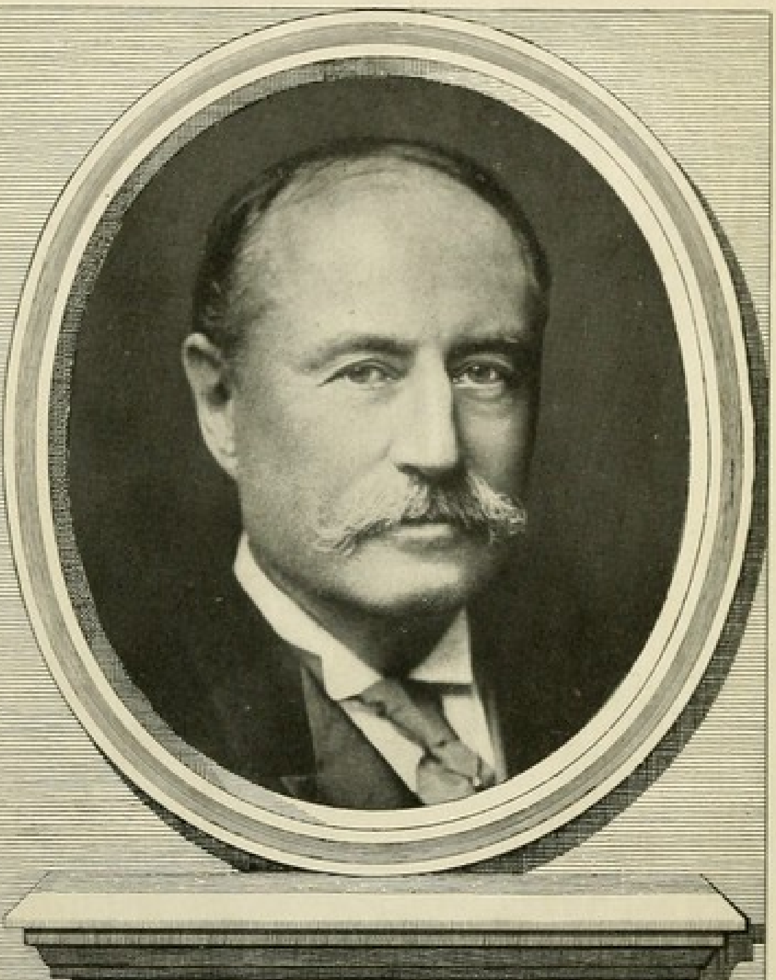
NATVRE and HEALTH

EDWARD CURTIS



NATURE AND HEALTH

A Popular Treatise on the Hygiene of the Person and the Home

BY

EDWARD CURTIS, A.M., M.D.
Emeritus Professor of Materia Medica and Therapeutics
Columbia University, New York

Nature is always wise in every part
Lord Thurlow

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PREFACE

MAN is master by reason of his intellect. Having tasted of the tree of knowledge, he should so order his life that it may yield its full fruition. And with ever-widening enlightenment come larger possibilities of such ordering—possibilities of culling from every experience, civilized or savage, ways that are wise, and of casting forth, no matter when or whence derived, those that are mischievous.

Sanitation steadily improves the human race. The armor of the mediæval ancestor gapes at every joint on the sturdier frame of the athlete descendant of to-day, and modern mortuary lists make a far better showing of the duration of life than do the tablets of old. The son of civilization, if he live simply and wisely after nature's lead, surpasses his savage brother physically as well as mentally, overmastering him in strength, and outvying him in endurance and in number of days.

This book has been written in great part out-of-doors. Thought out under the open sky, it has been committed to paper by the wayside, on knee or on the flat tops of fences. Brought forth in such fashion, it is offered not as learning, but as a lure—a lure for the wise living that shall gain from goddess fairer than Hera, than Athene, or than Aphrodite herself, that gift, all Hygieia's own, the priceless boon of health, happiness, and the usefulness of years.

E. C.

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CHAPTER I

BREATHING

Away to the window I flew like a flash,
Tore open the shutter and threw up the sash
—CLEMENT C. MOORE

"THERE is a draught here; I feel it on my neck; close that window!"

Why not put it thus:—

"Life is at the lattice; he blows a soft kiss upon my cheek. Shut him out!"

We feed the stomach three times a day, but feed the lungs five times as often every minute. We are dainty to a nicety about our stomach-food, but, for lung-food, will complacently consume stuff that already has passed in and out of other lungs over and over again, merely remarking, "The air is quite close in this room."

In inhalation, the lungs absorb from the air its active principle, oxygen; in exhalation, they give out, besides water, the effete gas, carbon dioxide ("carbonic-acid gas"), together with fine particles of an organic excrementitious substance. Carbon dioxide, or "fixed air", as it formerly was called, is the gas of effervescence of soda-water or of champagne. It is a true gas, colorless, odorless and tasteless, and obeys the law of gases, of diffusing quickly and evenly throughout the body of any other gas with which it may come into open contact. On this point there is much popular misunderstanding, and because carbon dioxide is considerably heavier than air, the notion prevails that the gas, when discharged into air, sinks by reason of its weight, so that the lower layers of air in an inhabited room are more highly charged with the impregnating gas than the upper. Such is not at all the case. If the metaphor may be allowed, the passion of gases for the waltz of the molecules is always so intense that any two of these intangible spirits meeting will at once join in dance on equal footing, though the one be as light as Ariel and the other as cloddish as Caliban. If an uncorked bottle of that lightest of gases, hydrogen, be inverted over one of heavy carbon dioxide, after awhile both bottles will be filled with a uniform mixture of the two gases. The light hydrogen has waltzed downward and the heavy carbon dioxide upward, all to satisfy the passion for the dance. Accordingly there is no danger of carbon-dioxide poisoning in sleeping near to the floor, nor is a dog overcome any quicker than a man on entering a mephitic cave.

Although deadly in strong charge, carbon dioxide is by no means so poisonous as many suppose, and is not what gives to exhaled air its noisome properties. By itself, the gas is neither unpleasant nor harmful even when impregnating air in more than ten times the proportion in which it occurs in rooms that may be foul from overbreathing. Carbon dioxide is a normal constituent of the atmosphere to the extent of four parts to ten thousand. But in soda-water factories, where the air is necessarily highly charged with the gas, the proportion may reach one hundred and fifty and upward to the ten thousand, without causing distress or even discomfort. In fact, in such case, the impregnation is hardly appreciable by the senses at all. Yet air vitiated by breaths begins to acquire an odor when the carbon-dioxide proportion measures six to the ten thousand, and is oppressively close when the figure for the same reaches eight.

It is the *organic* product of exhalation that is the offensive element. This product is not at all a gas, but a cloud of fine, particulate entities. These particles do not obey the law of gases but the law of soot. Exactly like that horrible substance they cling affectionately to whatsoever they touch. A pair of lungs, then, may grossly be likened to a smoking lamp, giving forth carbon dioxide, water, and smut.

But while the organic emanation is the active agent for harm in expired air, it is convenient to measure the contamination of a given body of air by the proportion of carbon dioxide present, since the gas and the organic effluvium go together, always, and it is a much easier chemical operation to determine percentages of carbon dioxide than of organic impregnation. Accordingly it is to be understood that breath-vitiated air begins to be noxious when the carbon-dioxide impregnation rises above six parts to the ten thousand.

Acute poisoning from exhaled air shows itself by a bad taste in the mouth, headache, drowsiness, lassitude, and even lethargy or faintness. Chronic poisoning by the agent is not so easy to define, since the effects are necessarily associated with the effects of other factors. Contamination of confined air by other agencies than the breath, uncleanly habits, poor and insufficient food, long hours of work, and lack of sunlight and exercise, are all concomitants of breath-poisoning among the poor, who so commonly live in unventilated rooms. But after making allowance for the operation of these other factors, there remains the circumstance of a difference in health between the indoor and the outdoor worker among subjects in the same walks of life, which difference would seem to be largely attributable to the quality of the inspired air, in the two cases.

Nature's scheme of life is life in the open, where breathing is done in the vast body of the general atmosphere. Under these circumstances, diffusion quickly dilutes exhaled carbon dioxide, which then, in course of time, is appropriated by plant-life, while the organic effluvium of breath falls an easy prey to sun, wind, and rain.

But when breathing is done in a ten-by-twelve or even a fifteen-by-twenty box in which all openings are closed, the conditions are as completely reversed from those of nature as possibly can be. Even by a single pair of lungs the air in such a box is soon vitiated. Hence, in closed places where human beings herd come readily those symptoms of foul-air poisoning just recited. Therefore, of course, man that hath eaten of the tree of knowledge maketh it a first care of his rare intelligence that his indoor air shall be just as pure as conditions will permit. Accordingly—

—Accordingly the countryman cowers over a close stove in a low-ceiled room and shuts doors and windows: the city-dweller closets himself in a steam-heated apartment-chamber with a dummy for fireplace and shuts *the* door and *the* window, while the suburbanite packs himself with fellow sardines in a trolley-car where there is neither steam-heat nor stove, and shuts both doors, all windows, and even all ventilators, ineffective though the poor things be!

The picture is true to life and tells its story without need of comment by the exhibitor! But, one will ask, what is to do? Perfect ventilation means machinery and elaboration whose cost is prohibitive, and open windows in winter mean the shivers and a sore throat; so what is to do?

There is much to do—much that is both inexpensive and effective, for whose understanding, however, there must first be stated the conditions of the problem.

Contaminating **carbon dioxide** is simply diffused throughout the air of the chamber to be ventilated. Its riddance, therefore, can be effected by changing the body of the air, a procedure that at the same time re-supplies deficient oxygen. Contaminating **organic effluvium** is but imperfectly diffused through the air, and also industriously attaches itself to all surfaces affording a good hold for clinging, which means particularly to such as are rough and hygroscopic. In the case of this contaminating element, mere change of air does not wholly effect removal, but must be supplemented by the cleansing of surfaces, which, according to the nature of the surface, will be by wiping or washing, brushing, beating, sunning and airing.

Ventilation, then, using the word to cover the general purpose of nullifying the vitiation of air caused by breathing, embodies two distinct items, namely, the renewal of air and the removal of deposited effluvium. The second item, being the simplest, may be considered first.

"An ounce of prevention is worth a pound of cure." Against the plague of buzzing insect busybodies a well-trimmed lawn is more effective than mosquito-netting; locked cupboards than fly-paper. Now the same kind office that long grass offers to mosquitoes, or a crumb-strewn table to flies, upholstery presents to the emanations of the human lung. Very grand is the drawing-room with its heavy tapestries, its thick rugs, and its thicker cushions, but after a crowded social "function" there will linger in the sumptuous apartment a noisome mustiness that opened windows will be powerless to remove. The reason is simple: those massy hangings and coverings make ideal harborage for stale breaths, an incongruity as mocking and as shocking as that of Christopher Sly in the chamber of a lord!

