons ago. Studying him closely we will find he is not floating idly here as a mere museum relic of what we once were, for there is little room for the superfluous or useless in the great body-composite, and these free, moving cells, though apparently not specialists in any line, are of great moment to the whole structure through their very possession of so many varied traits.

As there are always myriads of the simplest forms of life for one of the more complex, so, in the great human organism, there are myriads of the versatile amœba-like cells, or white corpuscles. Under the

microscope every drop of blood is found to contain many thousands of them. Each is a translucent, colorless speck of matter so small that a line of them placed side by side across the page of a book of ordinary size would number ten thousand or more. Since Nature is not prodigal with her expenditures, we may guess that these wanderers within us are neither idle nor useless to the whole. Indeed, we are finding them more accomplished than was dreamed. As we have pictured the single-celled first animal as doing, in a rude sort of way, all that succeeding forms of life do less clumsily, so we find the white blood-corpuscle (whose Greek name is leucocyte) making itself into a devouring mouth and a digesting stomach, pushing out a part of itself into a foot or a hand, and drawing itself from place to place, even against the currents with which it might otherwise be swept continually along. Yes, somewhere within its make-up there goes on a feeling and thinking process, indefi-

nite and slow, but like in kind to that which takes place in the elaborate, specialized nerve regions of the human body, of which the leucocyte is such an inconspicuous element. While the blood is the ready-prepared food for the body cells, it is not at all times wholly perfect, for there creep in certain things harmful to the fixed cells which, with specialization, have lost their primitive defensive powers. Certain low forms of life, more minute than even the individual cells of the body, make bold to multiply on the surface and within the food canal, and even creep through at unguarded crevices and find their way into the blood stream and thence to all parts of the body.

The white corpuscle finds in these marauders, which we name bacteria, a foreign foe, or, at least, foreign body, and forthwith it makes itself into a mouth, enwraps, digests, and destroys the marauder so that it no longer remains as a menace to the defenceless brother cells. The white

corpuscle, then, represents in the animal organism what in the social organism we call the police or soldiery, who stand guard against the sneaking foes of those who have abandoned, and more or less lost, the art of defence in the later acquired arts of peace.

Not only in the blood stream do we find these soldiers in white, but, at the sense of danger, they push their way through the curtains that form the vessel walls, and wander through the lymph material between the fixed cells in search of the enemy. Where the danger is greatest there they swarm in numbers, and in times of greater need the old power of reproduction is made use of to swell their ranks to even five times their usual force. Only where they are handicapped by lack of harmony and help from the fixed cells in the way of food supply and munitions, or where the enemy has taken them by surprise in overwhelming numbers, do they fail in their appointed work.

Certain fixed cells also retain to some extent the power of defending themselves from such enemies, but they are incapable of leaving their posts and of going to the help of other regions attacked. The white corpuscle differs from the primal amœba only in that he swims always in a medium of ready-prepared food which he has only to absorb to make his own. He is all the better prepared by this to do the work in hand, as he need spend no energy in foraging. His martial motto reads, Cleanliness and perfect integrity of each individual cell are essential to health of the whole. He is something more, however, than a cannibalistic scavenger of the body, for, the battle over, he takes the place of the fixed cells who may have been injured or destroyed, assumes to a certain extent their form, and, as best he may, their duties, at the same time relinquishing forever his manifold nomadic traits.

Along with the white soldier in the food stream hurry a multitude of other cells,

less independent and versatile; indeed, in the monotony of their humdrum life, these red corpuscles, to all appearances, early lose their semblance of a brain or nucleus. They are burden-bearers from morning to night, year in, year out. Their shape changes but little from that of a bun which has been compressed between thumb and finger, save as they are squeezed out of shape in passing through the narrowest blood channels. They are chiefly carriers of oxygen from the air to the fixed cells, and in those low animal forms in which the life processes are very slow and no large amounts of oxygen are needed to keep up the body fires, we find no such special cells. Since the fires of human life burn briskly, there are millions of these little bodies in each pin-head speck of blood, and, as the various organs are resting or at work, they are hurried along accordingly to feed the furnaces of each; from lungs, the source of oxygen, to the most remote cells, and from cells back to

lungs again; bright red when loaded with the heat-producing gas; darker red or bluish in the venous flood as they return unladen to the great air reservoir. Though myriad in numbers, their demands are slight: only coöperation—harmony—is all they ask of the fixed brother cells; fresh air they demand from the cells of general bodily consciousness, deep breathing from the cells of respiration, and sufficient good food material from the digestive tract.

It may seem a long stretch of the imagination to speak of man as a marine animal living on land, but such is not an extravagant definition. More exactly stated, he is a collection of myriads of individuals of a marine type, depending on and constantly washed by a saline fluid, and yet the complex whole moves about on land. The individuals of the group when removed from their watery home die as surely as a jelly-fish or amœba perishes when taken from the water, and yet the

whole land animal dies if submerged for a few minutes in the same watery fluid. It is all a matter of amount of oxygen and methods of getting oxygen, and, if deprived of the abundance of this gas which life in the free air brings to the air-breathing whole, all of the group suffer and perish.

SOURCES OF ENERGY

The fluid portion of the blood—so necessary to the life of all the individuals of the composite—is the primal, watery element plus the dissolved food material prepared by the digestive organs, and the waste material from the cells. Hurried along through the blood channels, it is constantly soaking through the walls of the smaller vessels to be carried back again to its starting point in the force pump of the heart,—round and round from hungry cells to places of supply of new material, or of disposal and purification of waste material,—a mixture of good and noxious stuff from which the fixed cells with un-

erring nicety of choice select the good and reject the injurious. For the highest welfare of the fixed cells it is necessary that the excretory organs, and, so, the individuals of which they are composed, do their work so perfectly that the waste matter be kept at a minimum, and that their brother cells, who find and prepare the dissolved nutrient atmosphere, furnish enough for all purposes of living; here, again, harmony is necessary for health.

Studying the fluid portion of the blood (plasma) from the statistical point of view, we find, of course, water to be a very essential part. In twenty parts, eighteen parts are water; one spoonful of food matter and one spoonful of waste matter to eighteen of water. In the whole body, eight pounds of plasma, which means something like a half pound of food and as much of waste material, is in constant circulation. The waste matter is being constantly removed by specialized cells in kidneys, skin, and food canal, while from

the inner-outer surface—the digestive tract—new material is being added.

Of the predigested material in the plasma the larger part consists of albuminous matter. The purely fuel substances are dealt out sparingly and as needed from the storehouses of fat and sugar. Among other substances there is about a level teaspoonful of common salt to every pint of the fluid, and there are, in solution, other minerals, as lime and magnesium, to be used for keeping strong the supporting structure.

PROTECTIVE APPLIANCES

Since to this land-dweller the watery, nutritive atmosphere within is as essential as, for a marine animal, is the watery element without, it is necessary that provision should be made to prevent the escape of this "vital" fluid in case of injury. That young student of physiology who defined the skin as "the stuff in which the body is wrapped to keep the blood from

spilling out," was not far from right. It is of greatest importance that the skin should be tough and not easily broken through; but, when it is so deeply and seriously injured that the nutrient vessels are separated, the leakage, if not from very great arteries or veins, is checked by an anti-leak material manufactured at once upon the spot and for the occasion, just as, in case of fire, by the mere turning upside down of a chemical extinguisher, the hydrochloric acid and carbonate of lime within the apparatus form a new compound, carbonic acid, a gas which will smother an incipient blaze. Any injury to the blood-vessels, even though the skin be not cut through, sets free some chemical substance held in readiness for such an occasion within the wall of the vessel, and this acts upon a substance within the blood (fibrinogen), which, through the magic touch, turns rapidly from a watery liquid to a sticky, solid material, plugging the injured vessels

and checking the leakage. The integrity, and, so, health (wholeness) of the body-composite demands that this hemorrhage-checking arrangement be always in readiness for any injury that may occur. An absence or imperfect working of this mechanism means a diseased condition, and such a state—which sometimes does exist—is called hemophilia or "bleeder's disease." Persons having this condition are lacking in one of the elements whose combination is necessary for the production of clotting, and may bleed to death from the slightest scratch, though when sheltered from all injury they seem in perfect health.

Besides these first-aid-to-the-injured-vessel chemicals, other defensive materials exist in the plasma; namely, substances which counteract various poisons which may obtain an entrance to the body. As one places arsenic in the cellar to rid the house of rats, and may even keep some on hand in anticipation of their destructive

visits, or, as one may have a gun and supplies of ammunition about the house in times of war or when in the regions of wild beasts, so, in the nutrient-protective fluid there are certain chemical substances ready-made or, like the fibrin clot-former, ready-to-make, for the purpose of destroying the pestiferous microbes should they find entrance, and of neutralizing their poisons. It is even claimed by some students of these matters that the white corpuscle only attacks these marauders after they have been first rendered harmless by the chemical substances of the serum. It is probable that these substances, like the blood-clotting elements, are held in a latent form to be let loose only on occasion of need. Whether or not this be the case, these antitoxic or antipoisonous substances are of great importance in the destruction of microbes, protecting the body cells from injury, an organ from impairment, or the whole body from disharmony or death. These evils must certainly follow where

there is an insufficient amount of this chemical substance to help the white corpuscles in their microbe-eating activities against the invaders. After once successfully resisting an invasion, the body keeps on hand, as left-over ammunition against the foe, sufficient "antitoxin" to prevent in most cases any serious future attack; hence, germs of measles, whooping-cough, and even typhoid, find it difficult to make a second inroad. It is even possible by vaccination with safe amounts of such microbes to set the human antitoxin factories at work to produce the protective substances, and it has also proved a good thing to develop these antitoxic substances in the body fluid of the horse or of other animals, and to inject them directly into the human cell-bathing liquid. So we may aid artificially the human organism in its fight against the microscopic hosts of diphtheria.

The cell-bathing fluid itself has, then, in the age-long process become wonder-

fully specialized, and contains, besides the predigested food matter and waste materials, the chemical safety substances for plugging leaky vessels and for making what otherwise is a paradise for germs a place full of sunken mines or of deadly torpedoes.

THE COMMUNAL KITCHEN

We have pictured the lowest animal, in the presence of food, as making himself into a mouth and then into a stomach, of devoting his energies for the time being to extracting the absorbable material from the foreign substance and building it into its own body. In those clusters of individuals which have begun to merge into a specialized, mutually helpful society, the group becomes more or less permanently formed into a mouth, and an interior sac in which the processes of digestion and absorption may be carried on to more purpose and with greater economy to the whole. At first the sac-like animal may

be turned inside out and the processes of digestion and absorption go on as before, but slowly the cells lining the inner walls become adepts at making dissolving fluids and in absorbing the dissolved (digested) food substances. The sac becomes later a tube around which the body cells are clustered, the food material entering one end, the waste and undigested matter being discharged at the other end.

Our own digestive tracts are but elaborations of this tube produced step by step, and the growth of each individual traces the same elaboration. First, a straight tube only the length of the body; later an enlargement appears, the beginning of the stomach; still later the tube becomes lengthened and coiled upon itself, until, in the developed man, it reaches a length some ten times as great as that of the body through which it passes, while the surface with which the foodstuff comes in contact is, when spread out, equal to half the outer surface of the body.

Along with the elongation of this inner surface and the double-pouching into the stomach as reservoir for new material and into the large intestine for waste substances, there goes a marvellous specialization of the individuals along the course which the food must pass, for the purpose of extracting the maximum of dissolved food from the raw material of varied kinds. In the primitive marine animal the ocean currents washed at will through an open tube, but, in this land-faring cell-group called man, the foods, as gathered, must be pushed along the food-tube surface by aid of specialized motor cells from inlet to outlet. With the aid of the motor cells various contrivances have developed for grinding the food substance and churning it about, certain groups of cells (the teeth) even taking upon themselves a stone-like hardness in order to aid in the fine division of food matter. Added to the mechanical means, every niche of this inner surface is crowded with little labora-

tories for supplying dissolving fluids, while great clusters of cells have been elaborated, as the liver and pancreas, which discharge their solvents through special tubes into the food canal.

There is nothing new under the sun, even within the marvellously complex human body—only development of amœbic possibilities; for even in the slow digestive process of the primitive piece of protoplasm the formation of pepsin and of an acid substance, which act as solvents, has been discovered.

All parts and special activities in the food canal are interdependent, and, since the food, when once passed into the grasp of the muscles which conduct it along, cannot be taken back, the appliances at the beginning of the tube must be used most carefully lest those below suffer from receiving but partially prepared material. In turn, the organs above suffer, and, of necessity, the whole body suffers, through imperfect working, from the passing

through of too much food or the imperfect earlier preparation of such food. Though capable of taking care of all the food necessary for the bodily needs, the laboratories of the food canal are not prepared to do much superfluous work, and can do none without drawing upon the general energies of the whole.

We have spoken of the life-enemies which find their way into the body fluid, and which, but for the defensive chemicals of the blood and the vigilant policing of the white corpuscles, would soon, with their rapid proliferation, work the destruction of the whole living structure. It is in the lower or waste reservoir of the great central canal that the hosts of bacteria gather and multiply. Some of them are harmless and even helpful to the whole, for they war upon more dangerous intruders, but when the digestive organs become overworked, and, as a result, the food is unsaturated with those chemicals which keep the bacterial hosts within

bounds, they increase in numbers and venom, and frequently find their way into the upper portions of the food canal, and even through the protecting walls of the canal into the body fluid.

Harmony and health, then, among the digestive forces mean that each organ must fulfil its ends and not shift its duties upon others. Likewise the health and safety of the whole body depend on the purity of the contents of the inner canal, the sufficient dissolving of the foodstuffs, and the keeping of the bacterial enemies in their proper places and uses.

Since not a little of the sum of general bodily energy is used in rendering the foodstuffs ready for absorption, attempts have been made to reduce this expenditure of energy by predigesting the food before placing it within the food canal. Mechanical chopping and cutting and grinding have helped greatly in this direction, and the jaws and teeth have become reduced in size since man has made use of mill

stones for molars and knives for canines. Cooking has also helped to relieve the chemical laboratories of the digestive canal of much of their outlay of energy, until we have come to depend on these accessory means of digestion. Still further, special digestive materials have been borrowed from our brother animals to aid an impoverished stomach or crippled pancreas. Indeed, in his desire to use his energies in other ways, man is near discrediting his own inherent processes, and would fain conduct all his food preparations outside his body, but not with the best results, for, as yet, the digestion of food is a large and important part of bodily activity, and, being a primal activity, is not to be set aside for artificial means.

Not only must the amount and character of the food material be balanced to the body needs and each special piece of digestive machinery given due exercise, but the waste matter which accumulates

in the lower reservoir of the food canal must be disposed of in due season, since, otherwise, the decomposing matter and the bacterial hosts which dwell therein become a menace to the integrity of the protective inner walls, and of the whole. Even with regular daily evacuation of the waste contents of the large intestine, some billions of microbes are discharged. (Klein finds 8 billions, Strassburger, 128 billions.) Fortunately, the vast majority of these bacteria are dead, and, in health, the remainder are of a nature helpful to the body. Then, the individual animals lining the wall of the food canal have, when all the body organisms live or work in harmony, a sharpened consciousness against all such foreign substances and, as Fleiner says, "the intestinal bacteria cannot effect an entrance into the interior of the body so long as the intestinal mucous membrane remains normal and unimpaired." It is believed, however, that certain poisonous substances easily gain an entrance, and

one of our greatest bacteriologists has asserted that the constant poisoning with materials made by these microbes brings on premature old age in all of us, and that by reducing the amount of these substances which leak through the inner walls we would increase the length of our days.

FOOD FOR MILLIONS

All the food material, though digested or dissolved, is yet as useless to the body as if it were on the outer surface—on the palm of the hand, for example—until it has been drunk or absorbed by the lining cells of the canal. The turned-in surface, besides being lined with the laboratory workers, finds room also for those cells which make it their business, and are endowed with the intelligence, to select the dissolved food substance and pass it through to form in the nutritive vessels a part of the general food material for the whole colony. The physiologist is free to confess that he does not understand why

these cells should take up certain substances and in certain quantities, and leave others alone. It is not more easily understood than why the primitive amœba should select and wrap itself about certain materials rather than others. The digested material is, much of it, rank poison; but the absorbing cells, in passing it through to the blood stream, change its chemical nature entirely, making it the life-giving matter of the blood plasma. Digestion is a very complex and important process, but absorption is as mysterious and needful a phenomenon. At any rate, each of these cells is possessed of a selective intelligence which, when its fellows are in harmonious working, is unerring. It rejects bacteria and the poisons with which it is familiar, but allows true food material to filter through its substance, changing some from poisonous to helpful materials as it traverses their bodies. It even assumes the old function of making itself into a mouth, and swallows globules

of fat to pass them through its body and discharge them into the body-fluid.

While the cells which take up the dissolved substances are in contact with the prepared food material outside the body proper in the central canal, yet the great majority of the many millions of workers in the myriad chemical laboratories throughout the length of the tube—in the liver, pancreas, salivary glands, and glands of the stomach and intestines—depend on the already absorbed food substance and oxygen brought from the inner nutritive fluid, the blood. Not only the material to keep up their own structure and life activities must be constantly thus supplied, but the raw materials from which they manufacture the food-dissolving chemicals must also be furnished, in sufficient quantity, from the blood stream. Especially at periods when the processes of digestion are most active, abundant nutriment must be furnished these special cells. It is plain that if another set of

individuals serving some other special purpose should, at the same time, make extravagant demands for the general nutritive fluid, the work of the digestive forces must be stopped, delayed, or deranged, since such economy prevails within the body-whole that not all special parts can work at their utmost capacity at one and the same time. Nor can one group of individuals set itself up in this community as more deserving than its fellows; the "thinking" cell—or rather one which is especially concerned with thinking—cannot usurp the rights and privileges of others to a full share of the general nutritive supply without sooner or later suffering from a diminished activity on the part of those it would rob. The thought organ is dependent on all the other organs, and, therefore, all, in a sense, become organs of thought. Here again, health means harmony and balance—no overdoing nor underdoing in any region.

The nutritive substance as prepared by

the earliest specialized cells was readily passed through the individuals lining the food sac or canal to those members of the group forming the outer protective portion. The number of cells was comparatively few and their activity slight, so that their needs were small. As the dissolving and absorbing cells became more and more adapted to their special work, and the whole body-cluster grew in size, the increasing fund of dissolved substance began to accumulate and form a reservoir in the body in the region of the central canal. Movements of the whole group squeezed the fluid collection this way and that between the cells. With the increase in size of the colony which this increasing supply of food now made possible, channels were formed, branching hither and thither until the general plan of the great food-distributing system of tubes began. It required only a matter of slow additions and modifications through the age-long advance in size and complexity of animal

life, to produce our own system of blood- and lymph-vessels, and their various structures. First, thinned-out cells formed a delicate wall keeping the fluid in its course. These again were covered with cells of elastic make-up to allow for currents of larger size. As the whole became more active, and each group of individuals needed a still better supply of nourishment to keep up its work, certain individuals in the neighborhood turned all their energies to the primitive quality of movement, of contractility, and, binding themselves about the blood tubes (as we shall now call them), came to form the muscle wrappings which squeezed the blood within them and kept it constantly in motion. The formation of valve-like flaps hanging in the blood-vessels kept the blood flowing in one direction only, while a large collection of muscle cells gathered together at one point, formed a force pump, the heart, which hastened the distribution of food. With these changes there is no going back

to the more simple life of earlier cell clusters, when the nutritive fluid was slowly moving, washed hither and thither in an indefinite fashion. All our life processes, through this very superior quality and quantity of nutrient substances, are made capable of more activity, and those processes become more and more dependent on a continuation of the same superior quantity and quality of food and oxygen, so that the mere stoppage of the force pump at the centre of the system of food-distributing tubes brings with it the death and dissolution of the whole.

The circulation of the blood is begun and carried on through the action of mechanical forces. The fluid, enclosed in continuous elastic tubes, is pushed always in one direction by the force-pump, the heart, and the flow is governed in rapidity and in quantity by the force and frequency of working of the pump, and by the size and friction within the tubes through which it passes. It is also continually influenced

by the pull of gravity and the pressure of the atmosphere. The specialized movement cells of these nutrient tubes are called on for a mighty amount of continuous work, night and day, to keep the whole cell-society of the body constantly supplied with food and oxygen. A hundred thousand times a day the heart pushes the good nutrient stream into the channels for supply, doing in that time enough work to lift the whole body to the top of the Washington monument.

ECONOMY OF SUPPLIES

So great is this expenditure of energy that it is economized to the utmost by limiting the various organs to necessary amounts only of the nutritive stream according to their activities of the moment, and reducing their rations proportionately when they are idle. Now one organ gets a full working supply, and now another. Thus, during the processes of digestion, the multitude of mechanical and chemical

workers along the inner canal of the body are abundantly supplied with blood, while the groups in other regions must be content, for the time, with less. This nice dealing out of the nutrient substance is brought about through a widening or narrowing of the vessels conducting the fluid to the part, by simply loosening or tightening the motor bands with which the tubes are wrapped, while these bands are made conscious of the local needs and of their duties in the matter through that general consciousness of bodily condition of well-being—the primitive sensitiveness to good and evil which has developed along with the elaboration of the other primitive qualities. Health and harmony again mean sympathy and subordination of each organ to all the other organs, since only thus can the blood supply be properly adjusted for the greatest good of the greatest number with the least outlay of energy on the part of the whole organism.

The liberation of energy in the animal

body is accomplished by the chemical union of oxygen with complex organic substances, both of which the cell takes from the blood stream. This process was, we may guess, already a part of the life of our primitive ancestor, and the oxygen was absorbed constantly from the water, to be given up again as a waste material, after being used and combined with carbon of the food substances. In the amœba the bubble-like bodies constantly forming in his interior and discharged at the surface are made up partly of this gaseous waste, the ashes and smoke from this microscopic engine being discharged from one and the same vent.

With the clustering into more than two layers of individuals, the cells, no longer exposed to the watery element, received, as the colony grew in numbers, ever less and less of oxygen. It mattered not, so long as the inner, sheltered cells served only to support and give shape to the whole, but with increasing layers of cells and increas-

ing bodily activity, along with the need of tubes conveying food material to the interior, there went an increasing need of oxygen to burn the food material and keep up the bodily fires for purposes of activity in securing foodstuff and escaping from foes. This need was supplied at first and in the simplest manner by the development of special tubes similar to the food tubes but containing flowing water from which each cell could extract its own oxygen. The lungs, by means of which man must furnish himself with oxygen, are but spread-out surfaces, bathed with oxygen-containing air, and protected by being placed within the body, while the air is carried in and out through tubes. On these lung surfaces the most delicate blood-vessels are looped in such endless profusion that an area of one hundred and fifty square yards is constantly exposed to the air, and the whole rapid-flowing blood supply of the body is aerated about every minute. Did we not otherwise know of the

great amount of energy used by the body, this surface for securing oxygen, so large compared with the whole body of the organism, together with the rapid circulation of the blood, would give us a good indication.

Some interchange of oxygen still takes place between the air in contact with the skin of the body and the blood, but, as an organ of such gaseous interchange, the skin is of slight consequence in man.

We have mentioned before how certain individual cells, which are named the red corpuscles, have become special carriers of oxygen from the lungs to the fixed cells throughout the body. These do their work so long as they are borne along with sufficient rapidity in the blood stream, and so long as the lungs are kept filled with sufficiently pure air.

The specialized motor cells were called upon to keep the blood currents moving rapidly throughout the body, and so these same moving specialists are necessary for

keeping the air currents constantly passing back and forth from air to lungs and from lungs to air, carrying in fresh supplies of oxygen and taking away waste products of combustion, carbonic acid, and other useless matters. Like the mechanical engine, the higher animal body, then, takes in water and solid food material, and discharges the used-up matter—the gases—through its air pipes, and the solid substances by way of the ash pits—the food canal and kidneys.

It is one of the conditions of general harmony and best working of all the individuals that the air in the lungs be frequently changed, and that the air breathed be, in itself, free from impurities of soot and dust and bacteria which are constantly floating about.

The vacuole or waste-matter droplet which is forever growing in the amœba to be discharged at the surface and reformed from waste matter within, is made up of carbon gas, of water, and also of

uric acid and other matter—the waste of the nitrogen-containing substances which it has used in complex chemical combinations but which, after burning, are, for its purposes, worthless. The more specialized body disposes of its gaseous waste, as we have just seen, along with vaporized water by spreading its blood to air, as it were, on the vast surface of the lung. The greater part of the non-gaseous waste matter, dissolved in water, is filtered out of the blood stream and thrown away by the collection of filtering cells—the kidneys. The individuals of this group do not act passively as mere pieces of filter-paper, but are endowed with a consciousness as to what is good and what is bad for their brother cells, and they keep or reject the good or the bad accordingly, often casting out the good along with the bad, when too much of the former in the blood (as, for example, sugar) might be of harm.

Sufficient unto their work under con-

ditions of general harmony, they are not to be abused by overloading of the whole with unnecessary quantities of harmful substances. Once, twice, thrice, they arise to such occasions, but they cannot always do more work than they are capable of, and so, in time, noxious matters slip by and accumulate in the blood, with resulting slow poisoning or death of the whole structure.

REGULATING THE FIRES

It is found that when the water in which an amœba dwells is heated to a temperature of about 98° F. the animal shows greater activity than when its surroundings are cooler or warmer. The lowest animals have no means of maintaining the medium in which they float at this temperature, but in the higher animals and in man there has developed a special heat-regulating mechanism which keeps the cells and the body fluids always at about 98°. In the dweller in frigid climates it stirs

up the body fires and demands fuel such as fats and oils that will produce the greatest amount of heat, while in tropic lands it reduces the internal heat production, rejects the greases, and asks for fruits and vegetables. It compensates for external heat that is higher than the body finds suitable by pouring water continually on the skin from its myriad sweat-glands, and the evaporation of this water reduces the body heat to the proper degree.

KNOWING AND DOING

Hitherto we have described only the elaboration of the vegetative traits of the great specialized composite: the dissolving and absorbing of food materials, solid, liquid, and gaseous; their conveyance to all cells of the body through the blood- and lymph-vessels; and the filtering out of waste substances as they accumulate. All this is possible only when the raw, energy-furnishing material has been placed within the grasp of the organs of the inner

digestive surface of the whole, just as the coal and water must be placed in the fire box and boiler of an engine, and the match applied in order to secure the liberation of energy contained in those substances. The engine differs from the animal in that it never goes about seeking for fuel, but must always burn the food brought to it.

Without the finding and securing of its own food the activities of the animal must cease, and, also, without the energy for doing so the securing of the food material would likewise be impossible. The obtaining of food material depends upon the supply already available to the individual cells, and, *vice versa,* the wealth of the food current depends on energy put forth in securing food supplies. For the lower animals, at least, life is made up of a continual adjustment between these two sets of activities, the food-getting and food-using—the energy-using and energy-getting ways and means.

This great division of life's essential

work is made up of, first, the apprehending or discovery of, and second, the securing of, the food substance. These two actions go together hand in hand and are helpless alone.

To illustrate by our remotest ancestor, that microscopic "mucous ball" is somehow conscious of substances in its neighborhood, and as the currents bring material, it wraps about or swims away from the object, according as it recognizes it as useful or harmful. With the clustering of cells such uncertain and ill-defined ways of obtaining food could not furnish a sufficient supply for the whole cluster. Such of these groups as fastened themselves in one place developed a means of bringing the food-bearing currents within touch, while those which moved about used the same means for travelling in search of new feeding grounds. We have described the earliest clumsy movements of the single-celled animal in making its whole body into a foot or arm. In the early group-animal

some of the outer cells pushed out delicate, hair-like fingers. These, as they waved forcibly always in one direction, were equivalent for the dweller in the watery medium to the oars of a boat, which, when the colony of cells was fixed, made currents in the water always toward its own mouth. In the unfixed type, the same appliances moved the animal about in the neighborhood. Just as the most primitive one-celled animal is to be found in the human body, so the examples of these first specialized motor cells of the earliest group are to be found within us on surfaces where, by their oar-like waving, they help to move foreign substances along their surfaces, and so to keep them clean.