Between upholstery and hygiene, then, there must ever rage an irrepressible conflict. On the one side stand arrayed paper, plush, and wool, and, on the other, paint, whitewash, and polish. If the stuffs must win, let them at least concede their worst abomination, the fixed carpet, and for the rest make of themselves movables for better acquaintance with sunshine and basting-stick. Let rugs, though, have adjustable attachment to the floor, so that, when they are down, elderly folk who go to cross them may not be down, too, with a sprained ankle or a broken hip.

For the understanding of the other and essential item of ventilation, the removal of air, there must first be appreciated the physical facts about air, as follows:

Air will not move unless forced. According to popular notion air is a sort of Saturday urchin free of school, romping actively here, there, and everywhere, in and out of every hole through which he can crawl, and up to every mischief he can find. So of an evening, at a window, we find the green blinds pulled to without, with slats closed, and, within, the impervious shade carefully drawn down; then, because, forsooth, the sash is up an inch between, the "window is open" and every call for fresh air is fully met!

But, quite to the contrary of the popular idea, air is the "Blue Monday" boy, due at school but slow to move, and certain not to start without pushing or pulling.

Nature's universal force for the setting of air in motion is difference in temperature. Hot air expands and rises; cool, dense air rushes in to fill up the gap. It is mainly this action that makes the winds to blow, from the zephyr that dallies to the hurricane that rages, and it is exactly this action that must be utilized for the ventilation of ordinary domiciles. In summer, when all windows and doors are—or should be—wide open, nature herself attends to the business. Her splendid breezes, fresh from sea or fields, blow through the house, and the air is full of vitality, clean and sweet. In winter, the house is warmed to a temperature higher than that of outdoors, so that, by an intelligent imitation of nature's methods, this difference in temperature easily can be made to do effective ventilating, as shortly will appear.

Air is not only sluggish but also sticky. It is, as it were, an aerial molasses. Like the Blue

Monday boy, again, who, bound for school, rubs dirty hands over every railing as he goes, and loiters by every corner and lamp-post, so air in motion clings to every object it meets, and pauses by every snag and roughness of surface over which it passes. A thin belt of trees or a mosquito-netting at a window breaks the force of a breeze to a much greater degree than is caused by the mere mechanical impediment.

By reason of this property of air, outlets for foul air should be smooth-lined and free-mouthed —*not* ornamented by an obstructive grating, whereas inlets for fresh air may with advantage be covered with netting to break sensible draught.

Air is practically incompressible to any but powerful force. Hence, in the case of a box such as a chamber, new air cannot be coaxed in at one hole unless old air be pushed or pulled out at another to make room.

Such being the vagaries of air, proper ventilation of a dwelling proceeds on the following principles:

It is a practical impossibility ever to make the air on the inside of an inhabited box as pure as that on the outside. For this fact there are six solid reasons, namely, the four sides, the bottom, and the top of the box itself. All that can be hoped, then, in the case of a house or a chamber is to keep vitiation within bounds.

Now the very first consideration in the changing of the air of a room is the size of the room itself. It is found that to keep the air of an occupied chamber fairly pure—below the odor-point, as expressed by a seven-to-ten-thousand carbon-dioxide impregnation, each pair of lungs operating therein must receive three thousand cubic feet of fresh air every hour. At the same time it also is found that to change the air of a given apartment oftener than three times an hour is to produce a sensible draught against which backs and necks, in winter-time, ever rebel. Accordingly, to get *three* thousand feet by not more than *three* shifts, the body of air to be changed must itself be not less than *one* thousand cubic feet in volume. This means that one thousand cubic feet, the dimension of ten by ten by ten, is the absolute minimum of air-space to be allotted to *each* occupant of a chamber as a fundamental prerequisite of ventilation. It is wiser, however, in practice, in order to offset deficiencies of ventilation, to allow a certain excess of air-space, and so to set the practical minimum at an allowance of fifteen hundred cubic feet for each occupant—the dimension of fifteen by ten by ten.

Now a fair-sized parlor for a New York house is one twenty-three feet long by fourteen wide and eleven high. But such dimensions give only a little over thirty-five hundred cubic feet, or just about the air-allowance for husband, wife, and one small child, or pug, according to the zoology of the family pride. Yet how often, on the occasion of some social function, will such a drawing-room be required to accommodate (!) ten and more times as many pairs of lungs, in different degrees of good orderliness, but all actively at work!

Practically, therefore, as homes go, there is nearly always a deficiency of air-space in chambers. To correct this fault there is only one thing to do, but fortunately that one thing is a very simple matter, being merely to open the door! Open all doors except the front door and that at the head of the kitchen-stairs, and leave them open, night and day. By this means the whole house becomes practically one body of air, where halls and temporarily unoccupied rooms contribute their quota of unvitiated air to help ventilate the occupied chambers. Of course, in an apartment-house or a boarding-house where unrelated boarders live in the different chambers, exactly this simple and effective feature in ventilation cannot be put into operation. Hence comes about the horror of the steam-heated flat, with its stuffy rooms, and the abomination of the boarding-house with its dark malodorous halls and stairways. In hotels it is different. There end-windows to the corridors and transoms to the chamber-doors supply the needful avenues of communication.

Assuming the private dwelling with its possibility of open doors, then the scheme is to heat the halls so that the doors can be kept open; to provide straightaway smooth-lined upward-reaching outlets through which the hot effete air may rush, on command, to the outer world, and grated or netted side openings to serve as inlets for fresh air to take the place of the old. The outlets will be the scuttle, the skylight, ventilating-flues (when there are such), and fireplaces. The inlets will be special window-fittings, as will shortly be explained.

As to the outlets: Few realize what an effective general outlet for ventilating purpose is afforded by an open scuttle. Situated as it is at the very top of the house, the scuttle is in exactly the right position for such purpose. One of the first things to be done on moving into a house, then, is to call in the carpenter to ease the scuttle-fitting—for scuttles always stick—so that the lid can be opened without a bumped head or a sprained wrist. In New York, a certain skylight-maker has devised an ingenious arrangement whereby by the pull of a cord at the foot of the ladder the scuttle is both unbolted and opened, and that, too, to any desired extent. Then by a jerk and a slackening of the cord the action is reversed and the scuttle closes and automatically locks itself. With this fitting there is no excuse for not utilizing systematically the ventilating advantage of an open scuttle.

The skylight, when provided with openings to the outer air and movable panes below, operates like the opened scuttle.

Ventilating-shafts, when provided, will be vastly more effective if the inevitable ornamental grating be removed. But ventilating-shafts are not common in ordinary dwelling-houses. For the individual chambers, then, the one and only possible outlet is the fireplace.

If this writer were to have his way, any architect designing a suite of rooms, especially in an apartment-house or an office-building, and neglecting to provide at least one fireplace—real, with chimney-flue complete, and not a dummy—should be drummed out of the professional camp!

And whatsoever odist may be casting about for a theme seriously deserving of rhapsody, let him sing of the ingleside! For in modern dwelling as in castle "old in story", whether for warming, for ventilating, or for binding together the family with "sweet influences", the open fire holds place immortal,—the one device handed down from the days when man first struck sparks that "modern improvement", with its devilish cunning in catering to sloth at the expense of health, has not wholly succeeded in "improving" into banishment.

The fireplace provides an air-outlet pointing straight to heaven, as such outlets should, where also by a fire at the base of the flue the up-draught is enormously reinforced. Even without any special inlet for fresh air, a room with an open fire will always be sweet. The gallons upon gallons of air sucked up, out, and off by the action of the fire make a void in the chamber that must be filled somehow from somewhere, else the window-panes would quickly be burst in by pressure of air from without. From every crack, cranny, and keyhole, as well as from open doorways, is drawn new air to make good the loss by constant uprush of the old. Also the quality of the heat given out by an open fire—radiant heat—while wasteful and uneven for the different quarters of the room, yet has a purifying effect that makes it a mighty factor for health.

An excellent device for the open fire, for those who can afford it and can overlook the abomination of its dysæstheticism, is the gas-log. The arrangement is convenient and cleanly, and—a great point—gives a perfectly steady fire and one that can be turned on or off as wanted. Objection is made sometimes that the gas-log smells and makes headaches, bad taste in the mouth, etc. But in any such case the fault lies not in the log but in the *flue*. There is no intrinsic difference between the products of combustion of gas and of coal or wood,—indeed, the burning of coal is but a crude method of burning gas. A flue, therefore, that discharges into the room fumes from a gas-log is one that would "smoke" to a corresponding extent with a wood or coal fire. In some cases the trouble is no flue at all, for, inconceivable though the iniquity be, the writer has known of the setting of gas-logs in dummy fireplaces with no outlet whatever for the noxious fumes save into the very body of air of the chamber itself!

Provided there be gas in the house, a gas-log can ordinarily be put into any fireplace at a fairly moderate cost.

Even without a fire, a fireplace operates to a certain extent as a ventilating-flue, as one can test by a smoking taper. But the effect can be enhanced by the simple device of putting a lighted lamp or even candle in the fireplace, set so that the flame is not much below the level of the upper border. For even so small a degree of heat as that so derived sets in motion the air in the chimney and so maintains a steady updraught through the flue.

The serious difficulty in house-ventilation is the matter of the intake of fresh air,—how to arrange it so that there shall be no objectionable cold draught. In really cold weather a slightly raised window-sash means a thin slice of cold air falling with sensible draught upon ankles or neck,—a wholly intolerable condition. Theoretically the use of the hot-air furnace to warm the house should solve the problem. For here fresh air is taken in from without, heated at the furnace and then distributed to halls and chambers by the furnace-flues to warm by admixture the general body of air of the house. But here a trouble all its own lies hid in the words "heated at the furnace". If only it would suffice that the air should be *warmed* at the furnace, all would be well. But in order to warm the whole house by admixture, the furnace-air must distinctly be *heated* and heated considerably. Now air furnace-warmed beyond a very moderate degree, 75° F., suffers a peculiar change—is "burnt", as is the technical phrase, and has lost its freshness for respiration purpose. Also it has less than its natural moisture. Partly because of these changes and partly because in a furnace-heated house fireplaces are apt to be lacking or to be disused, furnace-heat as the sole system for warming is as disagreeable as it is unwholesome. To the unaccustomed, indeed, especially in overheated houses, it is well-nigh intolerable.

There is no help for it, then, but to go to the windows for the intake of fresh air, and the practical problem presents of how to avoid a sensible draught. This must be effected either by changing the direction of the draught by shunting it upward, or by breaking its force with nettings, on the principle already described, or by both means combined. The simplest device is a narrow piece of board, just the width of the sash, to be set under the lower sash, raised just enough to receive it. By this arrangement an opening is established between the two sashes, through which air may enter and, necessarily, with an upward course. Or a box attachment may be fitted to the window, whereby, when the sash is raised somewhat, the incoming air will be delivered more or less vertically and be made to pass through a screen of wire netting backed with porous cloth. Then the top of the lower sash must properly be weather-stripped to prevent air from coming in between the sashes. In New York, ventilators on this principle are on the market. A narrow box-like attachment is fitted to the lower part of the window, whereof the opening is a hinged lid facing upward and consisting simply of an open framework covered with wire netting backed by a loose-meshed cloth. To the top of the window is fitted a flat frame, a few inches wide, similarly covered. The idea is that fresh air shall come in at the lower opening while the hot, foul air of the upper portion of the room finds outlet above. These ventilators do not interfere with the raising or lowering of the sash, and the lower, box-like attachment is removable. The ventilators are made to order to fit the windows and are built of any kind of wood to conform with that of the jambs. They are neat in design, handsome in appearance, and rather ornamental than otherwise to the window. They are thoroughly efficient for providing an intake of fresh air without a sensible draught.

In the matter of windows, what a Yankee would call a "cute dodge" is to have them reach to the ceiling. The uppermost layer of air in a room—that above the upper border of doors and windows—is practically imprisoned. It is lighter than the layers below, and so tends to cling to the ceiling, even when doors and windows are opened; diffusion alone operating to change it. Consequently such layer is always hot and foul as compared with the lower body of air, a fact easily demonstrated by a climb upon a step-ladder. If, now, the window-openings are cut high, then the lowering of the upper sash, as is the condition when the above-described ventilators are in operation, provides a flush opening into the topmost layer of air, and so effects thorough ventilation. Incidentally such high-cut windows enhance enormously the lighting of the room, for, of course, it is from the upper portion of the window that illumination is derived. There *are* architects who will build windows after this pattern and of their own accord, as witness the present edifice of the College of Physicians and Surgeons in the city of New York.

Under the conditions of the modern dwelling-house, then, the best available system for ventilating and warming is as follows: One body of air for the whole house; the warming of the *halls* by whatever scheme the house provides, the direct-indirect hot-water system preferred; a supplementary warming of the rooms by open fires; then, according to weather, open skylight, open scuttle, open ventilators at the windows, and not a square inch of carpet from attic to cellar, but only rugs, and they neither too many, too big, nor too thick.

If the householder be so fortunate that he can determine what shall be the method of **heating** for his house, the following points will present for consideration:

In house-warming it is not the house that is to be warmed, but the human bodies within it. Now the body will be comfortably warm under two distinctly different conditions: first, if bathed in air itself of a temperature between 68° and 70° Fahr., and, secondly, if similarly bathed in air ten degrees lower in temperature while at the same time the body is exposed to radiant heat. Radiant heat—the heat given off from a hot surface or a flame—passes through air in straight lines: *does not warm the air in passage*, but does warm any solid body upon which the rays may impinge. By reason of this fact, an open fire or a steam-coil will warm the occupant of a room at a lower temperature of contained air than must be the case where the warming is exclusively by hot air. And the lower the temperature of the air, while yet the body is warm, the greater the comfort and the more wholesome the condition.

Understanding this fundamental point, the special features of the different methods of warming may thus be summarized:

The **open fire** is ideal. It warms by radiation, and therefore at a comparatively low room-temperature, and at the same time it ventilates as nothing else will. It is, however, costly and unequal, and, in really cold climates, is by itself inadequate. If the fuel be wood, the fire is unsteady; if coal, the fireplace is dirty; if gas, the cost is serious. All these points combined make it the function of the open fire, in such climates as that of the northern United States, merely to supplement some system of general house-warming, as has already been set forth.

The **hot-air furnace** warms by warming the air, a disadvantage, as just seen. It introduces fresh air, but fresh air unduly dry for its temperature. It is liable to faults of construction, making its practical working a horror or a torture, one or both. First, the intake for fresh air may so be set as to introduce foul air instead of pure. The intake should be metal-lined, protected from vermin-intrusion, and set several feet above the yard-level. And, it is needless to add, the environment of its open mouth should be properly policed. Secondly, and very commonly, the heating surface is too small, a fault leading to two grave consequences. The heating capacity being small, the fire must be hot; the fire being hot, the firepot gets red-hot, and so permits carbon monoxide, a highly noxious fume, to pass through the substance of the iron itself into the air-flue; or, worse yet, the firepot cracks and so leaks fumes bodily. From an overhot fire comes also a superheating of the air in the air-flues, producing that disagreeable and unwholesome burnt quality of air already described. The air in a hot-air furnace never should be delivered into the rooms at a higher temperature than 100° F., and every degree of lowering from this point down to 75° F. will mean an added degree of health and comfort.

Hot-water pipes give radiant heat of low grade at the same time that they also warm the air by convection. The system is cheaper to maintain than that of steam-pipes and has the merit that the heat can be regulated at pleasure. It has the disadvantage, in the "direct" method, of providing no ventilation whatever.

Steam-pipes are similar to hot-water pipes in principle and effect, with the added disadvantage that the heat from any given coil cannot be regulated. Each coil is either fully "on" or wholly "off", without any intermediary condition. From this fact, and from the necessity of having the plant adequate for the coldest weather, it happens that except in cold snaps a steam-heated apartment is generally an overheated one. At the same time, if there be no fireplace, as generally there is not, the room is pretty sure to be wholly unventilated, so that the combination of hot air and bad air makes the atmosphere well-nigh intolerable to one not trained to be a salamander.

What is known as **indirect** hot-water or steam heating is quite another affair from the foregoing. This system is a combination of the features of the coil and the hot-air furnace. The coil is not placed in the room but somewhere underneath, where, like a furnace, it heats air in tubes, which heated air is then delivered into the room. Here is the advantage of a delivery of fresh air, and that never superheated, but there is the disadvantage of all hot-air systems that the air of the room must itself be warmed to the limit.

In yet another system, the so-called **direct-indirect,** the radiators are placed underneath the room-windows, and air is admitted upon them immediately from without by suitable openings in the house-wall controllable by a key within the room. This system, especially when the coils carry hot water, gives the advantage of radiant heat, clean and manageable, together with a delivery of fresh air, directly drawn. If also there be a fireplace or a ventilating-shaft, to carry off the foul air, the requirements of ventilating and of warming are fully met.

A point of great importance in connection with the heating of dwellings is that of **humidity** of air. Air loves water and water loves air. Accordingly there is always ready evaporation of exposed moisture up to the saturation-point of the surrounding air; and this same saturation-point varies with temperature, warm air being able to hold far more vapor of water than cold. In round numbers, the absorbing capacity of air for moisture doubles with each rise of twenty degrees of temperature, Fahrenheit. That is, air fully saturated with vapor at 60° F. will be only 50 per cent saturated at 80°, and accordingly at such temperature will take up as much again of moisture if it can get it. Now the human body exhales moisture from skin and exposed mucous membranes, such as those of the eyes and the respiratory tract, and is uncomfortable when the surrounding air is either unduly moist or unduly dry. And when cold air, which, because cold, can contain but little moisture, is heated to the summer temperature of 68° or 70° F., it is necessarily unduly dry for its temperature. Accordingly, such air is oppressive for breathing, and just this quality of undue dryness is one factor in the distress attending artificial heat, especially when the heating is by stove or furnace. To neutralize this effect, evaporating-pans should be provided somewhere in connection with the heating plant of a house, to supply moisture along with the heat. For comfort, the percentage of humidity should not fall much below thirty. When it drops to fifteen, glued furniture begins to drop apart! Too much humidity would be a mistake in the other direction: there would be as little sense as comfort in reproducing artificially an oppressively humid summer day.

A last point in connection with house-air is this: By day we breathe day-air; what shall we breathe by night? This writer, brought up by the best of mothers to be a fresh-air fiend by taste long before he was so also by understanding, will never forget his first practical experience with this question as an issue. It was on an occasion when, as a medical student, he was assigned by his preceptor to spend the night at the home of a patient close by, in order to be on hand in the event of a certain possible contingency. He was given for the night a hall-bedroom, and when came the hour for retiring, his host, a most kindly old gentleman, accompanied him to the chamber to see that all comforts were duly provided. Going, then, to the one window, the white-whiskered dispenser of benevolence opened it, drew in and fastened the outside green blinds and closed their slats. Then down came the sash, tight, down in turn came the shade, and lastly with a triumphant click home went the catch on a pair of old-fashioned inside shutters, solid and heavy, whose perfect closing completed the hermetical seal. Turning, then, with the serene smile of one who has done his whole duty to his fellow man, the dear old gentleman remarked in passing, "to keep the night-air off you", and with a pleasant good-night left the little room. The medical student, whose eyes had been bulging wider and wider with astonishment as the various performances at the window progressed, waited till the footfalls of his benefactor ceased to sound upon the stair, and then, like papa in his cap on the night before Christmas, "away to the window" he "flew like a flash, tore open the shutter and threw up the sash." Then purposely forgetting to close either, to bed he went. And, the dreaded contingency not happening, there slept he soundly, and in the morning awoke with clear head, fresh face and clean tongue, ready for home, bath, breakfast, and the duties of the day.

"To keep the night-air off you," forsooth! What, then, to breathe by night,—bottled day-air, befouled and stale? Oh, the horror, as that guileless medical student came later to know—the morning horror of a boarding-house bedroom, double-bedded and double-occupied, with doors and windows shut, during the long hours of a winter's night! "She'll see you in a few minutes, doctor, as soon as her room is aired," is a form of greeting at the early professional visit. And in the stuffy parlor, itself in sad need of airing, the old doctor seats himself to wait, and, waiting, bethinks him of his own sweet bedchamber, newly left, that never needs any airing in the morning, for the simple reason that it has been airing all night.

Let, then, those that may be pursued by this phantom terror of "night-air" understand that there is nothing abroad in the air of night different from what is to be found in the air of day save only bats, owls, and the *Anopheles* mosquito! And even the latter, when he is a possibility with malaria-laden sting, is safely barred by a netting at the window. Let, then, the superstition be laid, and when comes bedtime, freely up sash so far as weather will justify, nor fear infection from the silent kiss of the sweet, pure mother of day!

In malarious districts nettings to the windows and even to the doors of the house are all-important. It is now known definitely that malaria is carried by the *Anopheles* mosquito, and there is no reason to suppose that it ever is carried in any other way. The female of this mosquito bites a malarious subject and from the infected blood thus drawn develops within herself another phase of the contained malaria-parasite, which then she delivers through her sting into the blood of a second subject, bitten at the proper stage of the development. *Anopheles* flies and bites only after sunset, a circumstance that accounts for the well-known fact that even the most deadly malarious districts can safely be visited during the daytime. The retiring, by sunset, into a well-screened domicile, affords perfect protection from malarious infection.