In the larger animal colony it needed but the grouping together of many cells to produce a greatly magnified and flattened-out process, which, with certain joints and ribs of deposited, stiffening, lime material, slowly developed with the need thereof, produced a far superior

paddle; and this, drawn in definite directions by certain bundles of cells called muscle or movement cells, comes to be called a fin, though it is but the natural descendant of the hair-like finger described above, which, in turn, was only an improvement on the laborious making of the whole animal into a foot. What a vast saving of energy by this specialization in structure and function, by this division of labor! for, while propelled hither and thither in search of food by one set of cells, the special digestive and absorptive and circulative organs could be at work at the same time.

It is but a short step from a fin to a leg or an arm with their more complicated jointing and more elaborate arrangement of the colonies of motor cells. Still less of a step is it from the paw of the bear or cat to the hand with its prehensile thumb, which is said to have given man his prestige over all the other animals.

The ability to make itself into a foot

or to turn itself into a digestive sac is all-important to the continued existence of the animal, but the property of knowing that food material is in the neighborhood, that it is time to make itself into a hand or foot and draw itself toward the object, that it is in touch with the food, and that it should wrap itself about and enclose it, is as important for its existence as the processes which have already been described, and seemingly even more wonderful than those activities. That a bit of jelly-like matter should be able to distinguish between what is good and what is bad for it, is, if we can make comparison, more miraculous than that it should dissolve and absorb foreign matter and make it a part of itself. In the more highly specialized animal colonies the means of getting and of preparing the food is more elaborate, and the consciousness of needs and the power to select the good from the harmful is sharpened and aided, accordingly, by instruments of heightened precision. These

help detect the presence of food material even afar off, and guide the motor organs in moving the body toward the food supply. All these special mechanisms are but elaborations of the primitive quality of irritability, of sensitiveness, and of response to sensitiveness.

It is this quality which especially distinguishes the living from all other substance or structure. Man has been able to construct machines which burn carbon just as the body does, which develop energy for work, which even run about from place to place, saw wood, weave clothing, etc., etc.; but always they must be fed, for they never become conscious of their own diminishing heat or lack of fuel, nor will they eliminate their waste materials, but allow these to clog and finally fill the food box unless removed by the hand of man. A microscopic amœba is, then, more marvellous than the most complicated locomotive or silk loom.

As the primitive animal may make any

part of itself into a mouth or a stomach, into a foot or an arm, so every part seems endowed with sensitiveness to mechanical influence—the contact of another body, the molecular vibrations of sound and heat, the currents of electric energy and of light. Every part is likewise sensitive to chemical action. Every part of the primitive animal seems to conduct these mechanical and chemical influences to every other part. There is, too, a response to these impressions according as the primitive cell chooses to draw nearer to, or flow away from, the object which has come in contact with it. Somewhere within it is that something, most mysterious and wonderful of all things which we can study—the consciousness of what is good and what is bad for us, of what is helpful to the continuance of life's processes and what is harmful to those processes. We can know and understand this consciousness no better in an amœba than in a Shakespeare; we only know that it exists.

Though our single-celled animal has no special organs for feeding, digesting, or for getting about, it has a portion set apart for some definite end—a central portion called the nucleus. This never becomes a part of the stomach, and is never drawn out to help make a foot, and never divides save when the animal becomes so large that it divides as a whole to become two animals—and then each new animal has one of those unchanging central structures. It is well named the nucleus, for it seems to be that part of the animal about which the rest of its body is gathered. Moreover, this nucleus is evidently its seat of consciousness, the portion endowed with the gift of knowing its bodily needs, and, lying at the centre of the whole, it is constantly receiving communications from every atom of the structure as to whether these are in their proper position and relation with their fellows; while, through the messages that come from the outer portions, it receives

information of the objects in the neighborhood. The incoming messages are changed by it, interpreted into knowledge, and sent back in return messages which set the body material acting accordingly. The nucleus can be compared to the commander of an army who is continually receiving telegraphic information from the front as to the whereabouts of the foe, and also from his various subordinate officers as to the internal state of his army—each soldier representing a molecule, and the army the whole animal cell. He interprets the messages from all sources, sending orders for retreat or advance as he thinks the enemy is near or far, and as the country offers no forage or abundant provision.

With the clustering together of cells, each cell retains consciousness of its dangers and needs, and these are communicated from cell to cell. As the colony becomes larger and the formation of special organs for movement and diges-

tion goes forward, the sensitiveness which is still retained by each cell becomes more highly developed in a few which lie in contact with the outer world. These gradually push long and permanent arms from the surface through to a central point which becomes a meeting place and centre from which messages can be received and telegraph orders for action sent to the special organs of motion. Certain groups become especially sensitive to contact with other objects; certain groups to light, others to sound waves, and others to chemical action. We call these the organs of special sense, for they are specialized organs of sensitive response.

Not only does the centre of intelligence have connecting telegraphic communication with the special sense organs—the signal corps and spies of its army—but it likewise has wires (nerves) to and from its commissary officers, and each of these in turn is in communication with each individual of the whole myriad-celled com-

plex. Consciousness, therefore, not only directs an escape from dangers or an attack on foes which it hopes to overcome, but it sets the movement machinery going in search of any food material when the messages from any part of the body indicate a need.

With all the elaborate specialization of cells for various works, each retains, or acquires through long habit, its own cell consciousness, selects from the blood stream only such material as it needs, and rejects what it does not need. Thus every secreting cell of the stomach takes from the blood stream material for its own bodily needs, and also those substances which are needed for its chemical-elaborating of pepsin or hydrochloric acid, while the cells of the liver pick out the substances from which they form bile, and remove the sugar from oversweet blood, change it to glycogen, and store it for future use. Each is somehow conscious of its own needs and of the work it must

perform, and, through communication with the central conscious centre, is conscious of the needs of other parts of the whole, so that it carries on its special activities or rests, as the body as a whole requires.

The nucleus or conscious centre of the single-celled animal is all that is needful to keep the whole cell in harmonious working, and this is the case with our amœba-like white blood-cell; but more and more, with the elaborating of special fixed cells for special duties, each group of workers must be kept informed as to the condition and needs of the others in order that harmony and health may exist.

There are, in man, three sets of conscious centres: first, the nucleus of each cell, governing the life activities of the individual cell; second, the nerve centres of the spinal cord and medulla which constantly receive messages from the various groups of cells and organs, and which direct the supply of nutriment to each, controlling and keeping up the vegetative

processes of the body night and day; and finally, the highest conscious centre with its various instincts which are but conscious feelings as to the need of new nutrient material, of hunger and of thirst, of the need to evacuate waste material, of the need of heat or of cold, the consciousness of danger or of safety in the objects which impress the cells of seeing, hearing, smelling, etc. This highest centre is made aware from time to time, by the lower centres, of the bodily needs, and it proceeds to direct the motor machinery—the muscles and bone-levers of arms and legs—into such activities as will secure what is needed for satisfying those conscious needs for the preservation and perpetuation of life.

In the higher animals the activities of the highest consciousness and of the motor system in obtaining a living, are heightened by resting for about one-third of the time in sleep, during which repairs are made and stores of energy are laid up in

all the cells for the activities of the waking period. These periods of activity and inactivity have come to be so arranged partly through the alternation of night and day—of hours when it is easy to use the sense organs in detecting food, and times when it is not so easy. After periods of rest and in times of superabundance of food material, there comes to be a surplus of energy for driving the motor machinery, and such motor supplies come to be used in practising those movements which, in the real game of life, result in securing food material. So we, as a result, have play, or the exercise of the motor bodily organs through the discharge of the accumulation of surplus energy; even bears and foxes play. Whatever may be our theory of play, we may always be certain that it means superabundant nerve force and a goodly supply of nourishment. The hungry and sick never play.

In man this oversupply of energy in the realm of consciousness leads to discharges

in new fields. At first these new excursions of motor activities are originated by his instinct for what is helpful to his body. He finds a shelter a good thing, and so makes a covering of boughs to rest under, and this, later, is perfected into a house. He accidentally finds a palm leaf a protection from the tropical sun, and a mat of grass a good wind-break, so he soon turns these into a hat and a cloak. His prehensile great toe grasps easily a stone, and he finds this of use in getting food and in defending himself from enemies. Experience shows him that ground and softened grain is more easily chewed and digested than the raw material, so he proceeds to grind his corn and cook his various foodstuffs.

All this is but further elaboration of the means of keeping up the nutritive processes, but the conserving of the bodily powers by clothes and shelter, by external artificial heat, by grinding and cooking of food, and by the securing of a more suffi-

cient and steady supply of food, has brought with it superabundance of nervous energy which seeks outlet in all forms of mental work, in elaborating yet further means of reducing the outlay of bodily energy in the obtaining of the means of subsistence, and in all forms of the mental play of study and investigation. He invents sundry labor-saving machines, and in the energy and time he secures by these means his mind plays upon all the phenomena of the universe to which he is sensitive.

In the human microcosm, then, we have three sets of conscious activities existing on different planes: *First,* the continuous consciousness of the individual cell of its individual needs for keeping up its own energies and for carrying on its special work; *second,* the middle consciousness which each cell and group of cells has of the condition and activities of every other group—the blood-pumping organs of the digestive organs and the digestive organs

of the movement organs, etc.; and *third,* the highest consciousness, which we commonly call the mind, in which is reflected the general bodily feeling of well-being, of harmony or discord, of pleasure or of pain, and which attends to the supplying of bodily needs of food material and of body comforts, and which investigates and classifies its observations regarding the universe.

The figure of the army may well serve us again. Each individual soldier knows and supplies his daily needs in the way of food and drink, and carries on his daily work. He is conscious, by contact with them, of the members of his own company. He has information from, and is constantly in touch with, the sappers, engineers, signal corps, and other more distant parts of the army, through constant interchange of messages. The commissary department is called upon, and supplies the needs of the various sections of the army from day to day. The whole would, however, come

to dissolution without a central guiding consciousness, the commanding officer, who, though knowing nothing of each individual man, his activities and needs, and having no detailed information as to the doings of the commissary and other departments, yet is informed as to the general conditions within and without the army—the internal needs of the whole force, the amount of his supplies, and the ways of adding thereto, of protecting the army from attack, and of finding the weak points in the enemy's lines.

In the animal body all the connecting nerve machinery is more elaborate and perfect than the machinery of communication in any army, and the ready response of one part to messages from another keeps up the harmonious working of all until the fatal dissolution of one or another set of cells brings about disharmony and lack of support of organ to organ, and the whole goes to pieces in death.

As, in an army, the death of one person or the loss of a thousand will not interfere much with the activities of the whole, especially if these can be readily replaced, so, in the human body, individual cells are constantly dying, and often by some injury thousands will be destroyed without interfering with the life of the whole. If a corps of the army is destroyed or cut off from the main body, the army may be in serious danger, and so, if a limb or a lung in the human organism becomes diseased or injured, the whole must suffer or, perhaps, perish.

LIFE FROM LIFE

The simplest one-celled animal grew to adult size, and then, in most wonderful fashion, divided into two new cells, each of which became a separate animal of the same type as the parent.

In the animals which are made up of a colony of cells of different sizes and purposes, reproduction is brought about

by the budding of a few cells and their growth into another animal, just as in a plant a bud is formed which grows into a new plant. These offshoots may remain attached to the parent as in the coral, or become separated from the parent as in the hydra. In still higher animals, just as in the higher plants, reproduction is brought about through the union of cells from two separate bodies, the male and female. These united cells form the "egg" from which the animal develops. In some animals this egg cell begins its long process of division outside the body, while in man and other highest animals in which, because of its great complexity, the animal must pass through a long period of cell multiplication and division of work, the process takes place within the body of the mother, from which it gets all its food material. The new animal reaches the outside world only when its various parts have become formed. Even after birth the " man-cub" is not yet fully

developed, but must spend some twenty years or more in attaining to a complete unfolding.

In all this long process of reproduction the animal goes through the same process of cell multiplication and specializing into various organs—for nutrition, for consciousness, for activity in seeking food and avoiding foes, and, finally, for again reproducing itself—and it repeats in its life history the life history of all animal forms, from the one-celled amœba up to the final type of the parents.

Man is, then, an earth-walking, air-breathing collection of myriad marine creatures, each made up largely of water and bathed continually by a salty, sea-water-like fluid. Each single cell lives its own conscious life, but is dependent on all the others of the whole for its continued existence. Each is kept at its best by that germ of mind which we know as its instinct or habit, and the various collections of specialized cells of the whole are kept

in health (in harmony) by the instinct of the whole, by the consciousness of the body needs, and of the good or evil influences in the surroundings.

In him, as in the lower animals, life is made up of the four primitive functions: *consciousness of life's needs, securing of food, assimilation of food into his substance,* and *reproduction of his kind.* Though each function has become highly elaborated, yet all our activities have sprung from one or the other of these. *Health means a happy balancing of these activities.* Sickness and death are only disharmony and lack of sympathetic response and subordination of one group of cells to another.