The *Anopheles* mosquito differs from the ordinary mosquito of the genus *Culex* in many particulars, but most strikingly in the pose when resting. *Culex* stands with the back humped, head down, and abdomen drooping, while *Anopheles* rests with head, thorax, and abdomen in a straight line which is tipped up strongly from before backward. The insect, indeed, looks to be standing on its head, with the abdomen pointed upward, it may be even vertically.

Of course not every female *Anopheles* is necessarily malaria-laden. Before a mosquito can give malaria it must get it, and from man. But whether man first infected mosquito or mosquito first infected man is as idle an inquiry as that other, whether the first hen laid the first egg or the first egg hatched the first chick.

The hygiene of the **breathing organs** themselves must next receive attention. There is much to say concerning the very act of breathing, but since this act is intimately associated with others muscular, it is most conveniently discussed in the chapter on physical exercise.

The **avenue** for breathing always should be the organ provided by nature for the purpose, which is the nose and not at all the mouth. One may ask, what difference does it make, since both doors lead to the same passage, along which the incoming air is to be ushered? It simply makes all the difference between health and disease. What the lungs want of the atmosphere is its air, and the less they get of the dust that the atmosphere holds so abundantly—dust, animal, vegetable, and mineral—the better both for the lungs and the general economy behind. Also the lungs need their air somewhat warm and moist, so as not to be irritating to their delicate surfaces.

Now the nostril suggests a theatre-door, a narrow opening leading to a lofty vaulted space beset with overhanging galleries. These galleries of the nose are, of course, covered with warm and moist mucous membrane, and perform upon inspired air the triple office of filtering, warming, and moistening. In the case of the mouth, on the other hand, the suggestion is of a tunnel, an opening of the same calibre as the chamber itself, with no galleries to break the smooth and even passage. In mouth-breathing, therefore, the in-drawn air rushes straight upon the larynx in its crude condition, unfiltered, unwarmed, and unmoistened.

The importance to health of nose-breathing cannot be overestimated. Not only are throat, larynx, and lungs saved from the irritation given by cold, dry, and dusty air, but the ever-present germs of disease are stopped at the outer gate. So strong is the instinct to breathe through the nose that habitual mouth-breathing quite surely means some obstacle to the use of the natural avenue. In children, occlusion of the nasal passages is very commonly by a soft growth at the rear opening, which declares itself in no other way than by necessitating mouth-breathing and, as a possible consequence, causing deafness. The growth is not in view by ordinary throat inspection, so that its presence is unsuspected by the unitiated. When the subject reaches adult age, this growth generally withers away of itself, but leaves, alas, permanent consequences. Its existence during many years of adolescence may have hampered the proper development of the adjacent parts, so that the rear passage from the nose remains too small and the subject must continue to breathe through the mouth, more or less. From the unnatural position of the jaw in mouth-breathing, the muscles and even the bones of the face have developed wrong. The upper jaw is long and narrow, with projecting front teeth, and in the lower jaw the chin is peaked and receding. The whole face has a characteristic blank expression.

Every mother should be informed on these points, and as soon as the sharp maternal eye notices in one of her darlings a tendency, upon any exertion, to breathe through the mouth, then should that good mother whisk the little one to an expert's office without delay. Then at the home-coming of paterfamilias will she have to tell a wonderful tale of a surgeon and a bunch of grapes, and will she gleefully point to little Johnnie or Mollie romping about the room and breathing with mouth as tight shut as pussie or baby!

Mouth-breathing in adults is commonly from obstruction in the nasal passages, sometimes, as just described, in consequence of the peculiar growth of childhood. The peccant conditions are often perfectly removable, and, of course, should so be removed.

Catarrh is a vague term covering a multitude of sins, from an acute coryza following a chill or an exposure to breath-vitiated air, to the chronic or recurring inflammations that attend diseases, growths and deformities of the nasal passages or the throat. An acute coryza, or common "cold in the head," can often be aborted or greatly ameliorated by proper treatment, *if taken early*. Chronic catarrh may be a disease by itself or merely a secondary consequence of some organic trouble more or less amenable to the arts of modern surgery. Even hay-fever, reputed child of roses and ripening grasses, is often a mere Frankenstein of the nose itself—born of a polyp and not at all of pollen! However caused, chronic catarrh should not be neglected, for, apart from its disgusting qualities, making its victim an offense to associates as well as a misery to self, the condition is a constant menace. The wandering germs of pneumonia, diphtheria, tuberculosis and their fell brotherhood are, like the poor, ever with us, and, again like the poor, find their natural habitat in unwholesome conditions. A story might be made of two subjects and two germs, the one subject shall be taken and the other left. The one taken is a poor seamstress, snivelling with catarrh over a hot stove in a small, stuffy room, while he who is left is a burly motorman, clanging clear-the-way equally to tuberculosis-germs and to trucks, as he doggedly opposes the hardihood of health to the rough-and-tumble buffets of Boreas.

Catarrhal subjects, even more than the healthy, need to breathe through the nose, and to breathe only pure air. Yet, more commonly than not, it is exactly the victim of catarrh who shuts out the sweet air of heaven and bottles himself up with his own breath in a close room for long hours or even days without respite. The responsibility for this grave mistake lies with the stupid common name for catarrh, a "cold". The subject who, staying in the house with tightly closed windows, excuses himself with the complacent remark, "I do not go out in cold weather, for I take cold easily and cannot stand a draught", would probably be greatly astonished to be told that the true rendering of his remark would be, "I take cold easily *because* I do not go out in cold weather, and so cannot stand a draught." And still further would he be surprised to learn that he might add truthfully, "I predispose myself to colds by eating too much and too rich food; by wearing too much and too heavy clothing; by living in too hot a house, bathing in water too warm, and breathing air of a quality altogether too bad."

It cannot be impressed too strongly that, despite its misleading nickname, catarrh is *not* a temperature-disease like sunstroke or chilblains. Nansen in the frozen north, living through an arctic winter in a snow-hut, had plenty of cold, but never had *a* "cold", not even after a plunge into the icy sea. The exciting cause of a coryza may be an exposure to cold, but back of such exposure will lie the main factor of causation, the state of the system itself. Predisposing causes have already been enumerated, and, according to the writer's observation, a potent determining cause is exposure to breath-poisoning. A coryza comes after an evening at some public entertainment in January. The victim blames his affliction upon the clerk of the weather, when really it should lie at the door of the architect of the theatre or hall. The same acquaintance with Boreas made over a pair of skates in the park would have been followed by no coryza at all.

To correct a morbid susceptibility to catarrh, the scheme lies not in trying to keep cold air out, which necessarily means to keep foul air in, but in training the relaxed nerves and blood-vessels of the skin to brace up and take without shivering the impact of cold. Fortunate is he, trained by wise parents in early childhood to the daily cold bath. By this means as by no other the nervous system is taught not only not to shrink from slaps of cold, but to exult in the play, the rougher the better. The sport of a big sponge and the Croton just as it comes from the cold tap is and has been, since Croton was, this writer's morning joy in January as in July. If not learned in childhood, the habit still can be acquired in later life, and should so be by the victim of catarrh. The first essays, however, should be in summer, so that when comes cold weather, the nerves will already have become used to the new habit. The bath always should be followed by a vigorous rubbing with a coarse towel.

Besides cold bathing, outdoor exercise in cold weather, special exercise in breathing (see the chapter on physical exercise), and singing are useful anti-catarrhal measures. In every way foul or dusty air is to be avoided, and pure air only, be it warm or be it cold, permitted access to the sensitive mucous membrane. And the cold bath, sanitation of breathing, and care of the general health will be found fully as effective in warding off "colds" as pottering with sprays, gargles, and snuffs.

Failure of breathing, from other cause than disease or injury, occurs in syncope, as in an ordinary faint or in chloroform-inhalation, and in suffocation, as in drowning or the accidental smothering of infants in bed. In syncope the failure is primarily of the heart, but in either case the means of resuscitation is the same—artificial respiration. Respiration can be forced artificially, and return of lung-play will bring about renewal of heart-action also. There are several ways of conducting artificial respiration, all based on the same principle, namely, of contracting and expanding the chest in imitation of the natural process. The simplest method is to squeeze the chest with outspread hands and then let go again. In such case the inward pressure deflates and the natural spring of the ribs inflates, in turn. This process, however, only partially accomplishes its purpose and is ineffective for other cases than simple fainting. For grave cases, such as chloroform-syncope or drowning, the so-called "Sylvester" method should be employed. The subject is laid supine, with a roll of clothing under the back just below the shoulder-blades, so that the chest shall be thrown out while the head hangs low. The operator, then, standing or kneeling at the head, grasps the forearms near the elbow, and draws the arms to full extension overhead. Holding them so for two seconds, he then bends them downwards, flexing at the elbow, and with the flexure makes firm pressure on the chest-walls at the sides. After two seconds of such squeezing, he stretches the arms again overhead, and so continues the motions rhythmically at the rate of about fifteen a minute. In this procedure an all-important matter is to keep the tongue from falling back and plugging the throat. If the operator be alone he must rely on the position of the head, as described, to counteract the tendency, but if there be a bystander, as ordinarily is the case (often too many of them), he may be put to service for the following simple trick: Standing or kneeling by the subject's waist, the assistant spreads his hands around the neck, gets his thumbs against the angle of the lower jaw from behind and then by the purchase so obtained pushes the bone gently forward as far as its articulation will permit, and holds it steadily in such position. With the jaw thus pressed forward it is mechanically impossible for the tongue to block the throat.

Even though there be not the slightest sign of life, artificial respiration should be conitnued always for at least twenty minutes before the case is abandoned as hopeless. It is astonishing how very dead indeed a subject can appear and yet, through persistency, be snatched from Azriel's grasp. The writer recalls with grim satisfaction how once, in his early professional days, he disobeyed the direction of his senior to give up, with the result that the seemingly dead chloroform-subject left the operating-room as a man, on his feet, instead of as a "subject", indeed, on a stretcher.

If there be the faintest flicker of life, no matter how fleeting, the respiration is patiently to be continued indefinitely. In cases of heavy poisoning, as by opium or by illuminating-gas, life may hang by a thread for hours or even days, and that thread be kept from snapping by artificial respiration alone.