"The Reflection is not more common than just, That he who lives *physically* must live miserably. The Truth is, too great Nicety and Exactness about every minute Circumstance that may impair our Health, is such a Yoke and Slavery, as no Man of a generous, free Spirit would submit to. 'Tis, as a *Poet* expresses it, *to die for fear of Dying.* And to forbear or give over a just, charitable, or even generous Office of Life, from a too scrupulous regard

to Health, is unworthy of a *Man,* much more of a *Christian.* But then, on the other hand, to cut off our Days by *Intemperance, Indiscretion,* and guilty *Passions;* to live miserably, for the sake of gratifying a *sweet Tooth,* or a brutal *Itch;* to die *Martyrs,* to our *Luxury* and *Wantonness,* is equally beneath the Dignity of *Human Nature,* and contrary to the *Homage* we owe the *Author* of our Being. Without some Degree of *Health,* we can neither be agreeable to *ourselves,* nor useful to our *Friends;* we can neither relish the Blessings of *Divine Providence* to us in *Life,* nor acquit ourselves of our *Duties* to our *Maker,* or our *Neighbor.* He that *wantonly* transgresseth the *self-evident* Rules of *Health,* is guilty of a Degree of *Self-Murder;* and an *habitual* Perseverance therein is direct *Suicide,* and, consequently, the greatest Crime he can commit against the *Author* of his Being. . . . The infinitely wise *Author* of *Nature* has so contrived *Things,* that the most remarkable Rules of preserving Life and Health are *Moral Duties* commanded us; for true it is, *that Godliness has the Promises* of *this Life, as well as that to come.*"

GEORGE CHEYNE, M.D.

PART II

MAINTENANCE OF HEALTH

INTERNAL CONDITIONS OF HEALTH

COMPLEXITY

In studying the human body one is most impressed by its extreme complexity of make-up and delicacy of working, and the dependence of each part and of each set of activities on every other portion and function. The harmonious working together of all this maze we call health, and any lapse from perfect harmony results in lowered vitality or sickness. As Sir Thomas Browne said: "We that have examined the parts of men, and know on what tender filaments that Fabrick hangs, may well wonder that we are not alway more or less out of health."

This increasing complexity and mutual dependence has been a good thing according to Nature's thinking, for, as we have seen, toward such a condition the course

of animal development has taken its way through the ages. By the law of the survival of the fittest, Nature has maintained a harmonious growth and working in each of the complex organisms, and impaired organs or bad habits of working or attempts at insubordination in any of the parts have brought sickness and death to the discordant individual. In the struggle for existence health meant survival, and survival was equivalent to a certificate of perfect harmony of all parts, and the complete adjustment of the animal to its surroundings.

Man alone has escaped the full penalty of this harsh law; but, though he may not be destroyed by more powerful enemies, he is surpassed in the race of life by those of his own species whose bodily machinery, taken in the complete sense of the word, is in more perfect working order. Instinct tells a bear or a fox what to eat, when to seek food, and when to rest; but, in man, the instinct which should produce

the same bear-like or fox-like perfection of growth and of bodily strength and endurance and of mental cunning has been partly set aside, with the change to "civilized" living. We no longer have to shift for ourselves in a few months after birth; those who are weak or sickly receive special care; all are shielded more or less from Nature's attacks; and none of us have to be constantly on the alert for enemies who would take our lives. We are fairly encouraged to disobey the laws of bodily harmony by being sympathized with when we commit minor faults, and nursed back to health after gross disobedience. We know that for some present pleasure in overeating, overdoing, or in the use of narcotics, we can bring about a disharmony of our inner workings without apparently more than a few days of succeeding depression or discomfort. A man may become intoxicated, knowing he will not be devoured piecemeal by his neighbors, and so, for the present satis-

faction, he goes on a drunk, though he reaps a harvest of suffering from abused organs and lowered vitality. Likewise he ceases to eat to satisfy his needs, but makes the tickling of the palate with civilized viands and drinks an end in itself, forgetting, or not heeding, the warnings which the overworked organs of digestion or of excretion send promptly to the central governing consciousness. Headaches, drowsiness, etc., are not always recognized as of importance since the law of survival of the fittest has become less severe in its working.

Though the civilized, sympathy-breeding life allows the feeble and sickly to survive with the strong and vigorous, notwithstanding all this change wrought by social living, health means just what it meant ages ago—a complete harmony and mutual respect and support among all the body members.

CLEANLINESS

First of all among the essentials to this harmony is *cleanliness.* "Cleanliness is next to godliness," and godliness is health. Cleanliness is not used here in the ordinary sense of removal of foreign material from the surface of the body. Accumulation of soot or dust on the outer surface of an engine may interfere little, if any, with its working, but let a few grains of sand find their way into one of the polished bearings and mischief is done which can only be remedied by replacing the part with a new casting. The accumulation of ashes in the fire-box or of soot in the flues soon brings about a condition of diminished working—of poor health, or low vitality we may well call it—only to be prevented or corrected by a careful shaking out of ashes and cleansing of flues.

The first law of health, the first essential to bodily harmony, then, is cleanliness of the inner surface of the body, of that

turned-in surface along which the food substances travel. We can easily believe that any decomposing organic material would be detrimental if allowed to remain on the outer surface of the body, although that surface is protected by many firm layers of scale-like cells. Because hidden from view, we overlook the seriousness of such accumulations on the inner surface where only one layer of very delicate cells stands between the foreign, offensive, often poisonous, matter and the living structures beneath. Properly prepared food in sufficient amount is, if passed through the canal in the usual time, not only harmless but, as we have seen, the source of life to the whole structure. Even the bacteria which reside in such myriads in the lower parts of the canal are harmless to the body, and their action on the food is probably a help in its preparation for nutritive purposes.

Under "natural" conditions, as among the lower animals, appetite or the con-

scious intelligence of the condition of all the body cells, telegraphed to headquarters, is a correct guide as to the quantity and quality of food needed. So, also, a similar instinct informs these governing centres when the waste material has collected in such quantity in the reservoir of the large intestine as to need to be disposed of. These instincts are the double lines by which Nature has guided her children to cleanliness in her rule of the survival of the fittest. Any attempt at escape from either of those instincts brings more or less loss of health and vitality. The law and the consequences of disobedience hold as well for man as for the animals.

Through the prevailing power of the immediate pleasures of taste we are often led to eat more than we need for bodily uses, and this means that more food is taken than the muscles of the food tube are in the habit of moving, and they must either draw more for the purpose from

the total sum of bodily energy than is usually allotted to them, or they fail to move the stuff along at the proper speed. The digesting organs are also called upon for an expenditure of energy beyond their usual amount or beyond their utmost capacity. The foodstuff thus not only remains longer than usual within the canal, but the digestive juices fail to render it a poor breeding ground for the bacteria; these become enormously increased in number and tax to the utmost the protective cells of the tube walls, while the greatly increased poisons of putrefaction which they produce in their growth escape through the walls and into the blood stream and thence are carried to all the body cells.

This overworking of the structures of the food canal brings about a lack of harmony in the whole body, since the food material of the blood must be supplied to these organs at the expense of the organs of mental or muscular activity,

while the poisons escaping into the blood bring about general depression of these functions, felt as languor, fatigue, headache, dizziness, and the like. In children, fever, vomiting, or even convulsions may be produced by this disobedience of Nature's ruling—this lack of cleanliness of the food canal.

The imperfectly prepared material, the poisons from putrefaction, or the increased number of bacteria, may produce such local damage to the lining cells that germs of typhoid or tuberculosis often secure a lodgment in such numbers as to produce serious disease. Even if the amount and quality of food taken be not abnormal, there remains another source of uncleanliness in any failure to respond to the instinct which asks the higher consciousness to evacuate the contents of the large intestine. The large intestine has been developed to allow for periodical rather than continuous discharge of waste matter, but for health and relative cleanliness the

times of cleansing must not be too far apart. This instinctive warning, unheeded many times, is blunted or even lost. The longer the contents remain in this reservoir, the more water is absorbed from it, until it becomes dry and hard and difficult to evacuate. In time also the reservoir becomes more and more distended and, consequently, less easy to empty.

The overlong retention of material produces much the same results as overloading the food canal; the bacteria and their poisonous products accumulate, and, there being no other means of escape, pass directly into the blood and so to all the tissues.

The remedy for this source of uncleanliness and disharmony in the bodily machinery is not far to seek. It must be found in heightened respect for, and obedience to, the laws of the lower animal life from which we have sprung—the prompt response to the instincts for sufficiency of food and for emptying the waste

material from that food in due season. These instincts need only fair treatment to prove as efficient in man as in any animal. The child can easily be taught regularity of habit with regard to emptying the intestine, and, if brought up so, any deviation from such a habit will bring about such general bodily discomfort as will point at once to the cause of the discord. In an adult in whom the instinct for inner cleanliness may have become blunted by years of abuse, it can be re-established by care and perseverance. A regular daily habit at an appointed hour, a sufficient diet, and taking such an amount of water as Nature would have advised had she always been listened to, are often sufficient, while mechanical assistance may be given to weakened muscles by proper local massage or by the stimulation of the abdominal organs which accompanies moderate general bodily exercise.

The instinct for the quality and quantity of food, after the earliest years, pro-

vided the food be plain and easily digested, will take care of the matter if given an abundant allowance and variety of food materials. It is the too great restriction of foods which brings about, in children, overfeeding when occasion permits. "Excess is the vice rather of adults than of the young, who are rarely either gourmands or epicures unless through the fault of those who rear them." As pointed out by Spencer, we are too apt to foist our adult appetites upon children, and to look upon their craving as all wrong, both as to quality and as to quantity. If our tables were supplied with things which satisfy a child's palate as well as those which appeal to the adult needs, the former would not only escape the effects of clandestine candy sprees and green-apple orgies, but their growth and development would be the more perfect. By lack of moderate indulgence the appetite for such things as the body calls for is heightened into the abnormal. Probably some of the palate-

tickling dainties devised by confectioners which so appeal to the child's appetite are harmful, though if sweet things in general were less restricted they might prove less tempting to overindulgence.

While sufficient cleanliness of the food canal requires that the food shall not be above a certain average quantity, it, on the other hand, requires that the amount shall not be too small nor too digestible, since the muscles of the intestinal walls work best when they have something of at least moderate size within their grasp. Too much food is, then, opposed to conditions of cleanliness, and so is too little bulk. Appetite, or the feeling of general condition, should be the controlling monitor. Our civilized methods of living may necessitate a little additional knowledge of the bodily machinery, but, with this aid, our instinct will guide us aright even among the maze of food fads with which the twentieth century path of life is beset. We cannot get far away from our

inherited animal method of living without coming to grief, and the feeling of health —of power for work—is an unerring guide as to whether we are following out the right lines of bodily care.

APPETITE

In the adult the bodily activities required for obtaining the necessities of life have, among a large majority, become much diminished in amount, are often monotonous, and are usually of an indoor kind. The appetite which goes with the more active life of earlier years is not always diminished, and there often remains what might be called the more "natural" demand of a digestive system of large capacity which cannot easily adjust itself to the general bodily habits of comparative muscular idleness. If the man of sedentary life has descended from a line of shopkeepers or people of professional walks, the appetite is often diminished by inheritance, but where there is an ancestry

of active woodsmen or farmers, the appetite may outstrip the bodily needs. From such an ill adjustment of digestive capacity and demands to bodily needs, there takes place an absorption of an overplus of digested material, which results either in the storing up of burdensome quantities of fat or in the constant overloading of the excretory organs with more than their share of work. Some of the waste matter may even be deposited within the tissues, where it acts as a local irritant and painfully disturbs the harmonious working of the parts by its unwelcome presence. The work of riddance of the waste substances not only brings extra work upon the kidneys, lungs, and skin, which dispose of superfluous material within the blood, but the heart and the blood-vessels must work the harder to force the blood faster through these organs. A lack of harmony results, with slow thickening of the heart muscle and of the vessel walls, and a vicious round

of disharmony and disease results from this effort of the body to keep the blood in its normal purity. It is only a wilful control of this appetite, out of harmony with bodily needs under artificial conditions, that will prevent such conditions of impaired health, or, what is more in keeping with Nature's means, the maintenance of an amount of bodily and mental activity which corresponds with the individual ancestry. One must observe the old admonition "eat to live and not live to eat," if he would keep the blood in its best condition and the bodily organs in perfect harmony.

Though the appetite, under our civilized habits of living, may prove an imperfect guide, the general feeling of *well-being* and *power for work* which accompanies the taking of a right amount of food and of exercise we may call the corrected or restored appetite or the health conscience, which is the more sane guide to bodily needs. Appetite should represent the

general bodily condition rather than the condition of the digestive organs. For quality and quantity of food, the appetite, when the methods of living are as near the natural and the ancestral as society and the demands of occupation will permit, is a true guide. It must vary with the period of life and the demands of growth and of daily occupation. It is natural for the child to crave sweet things and fruit and to repel fats, while in the adult the hunger for sweet things largely disappears and he is able to appreciate butter and bacon. So, for the feeling of general bodily well-being the bookkeeper will want much less food and that much more easily digested than the wood-chopper who uses up twice the amount of energy and who has a digestive system as rugged as is his muscular apparatus. Pork and beans in large quantity set easily in the stomach of the latter, while the former asks for an omelet and a glass of milk, and considerable bodily

exercise is needed to make a "square meal" feel comfortable and not leave future depressing effects.

The food taken into the body serves many ends, but first it goes to keep up the vegetating functions. Thus, out of some 2500 units of energy which an active body of 150 pounds needs every twenty-four hours, and which must be supplied by the food taken, some 250 units, or one-tenth of the whole, is made use of by it in digesting and absorbing the energy-giving food material itself; about 350 units, or about one-seventh of the whole, is needed for distributing the digested food throughout the body; the breathing in and out of the air requires 150 units of energy, while the riddance of waste matter from the body will also take considerable energy, perhaps more than 100 units. Of the 1650 units which remain, more than half is needed for keeping up the heat of the body and general repairs of the tissues. Thus, of the total 2500 units about 1700 units are

needed for mere vegetative activities, while for hard muscular or mental work the food must be increased according to the amount of work done, up to as high as 5000 units in the most exacting occupations. The amount of food required must also vary with the temperature of the surrounding air, much more being required in cold than in warm weather. The loss of appetite which comes with the change from winter to spring and from spring to summer is the bodily intelligence telegraphed to the higher consciousness that there is less need of heat-forming substance—that we need to eat less.

The amount of food required varies also with the amount of fat by which the body is protected from cold, and also with the amount of clothing which prevents radiation of heat. Some bodies, like some engines, are more economical in their use of fuel and so require less food than others.

Man is the only animal that can adapt

himself to almost any kind of diet, provided the food substances contain the needful elements for his body, but it is absurd to try to fit all men of all races, and even in the same race the men of different habits and occupations, with the same kinds of foods or with similar amounts. We cannot improve upon Nature's guide—the feeling of general well-being and of capacity for our utmost physical and mental work, which comes with the taking of proper food in sufficient amount. Only sensitiveness to this guide can help one through the maze of dietary teachings which are so at variance.

BODILY ECONOMY

Man is the only animal that has learned to lighten the amount of energy used for work by the invention of machinery, and he is likewise the only animal that has relieved its vegetative activities of some of their work by beginning the digestion of food outside the body. This he does by

grinding and cooking the food, thus saving not only muscular force but also the outlay for the production of chemical solvents within the body. Even with the help of the grist-mill and the kitchen, we have seen that one-seventh of the total sum of bodily energy usually must go to the work of digestion and absorption. The common processes of cooking must then have a very important rôle in the economy of bodily force, and among those who stand at the top in all the activities of life and with whom there is constant need of all the bodily energies, it may be said that the methods of preparing their food is often a source of failure or of success in all lines of work. The art of cooking is of large import as an accessory to the art of living. A writer in Queen Elizabeth's time said: "Coquerie is a part of Physicke; and a good Cooke is halfe a Physition."

If it is a wise and economical thing to use these outward means to food digestion, it must be of even greater importance to

make the utmost use of the inborn food-preparing organs—the teeth and the secreted fluids of the mouth. After the food has once left the mouth it cannot be returned, as in the ruminant animals, for further preparation. It behooves us, therefore, to chew our food well and to moisten it thoroughly with the salivary solutions before allowing it to pass to the more delicate organs beyond, which are not equipped with structures for grinding. By so doing we may not become unusually robust, but with reasonable though not undue attention paid to these primary processes the food is more promptly and easily digested, and there is less wear and tear on stomach and intestines.

Up to adult life there may be temporary upsets of the digestive organs, due to rebellion on the part of those organs following excesses in eating. These reminders of the need of bodily harmony are Nature's means of keeping things in order in our inner working, and of shaping in-

stinct to new conditions of living. In adult life, however, with lack of bodily play or mental recreation, the digestive organs have not always the support they formerly enjoyed from the other functions, and minor disorders of working, or "dyspepsias," arise—gentle reminders of discord somewhere in our machinery. These are made worse by any sources of worry or of anxiety which come with the energy-draining strife of adult life.

Through lack of physical stamina, or of mental adjustment to the ambitions and vicissitudes of social competition, the nervous forces which naturally should find their outlet in the direction of physical or mental work or play are often turned in upon self with a resulting friction of introspection more or less disastrous to the digestive organs, whose workings are set awry. The only correction for such disorder is a reduction of the excessive drain of energy in over-ambitious work, or the

direction of the mind into happier channels outside self—in a natural outgo of physico-mental play which will help clear up the mental states which disturb the bodily functions. For those lacking in nervous energy it may mean that bodily rest is most needed; for those with super-abundant but misdirected energies it will mean that bodily exercise will prove a means of balancing the bodily machinery. Cicero, when dyspeptic, betook himself to the place of games, not to look on, but to participate, and our modern statesmen wisely follow the same example by seeking the golf course or tennis court for recreation. It all means that the bodily energies must be conserved and directed in old and normal channels in order that there may be the utmost sense of well-being and power for work.

POISONS FROM WITHOUT

By instinct Nature has guarded her progeny against poisonous substances from

without the body, but, in man, the sheltering from the destruction by other animals, which in the animal state he would be subject to, has permitted not only the poisoning from the overloading of the alimentary organs, but the taking of those poisons against which he has no special protective means; namely, alcohol, opium, and the like. These produce disharmony so long as they remain as foreign substances in the body, and the organs of excretion are taxed to their uttermost until they have been disposed of.

Alcohol acts especially on those most delicate because most recently developed of all the tissues,—the highest nerve-cells, the centres of the highest mind, and these are, for the time at least, rendered more or less incapacitated. Should such a condition have been brought about in the lower animals, they would soon have fallen victims to some saner animal, but in society the body degradation is protected by the sympathy of others and the

poisoned person usually survives to repeat the experiment. Not only is the finer working of consciousness temporarily impaired, but, if the abuse is continued, the higher nerve-centres become permanently damaged, while at the same time the extra amount of work thrown upon the organs of elimination produces overwork and consequently overwear, until, finally, liver, kidneys, heart, and vessels, and especially the nerve structures, become diseased. Through individual and racial experience of its effects upon self and society, man has been learning to leave this treacherous substance alone. The agitation of temperance and the making of prohibition laws are but the crystallizing of these many experiences of its injurious effects into a social instinct which would govern and control the individual who has not yet learned the lesson for himself.

While the digestion of too much food cumbers the body and imposes burdens upon the organs which dispose of needless

material, so alcohol adds to this burden, and a combination of overfeeding and the use of alcohol is the adding of insult to injury of these organs. Besides, this poison, in benumbing the delicate, latest developed mental machinery, brings about the curiously detrimental state of false feeling of bodily and mental well-being and condition for work.

Since each member of the body colony is constantly wearing itself out and needing new material for repair and rebuilding, and since the blood stream is the source of repair and energy-furnishing material, it is of the utmost importance that the blood supply be always at its best in both quantity and quality. The lack of sufficient food material must reduce the working power of the whole body, and the presence of foreign substances, such as we have just described as coming from constipation or an overaccumulation of waste matter from the working cells themselves, is a menace to bodily wholeness or

health. As to the quantity of food needed and the amount of water sufficient to keep the blood in its normal dilution, the appetite always has been, and continues to be, the true and only guide, provided we follow out the natural conditions for harmonious living. With the child who has abundance of sleep, of fresh air, of sunshine, and freedom of play, and who is not urged to overdevelopment of his mental powers, the appetite is, unless with the exceptions before noted, a perfect guide. It is only with a curtailing of Nature's conditions for healthful growth and living, often through overanxious efforts toward an impossible unfolding of its mental activities, that appetite and resulting nutrition fail to reach the normal. Any discharge of superabundant nervous force in bodily activity is beneficial and tends to bodily welfare. In the realm of those finer bodily activities which we call mental work the same is true, but where the abundance of nervous force is insufficient or where

the feelings of worry or strain arise, a friction is created which wears upon all the structure and upsets more or less all the bodily functions, disturbing the digestion and perverting the appetite. Fortunately, it is only those who are reared too far from Nature's care that are thus disturbed, and the remedy is always with us, if it be not too late to apply it—a return to Nature's ways.

Since all the food must pass through the mouth, it is of great importance for inner cleanliness that this cavity should be as clean as possible. While many bacteria, some of them of a bad reputation, are constantly finding their way here, they are kept in check or washed away by the fluids of the mouth. It is especially important that the teeth should be well preserved, for not only are clean, sound teeth necessary to good digestion, but unsound teeth are opposed to inner cleanliness. A tiger or a fox does not need a tooth-brush, but for the present the use of this instrument

of pig bristles helps to keep our teeth from attacks of bacteria. Where the food is best adapted in quantity and quality to the bodily needs, and the general bodily mechanism is in greatest harmony, the chances of decay of the teeth are reduced to a minimum. The general health depends on the condition of the teeth, and the condition of the teeth, again, depends on the general bodily harmony.

BREATHING

Equally with the food tract, the turned-in surface of the body, through which we receive our constant supply of oxygen and discharge an abundance of waste material from the body, needs to be kept as free from foreign substances as possible. Twenty thousand times a day the air flows through the long air-passages to and from the lungs. It is evident that if one minute grain of dust were carried into the lungs at each inspiration there would be accumulated, in a few days, a quantity of dirt suffi-

cient, if not gotten rid of, to choke the air-passages. Such a condition would diminish and finally extinguish the bodily fires. The greatest degree of cleanliness of the air-passages can only exist where the air breathed is as free from dust or other foreign substance as possible. Since constant pure air is not always possible, Nature has devised and fitted us with special appliances for filtering the air as it passes into the air-tubes. The entrances to the nasal passages are lined with a network of hairs which catch the coarser dust particles. Beyond these the air is sent whirling through tortuous ways lined with moist, mucus-covered membrane which entangles more of the foreign substance; while, further down, the tubes leading to the lungs are not only covered with sticky mucus but are lined with those most primitive of motor organs, the ciliated cells, whose hair-like processes are constantly at work night and day waving the mucus-entangled dust and bacteria toward the outer

world. Where these constant workers have been for a moment overwhelmed there are Nature's additional, more violent cleansing devices of sneezing and coughing, and of unusual discharges of mucus from the laboratories lining the air-passages. All this elaborate machinery is ample protection from uncleanliness of the lungs and air-tubes under any ordinary conditions, and it is only persistent disregard of an instinct for pure air, which goes along with this protective machinery, that causes any lack of bodily harmony from overworking of these means of cleanliness, or the production of injury through the accumulation of foreign substances. It is needless to point out that almost the whole of these protective appliances which Nature has spent millions of years in preparing for our welfare are of no use whatsoever where the breathing is done through the mouth instead of through the nose.

Nor is it important to breathe through the nose wholly for the sake of purifying

the air, for a part of this protective arrangement also serves to warm the air and to moisten it before it reaches the more delicate special cells of the smaller air-tubes and the lungs. Where the air is unnaturally dry, an abnormal amount of work is thrown on the mucous membranes of the air-passages in keeping them moist, sufficient sometimes to injure them from overwork. The breathing of air as pure as possible, which has not been artificially dried, is essential to the best bodily condition, but it is even more necessary for health that the air should reach the lungs through the specialized passages of the nose. If these—Nature's specifications—could be carried out, we would hardly know such a thing as tuberculosis of the lungs.

Nose-breathers who are forced temporarily to breathe through the mouth during an attack of hay fever or severe cold in the head, can appreciate the feeling of general bodily distress which mouth-

breathing brings with it. Those persons who have some chronic obstruction of the nose from adenoid vegetation or other cause show the evil effects which this disharmony brings about, physically and mentally.

BATHING

Cleanliness of the outer surface of the body is second to cleanliness of the interior of the body, but is nevertheless an important source of health. The knights of the Middle Ages and the old saints who went for years without a bath and who never knew the luxury of soap, may have escaped many skin diseases and have been in rugged health, but we would have considered them unsuitable as social beings. Bathing can, however, be overdone and the oil glands of the skin exhausted. The peoples who have been the most frequent bathers have recognized this by replacing the natural oil with lubricants from other sources.

The skin presents a large surface minutely sprinkled with delicately responsive nerve endings which keep the heat-regulating consciousness informed of its condition. The use of a bath in which the temperature of the water is very different from that of the body excites these irritable cells, which at once inform the heat-regulating consciousness as to the state of affairs, and this responds by increasing the blood flow to the skin in order to preserve the balance of heat to the body. Cold baths have thus a general stimulating effect on this part of the nervous system, and, by so exercising it, improve its powers of ready response; however, a cold plunge or any form of bath which is followed by a feeling of chilliness or of depression is better omitted by the person taking it, though it may be lauded to the skies by some one else. Instinct is, here as elsewhere, the safe guide.

Since the bathing of the body is accompanied by an increased flow of blood to

the surface, it follows, through the economy which the body exercises in distributing the blood, that a bath should not be taken just before or soon after a meal, as the digestive processes must, for the time, be interfered with, through the withdrawal of the blood supply from the digestive region.

MAKING REPAIRS

The life-bearing blood stream is kept in constant motion in its rapid round to and from the sources of food and oxygen supply and the places of waste disposal, travelling, in all, over a mile each day. This all goes on through working of the heart and muscle-tissues of the blood-vessels, and without the highest consciousness being made aware of the amount of work done, save when, during severe exertion on the part of the digestive, eliminative, or motor organs, the overaction of the heart becomes perceptible. It is all governed by that subordinate conscious-

ness which, as we have seen, looks after the regulation of the vegetative portion of our make-up.

As already described, the nutrient fluid is so valuable and requires so much outlay in preparation for bodily use that strict economy is exercised by the structures that govern the blood supply; the tubes leading to an organ are enlarged or contracted as the activity or idleness of that organ requires a copious or diminished food supply. While all the fundamental bodily activities may be carried on at the same time, there is never sufficient blood supply to carry on all at full capacity at one time, nor is it possible for more than one organ to be thus active, so that severe muscular work just before or after eating must delay or disturb the digestive processes, and severe mental work must do the same. The amount of food taken at a meal must, therefore, be regulated to the amount or quality of muscular or mental work to be done soon afterward. After a full meal

the lower or middle consciousness holds full sway; the mind, as it were, retires into the stomach, and we are incapable of good mental work, but are drowsy and stupid if our digestive organs are transacting business as they should. Even the primitive savage has noted this, and the Amazulas have a saying which runs, "The stuffed body cannot see hidden things." We often forget that the vegetative function is as important as mental or muscular activity, or even more important, and we begrudge the organs of nutrition their share of the nutriment they have produced —we, therefore, have to suffer the consequence.

We even begrudge the lower consciousness its period of absolute control—the period of sleep, when the activities of the highest mind and of the voluntary muscles cease altogether. This is a time for repair of these so-called "higher" powers and the time must be long or short according to the amount of repairing to be done and

the rapidity with which the activities of this kind go on in the individual body. A man with great vegetative activities may require but five or six hours, while another whose reparative processes are enfeebled will require a much longer period. The test, here as elsewhere, is the capacity for "doing things" which follows—the feeling of greatest freshness and vigor for work. The lack of such a feeling will mean that the waste matter produced by working organs the preceding day has not all been cleared away and those working cells restored to their usual condition for activity. Overstrained or overactive cells will repair more slowly than cells which have had their usual work to do, and will need a longer period of rest and repair.