In cases of drowning, there is much else to do besides making the artificial respiration. The moment the body is reached, it is first to be turned prone, the shoulders raised, and the jaw slipped forward as just described. At the same time pressure is to be made upon the chest. By this means any contained water is permitted to run out. If there be assistance at hand and shelter near by, the body is quickly to be borne under cover, the wet clothing to be cut off, the skin dried and warmed, while all the time artificial respiration, begun at once, continues steadily in progress. Delay is dangerous in the highest degree, so that if the nearest house be far away and no means of transportation at hand, time should not be wasted, but artificial respiration be instituted then and there on the beach, the subject being sheltered, dried, and warmed as best may be. Besides the drying and warming, the limbs should be rubbed vigorously by the dry hands, the strokes being from the extremities upward, so as to drive the surface blood toward the heart

In cases of ordinary fainting, as from horror, the sight of blood, or the oppression of vitiated air, heroic measures are rarely necessary. The subject should be laid on the back in cool fresh air, the clothing loosened about neck, chest, and waist, and perhaps a little cold water snapped upon the face. Smelling-salts, or, in their absence, some vinegar on a handkerchief, may be held to the nose, but care should be taken not to press strong ammonia too ardently upon the nostrils, lest, in the unconsciousness of the faint, a dangerously irritating dose be inhaled. If there be no signs of revival after these simple measures, pressure may be made upon the chest; if this also fails, then regular artificial respiration by the Sylvester method should be instituted at once.

As a general adjuvant to the well-being of the breathing apparatus, and indeed of the economy generally, **singing** is an exercise of distinct value. It develops and holds pervious the various passages and chambers of the respiratory tract from brow to diaphragm, and trains and practises in deep, full breathing. Entirely apart, therefore, from all idea of making vocalists, singing should be taught and practised in the family circle by all, be the voices good, bad, or indifferent. The natural instinct of children to sing should be fostered, and choruses of simple music, of a range well within the limit for little ones, should be a regular feature of the twilight hour.

Whoso essays to sing, whether child or adult, and whether simply for fun or to become a vocalist, will do well to start aright by early lessons from a competent teacher in the art of delivering the voice. In singing, as in every other art, it is far easier to learn than to unlearn, and a faulty method of singing once acquired is hard to break.

Singing never should be carried to excess, nor the voice strained by trying to climb too high or to grovel too low. One should not sing when, in adolescence, the voice is changing, or when suffering from a cold, whether in head, throat, or chest, or in foul or dusty or tobacco-impregnated air. Singing, besides being a healthful exercise, is an ennobling art, and has the right to demand that the environment of its practice be ever of the domain of the true, the beautiful, and the good.

CHAPTER II

EATING

Govern well thy appetite, lest Sin
Surprise thee, and her black attendant, Death
—MILTON

FROM a microscopic speck of protoplasm to a mushroom or a man, an oak or an elephant, is a far cry, yet such is the way of life—growth from an infinitesimal germ to the adult form, whatever it be. In such growth it is from food that the developing plant or animal builds its structure, and again it is from food that the mature organism renews its substance and gets heat and power for the running of its machinery.

To appreciate the rationale of the dietetics of man, there must first be understood the essential features of the nutritive principles contained in the food of that subject—the **foodstuffs,** as such principles are called—and the main facts in the story of animal nutrition.

The foodstuffs are necessarily organic principles, for while the plant can make organic matter out of inorganic elements, just this the animal cannot do at all. The thing of legs and locomotion, of spine and speech, can build his organic walls only out of organic bricks ruthlessly ripped from existing walls of other animals or plants.

Man eats a great variety of food, but the principles therein contained are few in kind, and may all be typified by the following substances: **white-of-egg, calves'-foot jelly, butter, honey,** and **arrowroot.**

White-of-egg typifies **proteids,** the albuminous bodies that constitute the organic basis of the actively living tissues of plants and animals. Proteids are of complex and indeterminate composition, but, among their many constituents, contain the element **nitrogen,** a circumstance of weighty import, as will appear later.

Jelly typifies **albuminoids,** a small and inconsequential class of bodies occurring as the organic basis of the inert, fibrous tissues of animals, such as bone, cartilage, tendon, and connective tissue. As the class-name imports, these bodies are closely related to albuminous proteids, and, like proteids, they contain nitrogen. It is unfortunate that the name "albuminoid" has been applied also to proteids. Gelatin is the principal example of an albuminoid.

Butter, honey, and **arrowroot** typify, respectively, **fats, sugars,** and **starches,** familiar substances all. These several principles simply represent inert material manufactured by plant or animal for fuel use, and held in storage for fuel purpose, like so much coal or wood in a house-cellar. Fats, sugars, and starches are bodies of simple and fixed composition and contain absolutely no nitrogen, but only the three common elements, carbon, hydrogen, and oxygen.

The foodstuffs, then, are of two general kinds, contradistinguished both by representation and by composition. On the one hand is the group of the proteids and albuminoids, bodies representing the organic basis of life and containing the element nitrogen, and on the other is the group of the fats, sugars, and starches, bodies representing organic fuel-material, only, and containing no nitrogen. For convenience, proteids and albuminoids are commonly designated as the *nitrogenous* food-principles, and the fats, sugars, and starches as the *non-nitrogenous*.

As to the **story of nutrition,** one would imagine it to be very simple. It concerns mainly two functions, on the one hand the building and renewal of tissue, and, on the other, the supplying of energy for conversion into heat, motion, and the doing of vital work; and two groups of foodstuffs are given, representing, respectively, the substance of tissue and fuel-material. Naturally, therefore, one would say, tissue-principles for tissue-building, and fuel-principles for fuel service; and, in the main, such prediction would be verified. But the facts are not rigidly according to scheme, for nature rarely works along exact lines. If the mysterious dame "abhors a vacuum", likewise does she despise a limitation, and dearly love to mix matters.

In the first item, that of tissue-building and renewal, the case is, indeed, simple. Tissue is nitrogenous, so that, of course, only nitrogenous food can serve for its making; but, of the two kinds of nitrogenous principles, proteids and albuminoids, behold, proteids only are of avail! Why this is so is unknown, since albuminoid is equally nitrogenous with proteid; but so it is,—proteid and proteid alone can fulfill the high function of furnishing the material basis of life. Gelatin cannot even go to make the very kind of tissue of which itself is a derivate. Alongside of its brother proteid, gelatin stands as a prince of the blood whose escutcheon bears the "bend sinister". Such a one, though of royal lineage, may never aspire to the throne. This nutritive disability on the part of gelatin is of little practical consequence, since there is not much jelly in food, and very little gelatin in jelly—rarely more than three per cent, the rest being water!

Tissue-nourishment is a duplex function. The *growing* organism must have material out of which to lay on the increment of growth, but also immature and mature organism, both, must have pabulum to meet a constant demand for the *renewal* of living substance. For protoplasm—the physical basis of life—in and by the very act of living, ceaselessly changes its substance. The organic cell may be likened to a rock-bound whirlpool in a river: the *form* has place within fixed walls, and endures; the *substance* is forever fleeting. This process of integration and disintegration of living matter goes on throughout life at a steady rate for the individual, unaffected by extrinsic conditions. It is not at all related to work, and pursues an even tenor, be the subject on his feet in the open, racing at top speed, or prone under shelter, in the profound rest of sleep.

The amount of proteid nutriment necessary for growth is, of course, commensurate with the growth. The certain steady supply needed for the renewal of substance is small—hardly more than one-tenth of the requirement for fuel-food.

The other great function of nutrition, the evolution of energy to meet the call for heat and power, differs from the function of tissue-nourishment in that it can be subserved by any and all foodstuffs. The requirement is simply for fuel: whatsoever burns can be put to fuel-use, and all organic matter burns. So in a battle royal between elephant and tiger, there is the picture of a ponderous engine driven by the burning of starch and sugar opposed to one whose swifter and more sinister power is generated by proteid combustion.

But while any foodstuff *can* serve as body-fuel, yet, despite the example of the carnivore, there is an intrinsic objection to the use of proteid for the purpose. The objection is strong—so strong that it is instinctively recognized by omnivorous animals, such as man, who, whenever they can get it, resort largely to the vegetable products, starch and sugar, for fuel-food. The objection lies in the simple fact that *nitrogen does not burn*. The atmosphere is a mixture of nitrogen and oxygen; accordingly, were nitrogen inflammable like hydrogen, a single stroke of flint on steel would blast the earth. But nitrogen does not burn, and *proteid contains nitrogen*. Proteid also contains the common combustible elements, carbon and hydrogen, so that its molecule may be likened to a frame house with a brick chimney. When comes conflagration, walls, roofs, and floor (carbon and hydrogen) go up in smoke, but the chimney (nitrogen), gathering about it some charred remains of woodwork, stands defiant of flame as a solid bit of ruin requiring special service of pick and cart for its removal.

So in the disintegration of proteid, while much of the carbon and the hydrogen of the molecule oxidizes fully and disappears as carbon dioxide and water, the nitrogen, together with a moiety of the other elements, remains as a residual waste. This nitrogenous residue, then, passes through a series of metamorphoses of which some of the intermediary products are distinctly noxious, and finally is made over by the liver into a certain crystalline waste-product to be excreted by the kidneys—the substance *urea*.

Omnivorous man, then, who in his omnivorous privilege has a choice of foodstuffs, does not, *when wise*, feed his furnace-fires with proteid, any more than he would stoke the furnace of his house with fine brass-bound cabinet furniture. The metal fittings, in such case, would not burn, and their warped and twisted shapes would only clog the grate, while costly carved rosewood or polished mahogany would give no more heat than plain pine sticks. In other words, the oxidation of the large amount of proteid necessary for fuel service would mean a serious tax upon the energies of liver and kidneys, and an impregnation of blood and tissues with a considerable proportion of more or less poisonous waste-products, all for the sake of a combustion yield of energy that could be got just as well out of simpler and safer fuels.

Such simpler fuels are, of course, the natural fuel-stuffs, the fats, the sugars, and the starches, stuffs which, being destitute of nitrogen, are wholly free from the proteid objection. These non-nitrogenous principles, containing, as they do, only carbon, hydrogen and oxygen, oxidize completely within the system—burn clear, so to speak—yielding as combustion-products only carbon dioxide and water, products innocent, volatile, and easily eliminated by the lungs or other emunctories.

The daily requisition of the organism for fuel-food is relatively large—ten times that for tissue aliment. Moreover, by the very nature of the case, it is variable, in which respect it differs from the call for tissue-food. The subtle act of living, subserved by proteid, moves ever with quiet dignity at an even pace, but the need for heat and power necessarily varies with conditions. Exposure to cold will call for more fire in the furnace: high pressure in the engine, as for the doing of an arduous physical task, for more steam in the boiler. Accordingly, while the song of substance for substance' sake is ever the one stanza sung on the one key, the song of substance for energy's sake may have anywhere from one to half a dozen verses and be pitched high or low to suit the voice of the individual singer.