During the period of growth there is need not only for repair but of adding to the cells from day to day. The new-born child sleeps most of the time, for it is little more than a vegetating thing. The

time must be as long as Nature dictates throughout the whole growing period, if the child is to develop to his utmost. Anything which interferes with the length or the depth of this vegetating condition must have its effect upon growth and the sum of vital energy evolved.

MOTOR ACTIVITIES

The voluntary muscles of arms, legs, and trunk originated, as we have seen, as specialized organs for getting the body from place to place in its search after food material, or in its combats with, or escapes from, dangerous foes. The latter offices are now largely relegated to the mimic play of children or the prize ring of adults, for, in defence against wild animals or vicious men, a rifle or revolver proves far more efficient than brute force. However, the office of food-getting by muscular labor of various kinds still remains; yet, except in farm districts and among laborers of certain classes, much of the activity of

former times is being done away with. Even the necessity of walking is fast becoming unnecessary to getting a living. This loss of an end for muscular exercise must, however, be made up for, to some extent, by various kinds of bodily exercise.

Since the nerves and muscles are so intimately related, the development of one must go on simultaneously with that of the other, so a complete growth of the muscular system is necessary to bring the nerve-cells to their fullest capacity. Indeed, without nerve force there is no activity, and it is a superabundance of nervous energy which brings about spontaneous activity in play, while exhaustion of that superabundance brings about fatigue. Back of this condition of wealth in the nutritive possessions of both the nerve- and muscle-tissues is the amount of prepared food material which these tissues have to draw upon in the blood supply, and the promptness with which the circulatory organs furnish repair material

and carry away the waste matter produced by activity. The feeling of spontaneous play is, then, in its essence the bodily feeling or "instinct" of superabundance of food material stored in the muscle- and nerve-cells, or promptly supplied to them, and the rapid recovery from fatigue means an excellent working capacity of the digestive, the assimilative, and the circulatory organs. Health, so far as the muscular organs are concerned, means a harmony in quantity and quality of their activities with regard to the assimilative system. In youth, exercise in play is the natural accompaniment of good nutrition, while lack of playfulness means an abnormal state in the nutritive system. Children are often driven to exercise when what they need is better food and purer air, or the riddance of some diseased condition, or liberation from confinement and strain of study, or even rest and sleep.

In adult life those who get their living by the use of their larger muscles in the

good old animal way need no other muscular exercise, but those who make little use of their larger muscles need some exercise, apart from their daily tasks, up to the point of fatigue, for fatigue here, as in the child, marks the limit to which exercise should be carried. It goes without saying that such exercise as takes one into the open air, and such as gives pleasure, is the best. Games that bring into play the largest number of muscles are superior to those which employ but a few. The violent exercises of the gymnasium, especially feats of strength and agility which employ largely the arms and chest muscles, are not the best, and may even do harm in producing bad posture or overstrain of the heart. Extravagance in athletic feats of all kinds is more likely to be injurious than beneficial, as the monitor, fatigue, or the feeling of strain, is lost sight of in the excitement of "beating some one." The training to endurance in prolonged vigorous muscular activity is far superior

to the brief, more severe strain of most athletic and gymnastic feats, as the former give time and opportunity for the gradual adjustment of nutrition to meet the increasing demands of the nerves and muscles; while with sudden and exhausting strain there is no such opportunity for repair, and there is danger of such wear and tear as cannot be recovered from.

Wisely directed gymnastic lessons help in correcting faults of posture induced by our present-day school work, and in bringing about a general neuromuscular development without undue strain of any part.

Play began as a discharge of superfluous energy in lines of mimic work, in activities which correspond to food-getting or to the attacking or escaping from an enemy in more primitive times. It is the more valuable as exercise because it absorbs the whole body-mind, and all parts of the organism respond in harmony to the motor activities. Those plays in which

the social element has entered in, where many participate on either side, are superior to individual athletic competition, in that, while they call forth all the bodily energies, there is not the damage from severe individual strain.

In the course of animal development it was the large muscles of the trunk and the limbs with their nerve-cells, that came first. The structures controlling the fine movements of hands and fingers originated much later. In the child it is these coarser structures which are brought into action first and should have full opportunity for development before the finer, later developed muscles of hand and eye are trained. Large, coarse movements first, and smaller, fine movements later, is the order of Nature. The complete growth and coördination of the large muscles is of chief importance because of the development of the general nutritive powers which goes forward at the same time to supply those larger muscular and nervous

structures, for it is the larger digestive, assimilative, and circulatory capacity thus produced which later can be called upon for the strain of life's work, either muscular or mental. There is a production of bodily vigor that can be turned into any channel of work.

Whether there is a connection, direct or indirect, between the nerve-cells governing all muscles of the body and those cells which have to do especially with mental work is unknown, but it is certain that any condition of muscular exhaustion or of fatigue brings with it a diminished capacity for mental work. It follows, then, that one cannot do a great amount of muscular work and at the same time accomplish the largest quantity and finest quality of brain work. *Vice versa,* very laborious mental effort diminishes the power of vigorous muscular exertion. For those whose bodily growth is not finished, too much mental work must tend to hinder development by allowing insufficient nutri-

ment or nervous energy for muscular exercise or for development of the nutritive powers.

While a certain amount of muscular strength is necessary for life's work, powers of endurance are of greater importance. The very strong are not necessarily in the best of health, and exercises requiring a great amount of muscular force may even bring about injury and disharmony in the bodily machinery.

While during the time of bodily unfolding vigorous exercise is needed for strong and complete development and is a natural tendency of a healthy, harmonious organism, in adult life comparatively little muscular exercise is required to keep the body-mind at its best, and for the best results this should be so mind-absorbing, so "natural," as to avoid all friction of self-consciousness. Here, as in other lines of conduct, it is the condition for work which follows the exercise—the instinct for bodily well-being—which is the test.

Bodily exercise should be spontaneous, for spontaneity means abundance of nutrient material for repair, and it should follow the guidance of instinct in ceasing with fatigue. Competitive games requiring great strain or endurance are more likely to overcome this sense of fatigue, especially in those whose nervous and muscular machinery are developed at the expense of the vegetative capacities. Any continued discord from overwork of muscles and nerves will sooner or later result in injury to the whole.

MIND WITHIN MIND

The well-being of each individual cell is looked after by its own cell consciousness, which, by its very age-long habitual activity, is infallible. So long as the middle and higher consciousness responds to the demands of this lower consciousness, it does its work perfectly and keeps the individual cell in the best condition. Its health depends wholly on the har-

monious response of these supervising intelligences above it. Likewise the middle consciousness of nutritive needs which governs the rapidity and force of the heart beat, the size of the blood-vessels to each part, the heat production of the body, and the disposal of waste matter of the blood, is perfect in its conduct of all this complex machinery if the highest consciousness responds to its calls for food in proper quantity and quality, for pure air, for proper exercise, and for cleanliness of the large intestine, and does not attempt to neglect or over-ride this "lower" nutritive mind. It will even correct the mistakes and forgive such neglect on the part of the higher mind for a few times, but it cannot do so for long, and being an obedient slave of the highest mind it does the best it can under such circumstances of disharmony, keeping the neglected body together as best it may. It often has much to suffer from the neglect of this highest mind, which is led astray by the "wandering

fires'' of present pleasures of deranged appetite. The higher consciousness has even abused the lower mind for the sake of the anticipated pleasures of a future life, and we are to-day suffering more or less from this ascetic idea of bodily neglect and maltreatment as a means to future blessedness.

The highest mind has to do, now as always, with the securing and selecting of food material, of evacuating the reservoirs of waste substances, and of directing bodily defence, if need be, from those who would destroy it, or, what amounts to the same thing, take its food in life's competitive struggle. The securing of a bare existence is easier than ever before, though we have advanced beyond animal life and include in a ''living'' all the things which may minister to our pleasure. The highest consciousness is guided in its ministration to the body by the instincts for food and drink, for heat or cold, for exercise or rest, and for the need of cleansing from waste

matter, that originate in the combined messages from all the cells. Its task in man is complicated by the multiplicity of foods and flavors which he has invented and sundry artificialities of society which he allows to take precedence of the calls of the health conscience. However, the instinct for health, the feeling of bodily condition for work, is unerring, and when the higher mind responds promptly and intelligently to the simple demands of the consciousness of the myriad cells, it will seldom be annoyed by later intelligence of the results of its own heedlessness in aches and pains and bodily weaknesses. When disharmony does occur from the uncleanliness or faulty working of any part, the higher mind may be so flooded with the outcry of the affected cells that ordinary processes of physical or mental activity are completely upset or abolished. "Even a toothache will warp a man's judgment," and a disorder of the stomach or even a hearty meal will cause the mind

to withdraw itself, for a part of the day at least, to that organ; also in times of great stress of cold or fatigue the "mind retires within itself," the bodily energies going to the aid of its suffering members.

The excellence of the work done by the thought structures of this higher mind depends partly on their habits and training, but also upon the quantity of nervous energy stored and the absence of drains upon that store by any disharmony from disease or weakness of any parts, and also upon the general nutrition and upon the powers of prompt recuperation of all the body tissues.

To obtain this harmony or health of mind there is needed perfect bodily growth to the limits of heredity; for the development and nutrition of the brain, which is the chief organ of this higher consciousness, depend upon the development and growth of all other organs. Especially does it require a complete functioning of the nutritive or vegetative portion of our

make-up, for, as we have seen, super-abundant nutrition brings about overplus of energy which finds outlet in muscular or mental play, and play is but the exercising of the neuromuscular powers in imitation of the serious activities of life. Only with a daily surplus of nerve energy is such a thing as education, or the unfolding of wrapped-up bodily powers, possible, and the process of education must not exhaust this store of energy or interfere with the nutritive, energy-forming powers. It is the digestive and assimilative—the vegetative powers—on which all the activities of the mind-body in the work of life finally depend.

Mental health and efficiency mean, then, the careful development of the primitive nutritive or vegetative powers by abundant and proper food, pure air, sufficient warmth, sufficient sleep, opportunity for exercise of the sense and motor organs in play and in instinctive investigation of Nature. Any parental interference must

beware of tampering too much with instinctive bodily tendencies and feelings, and any kind of formal schooling which may succeed this earlier parental guidance must take into account the needs of bodily harmony, of nutrition and physical exercise, lest one part be overworked to the depreciation of other parts with resulting permanent impairment of the harmony of the whole.

Health in the adult animal means, so far as the highest consciousness is concerned, the prompt and sufficient response of the motor organs to bodily dangers and needs and a prompt repair of all parts after any such exertion. In the adult human being, perfect health means the same active response, but in the complexity of civilized life, in the many wants or wishes which it brings with it, there often arises a conflict between the feeling and impulse and the powers of accomplishment of those desires. The spirit is not always supported by the flesh. We "fail" in

some pet scheme for attainment of place or of this world's goods through some bodily weakness, general or local. Or, in this competitive struggle, we allow ambition to silence the voice of the health instincts, and the bodily machinery becomes unbalanced and weakened. This weakness or disharmony has the effect of directing the mental energies from their "natural," timeworn outer channels in upon self and upon the real or imagined bodily weakness. Introspection once established easily becomes a habit. Such misdirected nerve energy magnifies and increases the disorder of body in which it may have originated, or the morbid imaginings and self-depreciation may even bring about discord and disease of the higher nerve-centres, and what we call insanity. Perfect health presupposes good bodily balance, and with our human competitive grasping after life's goods it takes a splendid bodily backing to bring about that which is called "success"—the doing

and being for both self and others. With any failure in this endeavor the highest consciousness is easily turned from its natural field of work in the direction of outward activity into a self-examination which aggravates any present fault. A condition of disharmony and of, as it were, mental uncleanliness results, which can only be corrected by again directing the consciousness outward into the work of life or in purifying it through higher ideals of religion or of philosophy. The mainspring of health, then, is some end and purpose toward which all the bodily powers can be directed, but an end and purpose which is proportioned to our physical powers of accomplishment. We must "accept our limitations."

SEEING AND HEARING

Those groups of highly specialized cells which have become sensitive to light and to sound—the organs of seeing and hearing—were of the utmost importance in

aiding the animal in his search for food and in his escape from his enemies. In man these are called upon for an enormous amount of work, for not only are they in constant use in the obtaining of a living, but in periods of bodily relaxation from work they are also in activity for the pleasure derived from objects seen or sounds heard. Like all other organs these are intimately bound to all the other cells throughout the whole body; their condition for quality and quantity of work depends more or less on the condition of all the body-cells and, *vice versa,* any imperfection of these organs, or any overuse of them, affects the whole body.

The eye, especially in man, is called upon for work such as it has not known in previous times and it must undergo not only the action of a sensitive camera plate in receiving hour after hour the changing impressions made by objects upon the delicate endings of the nerves, but there is constant unconscious adjustment of the

tiny muscles within and without the eye in focussing the sensitive plate of its camera.

Though the most perfectly developed eye, backed by vigorous nutritive organs, can stand almost unlimited usage, any imperfection in this organ brings additional strain which may not only be felt in fatigue or distress in the eye itself, but, through the messages which are constantly travelling from the cells of the eye to the central consciousness, a feeling of general depression, or, through reflected distress, headaches, nervousness, sleeplessness, disturbances of the digestive organs, and other seemingly unconnected conditions may be brought about. Conversely, any general state of lowered vitality or exhaustion from disease or overexertion will bring about a decrease in the amount of work which can be done by the eyes without fatigue or injury.

The use of the eyes for reading, for sewing and other work requiring close and

fine adjustment of the eyes, is comparatively recent. The young child is not prepared for such work, and the eyes may easily be injured by the too early or too prolonged reading of small type or the making of small letters or any other close work.

A large number of children are born with defective eyes which fortunately can often be helped by the use of properly fitted glasses. Since our eyes are so much subjected to constant usage they should be given the utmost care: they should be given sufficient rest from near work; their work should be reduced to a minimum by giving them the conditions under which they do their work most easily—namely, good light and avoidance of artificial lighting as much as possible, by protecting them from strong light which directly enters the eyes, by not using the eyes when the flow of nutritive and waste material to and from them is interfered with, as in the recumbent posi-

tion, and by avoiding their use when the body as a whole is greatly fatigued or suffering from disease.

It goes without saying that the eye suffers from uncleanliness due not only to the accumulation of poisonous waste within the blood but to dust which may find its way upon the outer surface of the eyeball. Fortunately Nature has arranged for constant cleansing of this surface by the secretions of the tear glands which are continuously washing downward over the eye to be carried off through a tube leading into the nose. On exposure to large amounts of dust even this cleansing may prove ineffective, and particles of dust and bacteria may find a lodgment and work damage to the delicate structures. Since the eye is so exceedingly useful and so very delicate, any injury which Nature does not correct in short order should be looked after by one who has made a special study of the organ and its treatment.

The organ of hearing is second only to

that of seeing in helping man to maintain his hold on existence. The ear undergoes less strain than the eye perhaps, but any serious interference with its delicacy of working not only hinders us in the strife for existence but seriously mars our happiness and so our health by depriving us of many sources of enjoyment.

It is estimated that about one-third of all adults are more or less deaf in one or both ears, and a very large proportion of this deafness could have been prevented. The marvellously intricate organs of hearing are connected with the back of the nose and of the mouth by a small tube from either ear; it is in diseased conditions of the nose and throat which affect these tubes that nearly all deafness originates. Catarrhs and "colds in the head" produce, more or less, disease of these tubes, and in such conditions or in scarlet fever, measles, and other similar diseases germs may travel through these passages to the middle ear and bring about destructive

changes in the structures of that region. Enlarged tonsils or growths in the throat often obstruct the entrance to the tubes and slowly interfere with the hearing. It is of the utmost importance that the nose and throat be kept free from diseased conditions of any kind in order that the hearing may be kept at its best.

Like the outer surface of the eye, the outer passage leading to the ear is naturally kept clean without any conscious interference, and any affection of this outer portion should be taken care of by one who understands its delicate structure.

POSTURE

When the body is lying down, the muscles which move it—the voluntary muscles—are at rest, but when the body is in the sitting or standing postures the muscles of the back are constantly at work keeping the head straight upon the body and the trunk straight from above downward.

In the lower races, among whom only the robust survive, and who, being satisfied with sufficient food, a little clothing, and a rude shelter, do not exhaust their energies in any way, either in work or in pleasure-seeking, there is hardly such a thing as bad posture. The expression "as straight as an Indian" is most appropriate.

In our modern civilized society the strong and vigorous and those who do not have to exert themselves unduly are usually as straight as Indians, unless they have been obliged to assume very unusual postures for a long time in their work. On the other hand, with the increase in inherited weaknesses and the severe drain which the overambitious suffer in the strife of modern life, there is often insufficient nervous energy left from study or work to supply the muscles of the back, and these gradually relax from their duties, allowing the head to droop and the shoulders and upper back to be dragged

forward with the weight of the head. Any imperfection of vision which requires the eyes and, consequently, the head to be carried forward to adjust itself to its work increases the tendency to deformity. The stooping posture is almost always the result of overdrain of the bodily energies from the nerves or muscles which support the back, due to too great an expenditure of energy elsewhere, and it should be prevented by stopping this overdrain. The voluntary assuming of a correct posture when standing, when sitting in a properly fitted chair, or when lying in bed, will help to prevent or to correct what may become a permanent unsightly or even physically harmful condition. Especially should school children be prevented from assuming bad postures both at school and at home; but what is more important, they should be kept in such vigor by the observance of all the laws of bodily cleanliness and harmony that they may have abundant energy for keeping the spine

erect. While school work is often ill-adjusted in amount to the weaker children and those who are overambitious, it is not usually so exacting as to affect the posture of the child of average vigor.

EXTERNAL CONDITIONS OF HEALTH

CLOTHES

Man is distinguished from all the lower animals by his use of clothes for protective purposes, by the elaboration of his dwelling and the heating of it by artificial means, and, finally, by his use of fire and water in the predigestive preparation of his food. All these inventions may be considered as belonging to the man-animal as an inseparable part of his make-up; the clothes, as additional layers of a changeable skin; the house, as a protective shell from which he can remove himself or enter again at his convenience, and as bodily need dictates. Again, machines of all kinds are but additional limbs and muscles which man can use at will to increase his working capacity without making demands upon his bodily energy.

All these artificial or man-made appliances have, as their end, the economizing of bodily energy which must otherwise be taken in food and liberated as nervous and muscular force within the body. Clothing and houses prevent the heat of the body from being lost in unnecessary amounts and so reduce the quantity of food which otherwise would have to be digested and burned within the body to keep up its fires. The use of external heat is but another means of saving body energy at the expense of the energy stored in plants or long-dead animals. The elaborate preparation of food before eating it is still another outward means of economizing the energy which the body must otherwise use in the digestion of food.

The use of machinery diminishes the amount of nervous discharge and muscular wear which would be required in the heavy and exhausting tasks of life, and not only reduces the nervous and muscular energy which would be needed but, at the

same time, lightens the tasks of the digestive and food-distributing organs which would otherwise have to keep up a more powerful musculature. All these inventions save energy and give time which can be devoted to something more than mere muscular exertion or the digestion and distribution of great quantities of food.

The change from the out-of-door animal life to this new indoor social living has been so rapid that man is not yet adapted to his new conditions. He does not always use his energy-saving inventions to the best advantage and often suffers more than he gains from them. He goes too far beyond Nature in his ways of living and loses sight of the old laws of cleanliness and harmony which should apply to his use of clothes, houses, and machinery, as well as to the body of which they form a part. He even neglects to use his natural motor organs as much as is needful to keep them in good condition, and substitutes energy-saving machinery.

The chief object of dress, in other than tropic lands, is to economize bodily energy by preventing unnecessary production of heat, and it does this through checking undue loss of heat to the surrounding air. Since animal cells do their best work at a temperature of about ninety-eight degrees, the heat-regulating consciousness constantly maintains the human body at that temperature. Among some savage tribes, as the dwellers of Terra del Fuego, the body heat is maintained with little protective covering, even in frigid surroundings, by the greater activity of the body fires; but among the civilized, who cannot afford such a waste of energy for this purpose, the highest consciousness is called upon for help in preventing unnecessary loss of heat by the putting on of clothing.

It is the amount of air caught in the meshes of cloth, rather than the material itself, which determines the rate of heat loss from the use of such protection.

Stationary air is a poor conductor of heat. Different substances woven in the same way have much the same protective effects. Those that can be woven tightly, as cotton or linen, hold a small amount of air, and so allow rapid dissipation of heat, while the more elastic fibres of wool and silk, which weave into fabrics of more abundant and permanent meshes, entangle a larger amount of air and are therefore better for use in cold weather. Additional layers of clothing retain more heat because of the layers of air held between them. Since it is not the thickness of the cloth but the amount of air space which it contains that makes warmth, mere weight of clothing is not in itself a protection, but is a waste of energy to the body which is made to carry about an additional burden.

As the body is constantly throwing off water and waste substances from the skin, the clothing must in turn take up these substances. Those materials the fibres of which do not easily become soaked with

water and which therefore maintain their air spaces take up moisture from the skin most steadily and liberate it to the air most slowly. Garments which have become saturated with perspiration are a source of danger from the rapidity with which they may allow evaporation and so the lowering of the temperature of the immediate covering of the body. Since the clothing is, in our civilized living, a part of the body—a changeable layer of the skin—it is necessary to keep it not only adapted to the heat-regulation of the body according to the season, but as clean as possible, since it not only collects the dust and dirt from the surrounding air but absorbs the outpour from all the sweat-glands of the body. Bacteria and insects which infest the skin of those whose clothes are damp and dirty find small encouragement in clothing which is clean and dry. The feet and legs, hands and arms, are especially exposed for radiation of their heat and are farthest removed from the

greater sources of bodily heat, and it is especially necessary for bodily harmony that these parts be well protected. Clothing which tends to interfere with the working of any part of the body is promptly rebelled against by the instinct of bodily welfare and can be used only under protest of that instinct and with final harm to the general bodily activities.

Man, in saving his bodily powers through the use of clothes, has made himself more sensitive to changes of temperature. Sudden changes are of little consequence, and the body can be easily habituated to them since the healthy body responds promptly for the time, but prolonged exposure to very low or very high temperatures is always injurious. The small and gentle inner voice warns promptly against such a condition of danger, but the higher consciousness is often slow in responding, and there result colds, catarrhs, or even pneumonia, kidney disease, and rheumatic conditions of all

sorts. Wet clothes or wet shoes are especially productive of such body chilling, through the rapid evaporation which goes on from them. Probably no one article of wearing apparel has helped more to keep the bodily powers in harmony than has the rubber overshoe. Through long covering with dense materials the feet have become especially sensitive to cold. It is not the mere wetting of the feet that is harmful but prolonged evaporation from the soles of the shoes which keeps the temperature of the feet many degrees below the surrounding air. The feet become like two wet-bulb thermometers; the dryer and warmer the atmosphere, the greater the difference between the temperature of the material next the feet and the air surrounding the rest of the body. Also, the thicker the soles of the shoes, the more moisture is absorbed and the longer the evaporation goes on, so that thick soles do not in any way take the place of protection from such wetting. It takes a vigorous

make-up to stand this prolonged unbalancing of the body heat.

Too great heat is even more dangerous than cold. The body's natural protection against high temperature is the evaporation of water from its surface, the taking of cold food or drink internally, and the reduction of the amount of clothing. Through ill-developed instinct the highest consciousness may go wrong and abuse these means of regulating the body temperature. Because cool water helps to reduce the inner temperature and supplies water for evaporation, we drink large amounts of ice-water which overchills the delicate cells of the stomach, while too large a quantity of water has the effect of increasing the body heat because of the effort that must be made to get rid of superfluous amounts of it. The feeling of general welfare rather than immediate pleasure is the true guide.

HOUSES

For the best working of the body, its changeable outer shell, the house, must be rendered as clean as possible and free from substances which would injure the body, and the air it contains must be as nearly pure and moist as the air out of doors.

Dust is opposed to cleanliness, both of the outside and the inside of the body, and, as we have lately discovered, it is a most convenient vehicle on which harmful germs may ride about and find their way into the body. Fortunately modern cleaning appliances are reducing the difficulty of getting rid of dust, and in this way are helping to do away with the harmful features of indoor life.

That the indoor air may be of the utmost purity there must be no contamination from faulty plumbing, from badly made stoves or furnaces, and it must be changed with sufficient rapidity to make up for its uncleanness due to the breathing of those

who may occupy the house. The air outside the house must also be clean from dust, smoke, factory gases, and other impurities.

A natural instinct for pure air exists and can be sharpened. With those who have always lived in pure air the demand for it becomes habitual. Like the other senses, however, this instinct is not appreciative of slow changes. A frog, which responds promptly to any sudden alterations of temperature and will jump out at once if placed in hot water, can be boiled alive if the water in which he lies is slowly heated. So the human sense of heat, the sense of smell, and the appreciation of foul air are easily disturbed in passing from a room containing pure air to one in which the air is vitiated, while we frequently remain in a room which at the beginning contained pure air at a comfortable temperature until the air becomes foul and the heat too great, without noticing the change nor being aware of the degree of physical and mental stupor

which results. Many a conference on ventilation has taken place in a room where the atmosphere had become robbed of oxygen and loaded with poisonous exhalations. The change comes too slowly to be observed, and only the senses of one who has not become accustomed to the impure conditions can test the quality of such an air. Purity of the air in a room can only be provided for by such frequency of change as will assure its proper condition.

The poor ventilation of houses is often due to effort in economizing artificial heat, but, since the body does its best work in a pure atmosphere, the economy does not prove wise.

HEAT AND LIGHT

While the heating of the air of the house reduces the amount of energy used by the body for keeping up its own heat, the air should not be so overheated as to drive out all the moisture from it. This overdry air takes up more watery vapor from the

air-passages leading to the lungs than these are used to furnishing, and the delicate moisture-supplying cells may be damaged by continued overwork.

The test of the amount of artificial heat must be not only comfort but best condition for work. This must vary somewhat with the bodily vigor of the person and the condition of his internal fires; for sedentary work it has been found that the neighborhood of 70° F. is the best temperature. The aged and the very young will require more. Since the body temperature remains constantly at about 98°, this lower temperature (70°) evidently gives opportunity for the best escape of the heat which is produced by digestion, food distribution, and the fires of waste and repair which burn constantly within the body. With the help of clothing, the heat-regulating mechanism probably has the least amount of work thrown upon it when the body is in sedentary occupations and the surrounding air at about 70°.

Sunlight is one of the essentials to health, and, at the same time, is most disastrous to the microscopic forms of life which are so dangerous to the human organism. As a germicide, if for no other reason, it should be allowed to find its way in abundance into every house and into every possible nook and cranny. Lack of sunlight soon shows itself in the diminished health of the individual; there is something wanting in the conditions that bring about bodily harmony. While there is an instinctive love of light, there is also an instinctive warning against too long exposure to a hot sun. Even light needs to be used with discretion, and we should follow our instinct when it persistently warns us to seek shelter from a July sun. Tan and sunburn are Nature's means of protecting the body against such exposure and are in themselves no indications of health.

In artificial lighting of houses those methods should be used which add the least of impurity and heat to the air. It is

needless to say that there should be sufficient light to prevent strain of the eyes. A generation past could read and work by candlelight but we to-day cannot spare so much energy for vision.