Thus are the several foodstuffs applied to the two main functions of nutrition. But in the case of **proteids** there is now to be noted an additional alimentary purpose. For some reason known only to nature, nutrition demands that there always shall be in free circulation a certain excess of proteid over and above what is required for tissue-renewal, which excess is finally to suffer oxidation without ever becoming living tissue. Apparently this "circulating proteid" operates in some subtle way to determine and regulate the nutritive processes generally. And now happens a curious circumstance. The prince of the "bend sinister"—the albuminoids—

may not aspire to the throne, but there is nothing to prevent him from offering his life, on occasion, in vicarious sacrifice for that of his better-born brother. So **gelatin,** which cannot replace proteid for the building of tissue, can and may, to a considerable extent, at least, serve as a proteid-substitute for this obscure administrative function. And herein lies the one dietetic service of gelatin. Gelatin is lighter than proteid and more easily digested. Accordingly, when the stomach is deranged so that it cannot handle a full allowance of proteid, the deficiency of nitrogenous food can be eked out by gelatin. The gelatin will replace proteid for "circulating" service, and so will "spare" for the higher function of tissue-nourishment such proteid as may be on hand.

An item of nutrition-service in which all the foodstuffs take part, though in different proportion, is that of contributing to the common savings-bank account of the economy. So much of consumed foodstuff of any sort as is not needed for its proper function may either go to waste by oxidation, each after the manner of its kind, or be converted into **body-fat** and stored. Sugars and starches are most easily so made over into adipose substance; next fats; and, least readily, proteids. The formation of fat from proteid has been disputed, but yet seems well proven. The combustible portion of the proteid-molecule simply turns into fat instead of oxidizing, while the nitrogenous, incombustible portion degenerates into urea in the usual way. Gelatin occurs in the dietary in such small proportion that it does not count in the present connection.

Even when formed from fat itself, body-fat is, under ordinary circumstances, an original manufacture and not a mere deposit. Each animal makes fat after its own kind, and human fat is neither lard nor suet.

A last item of nutrition is the making good of direct losses of substance. By the various transpirations, secretions, and excretions, there is constant loss to the system of water, mineral salts, and dissolved albuminous substance. The loss of water is made up by the water contained in food and drink; that of salts, by the similar salts present in food, supplemented by a certain addition of common salt, and that of albuminous substance by a new stock made from the proteids of the food.

Nutrition, then, embraces the following items: *first*, the renewal of the substance of life by the substance of proteid food; *secondly*, the utilization of energy got from the direct combustion of food, preferably of nature's fuel-foods, fats, sugars, and starches; *thirdly*, the regulation of the nutritive processes by some subtle influence of freely circulating proteid, or, in partial substitution, albuminoid; *fourthly*, the formation from any and all foodstuffs, in varying proportion, of a reserve stock of body-fuel in the shape of body-fat; and, *fifthly*, the making good of direct losses of water, salts, and albuminous substance by corresponding direct renewal of supply.

So much for the theory of nutrition. And now for the **practice of alimentation,** quite another story, since alimentation must take into account many other considerations besides those of the chemistry of nutrition and the foodstuffs. The first consideration is the matter of side-issues affecting the several foodstuffs themselves.

First as to **proteids:** These principles, indispensable as they are in nutrition, are in every way the most trying for proper disposal. Not only are they a tax upon liver and kidneys, by reason of their peculiar behavior in oxidation, but at the very gateway of the system, in the alimentary canal itself, they easily become burdensome or even noxious. Their digestion is complicated, and absorption neither prompt nor complete, about one-tenth escaping absorption altogether and going to waste. Failure of absorption is especially apt to occur where there is much indigestible matter present, as is the case particularly with vegetable food. The indigestible network of vegetable fibre entangles the contained proteid, which is not sufficiently diffusible to work out through the meshes. Vegetable foods are at best relatively poor in proteids, so that, for a double reason, vegetable fare furnishes a low percentage of proteid aliment for absorption.

If proteid be not properly digested, it decomposes in the alimentary canal, developing products more or less noxious. Such products, absorbed into the blood, poison with more or less severity, producing fever and other malaise. Many of the nondescript febrile seizures with digestive derangement, glibly ascribed to "malaria", are nothing but cases of "auto-intoxication" from poisonous derivates of decomposing proteid food.

Proteid aliment seems to have a distinct influence on temperament, tending to the development of that quality which, in mild degree, appears as aggressiveness, and in pronounced grade as ferocity. The solid matter of flesh is practically all proteid, so that meat-eating, which is synonymous with proteid-eating, is especially responsible for the belligerent spirit. A bear or a boar that is tractable enough while grain-fed becomes ugly and dangerous when given meat, and what parent is there who has not "viewed with alarm" how old Adam enters into baby along with the first spoonful of chopped beef?

This effect of meat has been attributed by some to the **extractives** of the flesh (certain innutritious, but stimulating, constituents of flesh that give to meat its flavor), but since it is declared that the extractives, by themselves, are devoid of the influence in question, the cause would seem to lie, indeed, in the mere circumstance of proteid abundance in the fare.

Excess of proteid in the dietary tends to diseases of nutrition, such as gout, calculus, etc., because of the clogging of the system with the solid waste-products of proteid disintegration.

There is no dietetic difference between individual proteids, whether of animal or of vegetable source.

Gelatin, practically the one dietetic representative of the albuminoids, behaves like an easily digestible and easily assimilable proteid. It has, in kind, all the proteid potencies, except as to the nutritive virtue of assimilation into living substance, but is present in the ordinary dietary in such small proportion that it has little opportunity of showing any individual characteristics.

The non-nitrogenous fuel-foods — the **fats, sugars,** and **starches**—make in many ways just the opposite picture to that of the nitrogenous principles. Digestion, in their case, is simple, absorption quick, easy, and thorough, disposal by oxidation complete, and end-products harmless, volatile, and easily eliminated.

Fats are animal and vegetable. Animal fats are commonly solid or semisolid, as witness butter and lard, while those of vegetable origin are mostly oils, such as olive-oil. A notable exception in this regard is the fat of the cocoa-bean, which is a firm solid known as **cocoa-butter.**

The digestion of fats is little other than simple emulsification,—that is, fine mechanical subdivision.

Fat has the highest fuel-value of any of the foodstuffs, its proportionate yield of energy being twice that of the sugars and starches. In the case of the sugars and starches, the proportion of hydrogen and oxygen in the molecule is such that the *hydrogen* is already fully oxidized, thus leaving only the *carbon* available for burning. In the case of the fats, however, the proportion of oxygen is less, so that, in burning, there is hydrogen as well as carbon waiting to be satisfied. Weight for weight, therefore, there is more combustible matter in fat than in sugar or starch, and therefore a higher yield of energy.

But fat, despite its high *fuel*-value, is held, in practice, at a low *food*-value, being consumed by most persons in only a fraction of the quantity of combined sugar and starch. The reason for this treatment lies in the intrinsic quality of oleaginous substance. Neither palate nor stomach of civilized man will brook fat in large quantities. The Eskimo can quaff a cup of train-oil, or the African savage bolt a lump of suet with the smile of relish, but not so the European. The son of civilization can take fat only in moderation and mixed always with other substances, whereby the fat undergoes a crude emulsifying in mastication. Nevertheless the fuel-value of the food is attested by the instinct of the Eskimo—needing, as he does, all the heat he can generate—to consume large quantities of oil and blubber.

There is practically no difference in food-value between animal and vegetable fats, but the former are the more readily digestible. The heat of cooking affects fat, liberating certain fatty acids which are more or less irritating. The mere melting of a fat by gentle heat does not produce this change. Because of the action of high heat, fats of all kinds are more digestible raw than cooked. Thus a tender stomach may accept butter on bread but revolt at the fat of a slice of broiled ham. Fat is best borne in emulsion, as in nature's emulsion, milk or cream, or in man's emulsions of cod-liver oil.

Fat is a very common subject of idiosyncrasy. Some will prefer a fat cut of meat, while others will carefully dissect away every particle of the hated stuff, and, when offered sandwiches, will complain, like the carpenter to the walrus, that "the butter's spread too thick." Others still have a complete abhorrence of fat in any form; will take no fat of meat, nor any food cooked with much fat, nor even butter, commonly the most agreeable article of fat. Such cases are unfortunate, both because of the food-value of fat, and of the intrinsic objection to the utter rejection of any one distinct kind of foodstuff. In the intricacies of digestion are many interrelations which are liable to upset if any one member of the alimentary brotherhood is withdrawn from service. There is special machinery for the digestion of fats, which is liable to get out of gear if there be no fat to digest.

Many who abhor what may be called obvious animal fat, such as butter or fat bacon, yet do not object to cream or to any edible *vegetable* fat. Such persons should make it a point to take cream, dressed salads, olives, nuts, etc., in order to make up for their abstention from ordinary animal fats.

Fats, when not properly digested, turn rancid in the alimentary canal, developing acrid products.

Sugar and **starch** are twin stuffs—twin in composition and in alimentary purpose, yet with minor points of difference. Chemically, the sugars and starches belong to a class of carbon compounds where the hydrogen and oxygen of the molecule are in the same proportion as in the case of water. Bodies so constituted may be considered as **hydrates** of carbon, and so may be called **carbohydrates.** From the point of view of nutrition, sugar and starch do not need to be differentiated, so that it is common to refer to the sugars and starches of the dietary as **the carbohydrates.**

In the process of digestion, carbohydrates of all kinds—sugars, starches, and certain unimportant congeners—are converted, or "inverted" as the technical term goes, into certain simple forms of sugar, mainly grape-sugar ("dextrose") and fruit-sugar ("levulose"). This "inversion" is, chemically, a very simple affair, and actually begins in the mouth, during mastication, through the action of a digestive ferment contained in the saliva. Arrested in the stomach by the acidity of the gastric juice, it proceeds anew and is completed in the alimentary canal beyond the lower egress of the stomach. The resulting "invert" sugar is then quickly and greedily absorbed into the blood, down to the last particle—a swift and thorough action quite in contrast with the slow and imperfect absorption of digested proteid.

And now happens a singular thing, unparalleled in foodstuff careers. The circulation is so arranged that all blood laden with products of digestion must pass through the substance of the liver, as through a filter, before gaining access to the heart for further distribution. But at this toll-gate upon the circulation-highway, all sugary itinerants are incontinently seized, held, stripped of their outer vestment and thrown into the strong chamber, thence to be rehabilitated and sent forth one by one only, at regular intervals, so that at no single time shall there be anything like a crowd of such itinerants at march together on the turnpike. Certain of the itinerants are held up yet a second time by the muscles.

This metaphor means that the sugar of digestion is seized upon by the liver-cells, dehydrated into a sugar-like product called **glycogen,** which product is then held provisionally, and little by little only is doled out to the general blood-supply. The muscles, in turn, hold up some of the sugar reaching them through the blood, reconvert it into glycogen and store it, dissolved in their juices, for future use as fuel. The consequence of this action by the liver, and, to lesser degree, by the muscles, is that there never is anything like a flood of sugar launched upon the blood or present within the circulation at any one time, not even after the rush of absorbed digestion-products from a heavily saccharine or farinaceous meal. The sugar-proportion in the blood is kept low—so low as a fraction, only, of one per cent.

Why this discrimination against sugar? Why are the digestion-products of proteids and fats permitted free access to the circulation, but those of carbohydrates held up in this highwayman fashion? The teleologist would answer as follows, and it is a convenience to accept his phrasings even if judgment be withheld on his doctrine:

The hold-up of absorbed sugar is for a double reason, important to the economy in both aspects. In the first place, sugar differs from proteids and from fats in being highly diffusible. Accordingly, any considerable percentage of the substance in the blood would speedily suffer loss by depletion and excretion—would be wasted before it could be used. In the second place, sugar again differs from proteids and fats in being a *poison*, so that any sugar-impregnation of the blood above the normal extremely low percentage, would be intrinsically deleterious, even seriously so!

Doubtless it will surprise most lay readers to hear that so seemingly innocent a substance as the sugar of the grape is poisonous, but a poison it is, and of such potency that the daily service it demands of Azriel is one of no mean proportion! Indeed, were it not for the faithful wardenship of the liver, the entire race of bread-eating man would be but an aggregation of semi-narcotized dullards, drifting hopelessly to the doom of a not-far-off comatose ending!

Grape-sugar is an alcohol—diglucosic alcohol—and when present in the blood in any marked excess over the natural small proportion, as happens in the disease diabetes, shows itself an alcohol indeed by producing wide-spread disorder of nutrition, with semi-narcotic symptoms. It would appear, then, that nature furnishes a poisonous alcohol to be a principal foodstuff, and most ingeniously provides an automatic regulator to prevent intoxication. Could such regulator but seize, hold, and convert the nimble and elusive offspring, ethyl alcohol, as it does the heavier-footed sire, grape-sugar, from how much misery might mankind be spared!

These points concerning carbohydrate assimilation are not only dramatically interesting, but also they have a practical bearing. It is so common as to be entirely consistent with health that somewhere in the complicated process of the disposing of carbohydrate aliment the machinery slips a cog, as it were; the absorbed sugar is not all cared for as it should be, so that the percentage of sugar in the blood rises temporarily, it may be for only fifteen or twenty minutes just at the high tide of digestion. In mild cases of this fault the excess of sugar is not enough to poison; no symptoms are produced, and the error of assimilation is wholly unsuspected and is discovered only by accident, as by an examination for life-insurance. But from this mild degree of fault, to pronounced diabetes, occurs every possible grade of imperfect disposal of sugar in the blood, and diabetes itself may begin as just such a trifling flaw of physiology. When the fault progresses to a point where the accumulating sugar begins to poison, the tell-tale symptoms are a dry, pasty mouth and an overmastering drowsiness, occurring just when absorption of digested food is at its height, that is, from an hour to an hour and a half after conclusion of the meal. Such symptoms will be especially marked if the meal have included much saccharine food. A proper chemical examination, timed so as to cover the showings of the period mentioned, will reveal whether or not the symptoms described be due to an excess of sugar in the blood.

In mild degrees of faulty assimilation of sugar, the error can be circumvented by a modification of the diet. The different carbohydrates do not all behave alike toward the fault in question. Those most obnoxious to malassimilation are cane-sugar and grape-sugar; fruit-sugar is much less so, and least of all are milk-sugar and the starches. Accordingly, in mild cases of diabetic tendency, the subject may be able to continue his bread and butter and his farinaceous breakfast-food and cream if only he will season with salt and pepper instead of with sugar. He may take fruits in moderation, except grapes, apples, apricots, pears, and pineapples, fruits which contain notable amounts of either grape- or cane-sugar. The writer knows of a case in point where the condition, unsuspected, had progressed to the stage of overpowering drowsiness for an hour or so shortly after eating: was discovered by the accident of a chance chemical testing, and now, for over a quarter of a century, has been perfectly held in check by simple abstention from cane- and grape-sugar, other sugars and all starches being taken freely. The subject is in perfect health, but may not eat sugar on peril of his life. The least indulgence in cane-sugar poisons exactly the same to-day as twenty-five years ago. In established diabetes, the dietary restrictions are more severe, but are to be undertaken by the physician, since each case is a case unto itself.

When carbohydrates are not properly digested, they are liable to ferment in the alimentary canal, developing acidity and flatulence,—sugars more so than starches.

Although sugar is more tasty than starch, any considerable quantity cloys, so that by no means so much sugar can be eaten as starch.

Reviewing the subject of the carbohydrates, it is plain that, of the dietetic twins, sugar and starch, sugar is distinctly the leader in all mischief! So comes it about that, of the three non-nitrogenous fuel-foodstuffs, fat, sugar, and starch, starch is the stand-by, preëminent for negativeness, pine-stick of pine-sticks!

Reviewing now comprehensively the whole subject of nutrition and the individualities of the foodstuffs, it is interesting to note that instinct guides man true. Man partakes of a mixed animal and vegetable diet because thereby he gets the proper proportion of the several foodstuffs without waste. Because of the tax that proteid lays upon the economy for its disposal, the human omnivore eats of that foodstuff (or should do so) no more than the very moderate quantity required for the proper proteid functions. For the considerable fuel-supply, he turns to the nature fuels, relying most on the one least likely to make trouble in large quantity, namely, starch. Fat and sugar he consumes as supplementary to starch—of service as flavoring agents as well as foods.

Though the principles that should guide in alimentation seem simple enough, they are only too often strangely disregarded. The errors so committed may now be considered.

Nothing is commoner than the remark to the effect that such a one takes a good deal of exercise, or does hard manual work, and accordingly needs a liberal allowance of animal food. Now, as a matter of fact, such a one needs nothing of the kind, as any reader of the foregoing pages will see for himself. The muscles are doing work, it is true, and therefore need fuel whence to get energy, but, as already seen, it is not proteid but fats, sugars, and starches that make the best fuel-food. The athlete or the laborer, then, while he needs more *food* than the sedentary occupant of a desk, needs his excess in the form of bread and butter and not of beef.

The erroneous idea in this case is a corollary of the famous theory of Liebig that a muscle in doing work gets the energy therefor from oxidation of its own substance. This theory, once well accepted, has gone to pieces before a very simple but conclusive observation. Muscle-substance is proteid, and proteid combustion produces proteid ash in the shape of the non-burning nitrogenous waste-product, urea, already described. If, then, muscle-energy comes from the oxidation of muscle-substance, the output of urea should rise and fall with muscular activity, keeping pace with the amount of muscular work done. But, as a matter of fact, it does nothing of the kind! Muscular activity affects not at all the *nitrogen* waste of the body, but increases enormously the *carbon* output, in the shape of the carbon dioxide of expiration. This simple observation, then, upsets completely the Liebig theory with its corollaries, showing, as it does, that the energy converted into muscular work, like that converted into heat, comes from the oxidation, not of living tissue itself, but of dissolved pabulum, mostly non-nitrogenous, brought by the blood and delivered into the juices of the tissues for direct fuel use.

The exposure of the fallacy as to the special need of the manual laborer for meat is thus made particular, because of the deep root of the fallacy itself in popular understanding. There is no error so hard to eradicate as that which once had authoritative vogue as truth. The Liebig theory was formerly believed by physiologists, but now is simply a bit of ancient history.

There is in this connection, however, one point that must not be overlooked. Animal food seems to stimulate the nutritive processes generally, it may be simply by presenting an excess of circulating proteid, or possibly also through some action by the extractives of the meat. Accordingly in the severe strain of *overwork*, either physical or mental, a liberal meat allowance may prove specifically sustaining and vivifying. Such influence, however, has nothing whatever to do with the dynamic requirements of work *as* work. This point is further proved by the fact that this same peculiar sustaining influence of animal food is experienced just as refreshingly by the hard-driven brain-worker as by the exhausted plier of the pick. But yet the amount of kinetic energy required for conversion into intellection—the doing of mental work—is so small as utterly to elude measurement by even the most refined methods of laboratory research!

Another phase of this same error of understanding as to the effect of proteid food is the notion that hearty meat-eating will tend to develop muscle and increase strength. It will do nothing of the kind. The protoplasm maelstrom will not whirl the faster by turning more water into the stream, and while *growing* muscle, *set to growing by exercise*, will seize upon proteid bricks for the building of its added thickness of wall, the converse idea is far from true that the mere dumping of bricks into a yard will, by itself, start building operations. He who eats heavily of proteid will gain in weight, it is true, will "lay on flesh", as the saying is, but, alas, the "flesh" is not flesh at all! The excess of proteid over and above what the system needs in regular routine only runs to waste in the usual way. Out of the one half of the waste will come urea to tax liver and kidneys for its disposal, and out of the other, not flesh, but *fat* to delude its proud possessor by added avoirdupois!

In bountiful America, well blessed with nodding cornfields, waving pastures, and open-hearted citizens, **insufficiency** of food is happily the exception. Nevertheless its effects must be studied, since underfeeding, voluntary or involuntary, constitutes a practical error of alimentation.

If the supply of **proteid** be too small, nutrition suffers, even though other foodstuffs be taken in abundance. For the maelstrom of the protoplasm molecule revolves unceasingly, and its stream can be fed by proteid food only. When, then, the nitrogen income falls short of the nitrogen outgo, trouble begins as with a bank whose receiving teller takes in less money than the paying teller passes out. Sooner or later the doors must close. Under a deficiency of proteid, subjects may keep their weight, so long as non-nitrogenous food be in plenty, but they will weaken progressively from the failure properly to nourish the substance of life. A certain minimum of this king foodstuff, proteid, is thus seen to be nature's ultimatum for nutrition. To this inexorable decree dietetic fads of all kinds must conform, as to a first and fundamental law of the alimentary code. Examples of proteid starvation are afforded by cases where the dietary consists exclusively of such food as potatoes or rice.* These foods contain but a small proportion of proteids, so that an inordinate quantity must be consumed in order to get an adequate proteid allowance.

Deficiency of **non-nitrogenous** food, **with an increased allowance of proteid in substitution,** harms not by inanition, but by the intrinsic deleteriousness of a high proteid supply. So far as merely concerns nutrition, proteid can fulfill all the requirements for organic food. Carnivorous animals and exclusively flesh- or fish-eating tribes of men are examples of subsistence with no carbohydrate at all and a minimum of fat, only.