DISEASE

The body in the state of nature is well supplied with substances which guard it from the inroads of bacteria. The outer and inner surfaces of the body are alive with myriads of germs, often dangerous ones, but so perfectly does the body protect itself that even though a few of these microbes gain an entrance to the interior they may do little damage. It is only when the animal has had its protective powers reduced by uncleanliness or disharmony among its parts that the microbes produce disastrous effects. Pigeons, which, under usual conditions, are little affected by the dangerous anthrax germ, quickly die from it when not fed their usual food in usual amount. Animals which do not have suffi-

cient water also succumb to this germ. The white rat is never, under natural conditions, subject to this disease, but when forced to run in a treadmill until exhausted, he becomes an easy prey to it. The chicken, which ordinarily is immune to the disease, becomes susceptible to infection after becoming chilled by being kept for a time in cold water. So, also, frogs are made susceptible by keeping them at a higher temperature than their instincts would naturally allow them to submit to.

The protective powers in man are gradually developed, and are not so strong in children as in adults. The former are, therefore, more often a prey to germs. Probably man has some means of resistance for at least a small number of all germs, and can in emergency increase the quantity of these substances with which the body antagonizes the invading microbes. Two experimenters in a German laboratory took small amounts of the

cholera germ and both showed symptoms of the disease in mild form, while another scientist, who took a larger quantity by accident, died of the disease. Probably ninety per cent. of all persons have some form of tuberculosis at some time of life, but most of them are successful in resisting the attack.

After one invasion the body usually keeps on hand a store of protective substances to defend itself against a second invasion by the same germ, so that, though we may be just as much "exposed" to a second attack of measles or typhoid, the organisms do not often get a second foothold.

For some microbes, and perhaps for all, the human body seems to be gradually acquiring more and more natural powers of resistance, the tendency to the formation of the protective substances being transmitted from generation to generation. Thus, among the white race there seems to be a growing immunity to tuberculosis,

while among the Indians, to whom this germ is comparatively new, the body makes a much feebler fight against it.

Modern medicine is devoting itself to aiding the body in its fight with these invaders by producing substances outside of the body, which, when injected into the body, help it in its wars against the germs.

The causes which allow the entrance of microbes into the body, or of what we call an "infection," are: some weakness produced by local or general overwork, by prolonged exposure to cold or to great heat; lack of proper food or of sufficient food; too little rest or sleep; and uncleanliness of the inner surface of the body.

In the civilized way of living the dangers of microbic infection have become greatly increased. Wild animals seldom come to an untimely end through such causes, while man dies off by the thousands each year through infectious diseases. Two conditions bring this about: first, the blunting of instinct and the bodily abuse and dishar-

mony which come with it; and second, the great numbers of bacteria which exist where men are huddled together. Human habitations have, until recently, offered, and most of them are still, good dwelling places for germs of all sorts, for they thrive best in dirt and damp and away from the light. Then the human being in whom the harmful germ has found a weak spot becomes a place of propagation and helps to spread its progeny abroad in enormous numbers. It is estimated that a tuberculous patient may expectorate as many as 500,000,000 to 3,000,000,000 tubercle germs in twenty-four hours.

For health and bodily harmony, the human dwelling, clothing, the air, and all other surroundings, must, like the body of which these have become a part, be kept as free from germs as possible by cleanliness and sunlight. All those persons in whom the germs have found a lodgment become breeding-grounds, and are more or less liable to transmit them to others,

either directly, as in diphtheria or scarlet fever, or through discharges containing the germs, as in typhoid and tuberculosis. To prevent the infection of other persons, it is therefore necessary to isolate the infected or to destroy their excretions which contain the bacteria. All contaminated materials must be carefully disinfected by heat or chemicals. Flies and other insects which come in contact with discharges of infective material, or which have bitten infected persons, may carry the germs directly or indirectly to other people.

The houses in which infected persons have lived should be so thoroughly cleaned as to destroy all germs, and all houses should be so flooded with sunlight and pure air, and screened from insects, that no germs may find a permanent lodgment.

It goes without saying that the air in and out of houses must be as free from dust as possible; many bacteria may ride upon one tiny speck of dust. Water and

milk and foods must be made as free from dangerous germs as possible by cleanliness or heat.

We have always had microbes with us, though we were not aware of their presence. At the same time some of the race have survived the severest pestilence, and there have always been healthy, long-lived people, so that, while it is of the greatest importance to guard ourselves against the presence of dangerous organisms, we should remember that it is even more important to keep the body in such condition that germs cannot gain an entrance.

The discovery of microbes and their habits has served to explain the cause of infectious disease, and also to explain the nature of such "disease." We have seen how a few microbes are soon devoured by the germ-eating white corpuscles aided by certain chemicals of the blood. When, however, many germs gain an entrance, the whole body takes up the fight against them. The lower consciousness takes full

charge of the body, the activities of higher mind and muscular movements being not only useless but wasteful of bodily energy which the vegetative cells need in reproducing hosts of white corpuscles and in making substances for neutralizing the powerful poisons produced by the invaders. The waste of energy in digesting food is reduced as much as possible; the stored fat and even the muscle-cells are used for keeping up the energy in a long fight. The great activity going on within the laboratories increases the heat of the body and we have what is called fever; the food-distributing organs are equally active, and there is increased rapidity in the working of heart and lungs, while the sweat-glands, the kidneys, and often the intestines are working to their utmost capacity to rid the body of poisons. The "disease" is a fight of all the body vegetative cells against the invading bacteria and their poisons, and is long or short, mild or severe, successful or unsuccess-

ful, according as the invaders are of one kind or another, are few or many, and whether the body is strong or weak in its development of protective powers. Every microbic disease must "run its course" according to the time it takes the body to overcome the invasion. Medicine can only aid the body by conserving its forces, aiding in the riddance of poisons, or by helping the natural resistive powers through the use of antitoxins produced artificially. All such microbic diseases are "self-limited," the disease symptoms abating as the body gains the upper hand in the fight. It is such diseases as these that the faith healer and charlatan often appear "to cure." In reality the body has been successful in its fight in spite of the aid, or lack of aid, of such "treatment." While the patient recovers, it is at a risk of fatal termination, or of serious after-results which the help of medical science would have reduced to a minimum.

As medicine aids the body by helping

to restore cleanliness and harmony, so surgery does the same, hastening Nature's means of cleanliness by evacuating abscesses, cutting away useless parts, and putting the body into best condition for repair from injury.

HEREDITY

Although with the animals there is some difference among the individuals as to their ability to cope with the problems of existence, with man the inheritance of weakness, the effects of errors in education, and of the failure to follow the conditions for health have brought about a far greater proportion of those ill-prepared for life's activities. The desires and ambitions, however, may exist equally among the physically well and the physically weak. This results in overstrain of competitive strife, or in introspective disturbances due to anxiety and worry over failure to attain to that to which some one

better fitted naturally or by training or by some other fortunate circumstance gains access. The word "success" is a source of disharmony and ill health in itself—unless it be interpreted in a relative sense and fitted to each according to his ability. The very knowledge of heredity should make us more content ourselves, and more sympathetic in our attitude toward other lives.

We cannot all be equal, and any striving after the impossible must result in some bodily strain or damage, or in disorder from mental friction of discouragement. The sum of attainment will be less than if we had recognized our limitations earlier. The attainment of perfect health takes into consideration the limits of heredity.

It is but a selfish view of the lessons of heredity to consider only its effect upon ourselves, and one of the ends in maintaining our own harmony and vigor of body and the study of the best conditions

of living is that our descendants may be endowed with the best possible inheritance which we can provide.

SEXUAL HYGIENE

Like the other chief bodily functions, that of reproducing itself has had to be modified to suit the change to conditions of social existence. The very living together in families, tribes, and states, has rendered old "natural" instincts leading to perpetuation of the race out of joint with the new state of living. The instinct is none the less strong, for its very necessity to the continuance of the race makes it strong. Survival of the race without such an instinct is impossible, so that only those possessing it can live beyond the present generation. In the lower races this instinct remains very much as with the animals, but more recently the period of development and of education has become so prolonged, and the needs of domestic life have, at the same time, become so

manifold, that the time for marriage has been made fairly impossible until years beyond the time when the instinct is strongest. The very strength of this appetite in those who are not yet fitted to the social conditions of the age impells men and women into "natural" satisfaction of that appetite in the unmarried relation.

The failure to bring this appetite under the control of the individual, as he must live in a civilized state, brings about discord in family relations and is, in a way, a source of social disorder; also, through the microbic diseases that infect those who abuse the appetite, an enormous amount of misery and suffering is brought upon the individuals who cannot control their truly "natural" tendencies, while the diseases may be transmitted by them to the innocent. A very large proportion of the diseases of men and women are due to this cause.

In the animal state the finest specimens of physical development reproduce like

strong and well-balanced offspring. In man the same holds true, but as so many men have reached high places at the expense of physical exhaustion, their offspring show a diminished condition of the vegetative part of their make-up, and fail to develop into strong and enduring well-balanced mind-bodies. They may inherit a finer mechanism for thought and mental activity, but this machinery fails to receive its proper support from the vegetative structures. Thus, continued disharmony in the working of the parent is passed on in disharmony and weakness in the child. For this reason the race is ever dying at the top.

EDUCATION

The lower animals help their young in the development of their powers, in the finding and securing of food, and the dealing with enemies. With man the process of education is far more complicated, though the results of his training are not

always so fortunate. Since he has hitherto failed in appreciating the value of bodily harmony and the development of all the powers, it is not to be wondered at that similar mistakes would occur in his attempts at helping the unfolding of the powers of the child. The instinctive needs of the child for pure air, sunlight, and exercise, have been overlooked and even ignored, while the mind has been looked upon as superior to, and independent of, the body as a whole.

A change is going on, however. Schools are better lighted; the air in them, if not yet pure, is less impure, and there is some attempt at adjusting hours and lessons to the requirements of growth and the storing of energy for work. The whole body is being looked upon as the organ of the mind, and the organs of nutrition as the real source of mental and motor activity. Cleanliness, full nutrition, and balancing of all the parts, is seen to be necessary to the best activity of those dependent organs,

the brain and the smaller muscles which are so active in our modern life.

Along with the exercise of the brain, the sense organs, and the hands, education, to be of most benefit, will help to quicken and direct the instincts for health, and will help to make habitual the cleanliness and care of the body, the cleanliness and care of the clothes, of the home, and the harmonious adjustment to all the conditions of civilized living which make for social wholeness and health.

CONCLUSION

The idea of the harmonious working of the body as the basis of health and achievement is not a new one. It dates back to the time of the Greek philosophers. The carrying out of such an idea was perhaps easier with them than it is with us. Our clothing, houses, machinery, and the complications of competitive industrial strife have increased the difficulty. The blunting of the bodily instincts through many centuries of one-sided religious teaching has obscured the relationship of bodily and mental well-being. At the same time our various energy-saving inventions and the developments in modern medicine have allowed more of the weaker and disordered to survive.

Disease and weakness have proven good, though severe, teachers, and are themselves awakeners of the appreciation of

bodily wholeness and vigor. We more and more appreciate that our failures to be and do often arise from disharmonies, inherited or acquired, which might have been prevented.

The study of the conditions influencing bodily well-being and the response to those indwelling voices of the lower (but not lesser) consciousness, the instincts which would raise us to our best condition for work, become a part of moral conduct.

While with the animal there is only hunger and cold or the attacks of enemies to draw out his powers, for man there is also the spur of competitive excellence, or, what is better, the beckoning of the ideal. He who makes bodily wholeness a response to that ideal must be in the way to the attainment of the highest working capacity, for he alone can appreciate the full meaning of health, and will govern his appetites and his surroundings so that his body may be at its best. For such, the knowledge of the body and of anything

which can influence the body for good or evil will always be the most interesting and important of studies, not only for his own happiness but for the shaping of lives dependent upon his guidance.

On the other hand, the undue attention to physical welfare and any unnecessary time spent in its care is, as Dr. Cheyne said nearly two centuries ago, unworthy of a man and defeats its very object.

We hear much about the influence of the mind on the body. The activity of the highest consciousness when directed outward draws out the bodily powers to their utmost, but as it is only that violin which is in perfect repair and adjustment of all its strings which produces the best music, so it is through a body which is in perfect order that the mind accomplishes its best work. The whole of a musical instrument enters into the quality and quantity of tone which can be drawn from it, and, in like manner, what we call mind depends for its expression upon cell consciousness and

condition throughout the whole organism, and rises and falls in the character of its work with the fluctuations in the various bodily functions.

As the violinist, in his efforts to produce a finer music, becomes ever more sensitive to, and corrects, any faults of adjustment in his instrument which hinder his best performance, so the man who would accomplish most will have a lively interest in the body and its surroundings, and will respond to its needs, not by introspection and worry, but by giving each function what it demands in order to bring all into working harmony. No violin, not even a Cremona, is wholly perfect, yet the most common instrument is capable of giving forth a superior or inferior music according to whether it is in good or ill repair, and its strings in or out of tune. So human beings differ in their capacity for soul expression, and each is capable of his best only when the demands of all parts of his make-up are heard and heeded.

INDEX

Index

Index

Index

A NEW BOOK OF VITAL IMPORTANCE TO THE HEALTH

SELF HELP FOR NERVOUS WOMEN

FAMILIAR TALKS ON ECONOMY IN NERVOUS EXPENDITURE

By JOHN K. MITCHELL, M.D.

Fellow of the College of Physicians of Philadelphia; Attending Physician to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases.

12mo. 202 pages. Cloth, $1.00 net.

A BOOK intended for the nervous, for those who apprehend nervousness, and for those who have to do with nervous invalids. It is in no sense technical, but written in the plainest and briefest manner. The line is carefully drawn between such cases as need the doctor's help and those which can be aided by the regulation of their lives at home, according to the rules which the author has formulated from experience, enlightened with common sense. Here are no transcendental counsels, no pseudo-scientific or half-true psychologic prescriptions, but plain talks about food and rest, air and exercise, self-control, discipline, the training of the nervous system, and how to form and confirm good habits of thought and action.

J. B. LIPPINCOTT COMPANY

PUBLISHERS PHILADELPHIA