Deficiency of non-nitrogenous food **without** compensating excess of proteid is as disastrous as direct deficiency of proteid. The furnace-fire of life is as inexorable in its demands for food as is the living substance of the engine, and if it cannot get fuel from one source, will seize it mercilessly from another, no matter what the immolation. As a storm-tossed steamer with empty bunkers will burn decks and bulwarks to keep the engine going, so the living organism, fuel-starved, will, after first exhausting the reserve of adipose substance, turn upon itself, that is upon the tissues, beginning with the muscles, and ruthlessly burn them. So, after a pre-

* The common statement that the Japanese soldier subsists wholly on rice is an error. Proteid is added, generally in the form of dried fish.

liminary ıat emaciation, comes the same muscle-wasting, with weakness and ultimate death, that attends primary proteid starving.

Deliberate underfeeding is comparatively rare, because at once so purposeless and so distressing. When occurring, it is either because of dyspepsia, in which case it really is involuntary, or comes from some silly notion born of a combination of innate mental crookedness and that "little knowledge" that "is a dangerous thing".

"No, I don't take much food; I don't need it: this splendid air is sustenance enough by itself."

This preposterous remark, glibly controverting the very *a b c* of chemical physics, was once made to the writer by a fanatical young girl, whose bloodless lips, shrunken figure, and fluttering heart should have told her of her fatal error without need to consult a physician.

Dyspeptics often make the mistake of skipping meals because not hungry. Hunger is simply the cry of the *stomach* to be filled. The less blatant *tissues* do not cry for nourishment; they simply take what is given them, and if the amount be insufficient, they complain not, but calmly turn about and consume themselves. Whoso, then, imagines that his substance does not need nourishment, because, forsooth, the stomach calls not for food, will have his error brought home to him later in a very realistic way, when he finds knees strangely quivering and shoulders strangely shivering, while within the now loosely hanging clothes the poor half-starved frame shrinks on all sides in emaciation.

Regularity in eating is a first principle in alimentation, so that unless the stomach be so utterly upset that even the simplest of viands will not digest, the dyspeptic should punctiliously take his place at table and essay to eat a little, at least, even though appetite be wanting. At first the mere thought of food may disgust, but after a mouthful or two, behold! that scalloped oyster or that breast of chicken does not taste so bad after all, and so, before the fact is realized, appetite coming with eating, quite a little meal is made and with relish. Without sufficient food, the morbid condition tends to perpetuate itself by working in a vicious circle,—the less the nourishment, the weaker the system; and the weaker the system, the worse the dyspepsia.

"Yes, I suppose I am a hearty eater, but what of it? My digestion is good." And protuberant paunch, pursy chest, purple face, and knobby knuckles depict, "with such a lustre he that runs may read", an internal economy where ash-barrels are full to overflowing and drain-pipes clogged and foul.

Overfeeding is the predominant dietetic sin, and is so common, indeed, that it is hardly an exaggeration to say that the majority of those that can afford it eat more than is necessary, and therefore more than is wholesome. And what else is to be expected in a civilization where, from the days of Lucullus down, the pampering of sated appetites has been elevated into a fine art whose expositors command a higher or a lower wage according to their certified success in temptation! That food should be varied and should be nicely cooked and served is, of course, right and proper, but quite a different thing is the *ménu* whose avowed design is the pursuit of happiness through the sense of taste—the eating for eating's sake, long after nature's call for nourishment has fully been met.

General overfeeding predisposes to a long train of woes. First and most commonly is a tendency to grow fat, showing itself in the third or fourth decade, and increasing with the advance of years until old age is reached, when the tide turns and much of the adventitious fat is reabsorbed.

In this matter of fattening, however, there is much idiosyncrasy. Some subjects, especially such as are tall and long-bodied, remain thin in spite of even excessive overeating, while others, even though quite temperate in the pleasures of the table, may grow inordinately fat. In the one case, the subject burns, instantly and mercilessly, every stick of fuel delivered at his door, whether or not he needs the resulting hot fire roaring within, while the other, miser-like, burns barely enough to keep the pipes from freezing, and hoards the rest in vast piles filling the house from cellar to garret.

A certain amount of adipose tissue is normal and useful, both as a reserve of fuel and for the rounding off of sharp corners in skeletal architecture. But anything like a pronounced adventitious fattening in middle life is abnormal, and commonly is a telltale of overeating. The excess of food, or some of it, instead of suffering oxidation, is converted into fat, which then is stowed away in the corner-cupboards of the anatomy, and then when these are filled, is dumped openly anywhere and everywhere beneath the suffering skin.

Any considerable degree of fatness is intrinsically deleterious. The fat mechanically clogs the free play of the muscles and muscular organs, such as the heart and the stomach, and also bans physical exercise by its weight. Finally, and all too often, it creeps in and among the cells and fibres of the tissues, substituting lifeless oil-globules for living protoplasm—produces, in short, *fatty degeneration.*

In the case of dumb beasts, animals are fattened for the slaughter-pen, but are sedulously kept lean for the hunting-field or the race-track. Yet the same Lady Clara Vere de Vere who would scold roundly the groom that might let horse or hound grow fat in service will, in middle life, complacently loll in her carriage in voluminous embonpoint, as perfect an example, herself, of an animal heavily out of condition from over-feeding as well could be imagined!

The special excess of proteids consumed in good living, by reason of the seductive tastiness of animal foods, brings special penalties all its own. To repeat what has so often been said in the foregoing pages, the combustion of proteid within the organism yields a solid ash which must be raked down by the liver and thrown out by the kidneys. Now when this task gets to be over-laborious, the laborers are likely to go on strike. The grate, then, is not properly raked: clinkers form, and slowly the smothered fire glows dull and dies.

That overeating tends to shrink the span of life in proportion as it expands the liver is demonstrable both directly and indirectly. Let any actuary of life-insurance be asked his experience with heavy-weight risks, where the waist measures more than the chest, and the long-drawn face of the business-man at memory of lost dollars, will make answer without need of words. Then let be noted the physique of the blessed ones that attain to green old age, and, in nine cases out of ten, spry old boys—no disparagement but all honor in the phrase—will be found to be modeled after the type of octogenarian Bryant or nonagenarian Bancroft—the white-faced, wiry, and spare, as contrasted with the red-faced, the pursy, and the stout. It is true, as has already been mentioned, that in old age much of an adventitious obesity is absorbed and disappears, but the Bryant-Bancroft type is that of a subject who never has been fat at all. And just such is preëminently the type that rides easily past the four-score mark, reins well in hand, and good for many another lap in the race of life.

It may truly be said, then, in alliteration, that fine fare leads to feasting, feasting to fat, fat to degeneration, and degeneration to death, all "as the sparks fly upward"!

From this presentment of the dangers that frown by the Scylla of starving, on the one hand, and the Charybdis of stuffing, on the other, it is plain to see that the warning of Phœbus to Phaethon, *medio tutissimus ibis*, applies as well to him who would navigate the straits of nutrition as to him who would dare the dizzy course of the zodiac. So comes, then, the vital inquiry, just where runs the safe mid-channel line?

The physiological chemist can easily draw a line on the Scylla side of the channel. A dietary whereby the system gets less than it pays out is, obviously, a dangerous veer toward starvation rock. But on the Charybdis side, just as the whirlpool itself has no well-defined border, the channel boundary is not so easily marked. The case is exactly analogous to the stoking of a furnace. The proportion of ash to live coals is a telltale as to *under*feeding but not as to *over-*

feeding. With undersupply of fuel the ashes overbalance the live coals and the fire is thus foretold to be going out. But with an oversupply the fire simply burns the faster: all the fuel continues to be consumed: the more coal simply makes the more ash, so that equilibrium is not disturbed, although maintained at a higher level. To argue, therefore, that a given dietary is none too large, because the balance between the material receipts and expenditures of the economy is not upset, would be like saying that a given furnace-fire is certainly none too hot, since the ashes raked out of the fire-box just correspond to the amount of coal shoveled in. The same would be equally true of a slower fire consuming much less fuel.

The philosophy of the matter is, then, to find the minimum of steam that will run the engine, and then maintain a fire somewhat hotter than the exact requirement, in order to run no risk of failure; or, to return to the metaphor already employed, the would-be careful liver must simply note how close to Scylla other voyagers have sailed with safety, and then steer his own bark accordingly.

Now there are plenty of examples, both of individuals and of whole communities, where subjects have subsisted, with full maintenance of health and vigor—crude test of nutrition equilibrium—on a dietary far below the commonly accepted standard of European civilization, especially in the matter of the proteid allowance. Thus, to take a case near home, the venerable poet-editor, Bryant, whose lithe figure, in springy gait, was, even at age eighty and over, a familiar sight on the streets of New York, subsisted habitually on a dietary largely vegetable, whose frugality would be dubbed by the average good trencherman as fit only for an ascetic. But a more striking example still is afforded by a remarkable centenarian of a bygone period, whose story, as told by himself, is as fascinating as it is instructive.

Born in the fifteenth century, there lived for over one hundred years, in Italy, one Louis Cornaro, a man of noble birth. Up to forty years of age, this now historic personage was a reckless debauchee, when, frightened by desperate illness brought about by his habits, he resolved to reform, and not only that, but to live the ideal life, and prove his claim that the proper span of life for man is one hundred years. Inflexibly he held to his purpose, and triumphantly he made good his claim: for not until the tally had scored the second notch in the second century did this serene and happy life find its natural end, passing as passes a flower when bloom-time is done. Cornaro followed faithfully all the laws of health, but especially was he abstemious in eating, his dietary being of the simplest and his ration most frugal. Once he yielded to the importunities of physicians, family, and friends, and increased his daily quantity of food from twelve to fourteen ounces. A "severe illness" followed, and quickly the wise old man went back to his own prescribed allowance.

This admirable philosopher has preached his doctrine in four essays on "The Temperate Life", the first written at age eighty-three, the second at eighty-six, the third at ninety-one, and the fourth at ninety-five. An English translation is in print * and is most interesting reading. Besides the worth of the doctrine expounded, the book reflects the sweet personality of the writer, the habits of the times, and the quaint notions of physiology then prevailing.

The great point set forth in Cornaro's book, and proved by the venerable author in his own person, is that not only is a frugal fare all that is needed for the support of life, but also that frugality actually gives increase of vigor, physical and mental, freedom from illness, and added length of years. And with these benefits goes, as always, that joy of mere being that lies only in the gift of the goddess Hygieia. Cornaro, at age eighty-three, writes of the delight he has in joining with his grandchildren in song: for his own voice "is now better, clearer, and more sonorous than it ever was before".

* The Art of Living Long: A New and Improved English Version of the Treatise of the Celebrated Venetian Centenarian Louis Cornaro (etc.). Milwaukee, William F. Butler, 1903. Moody Publishing Co., Publishers, 35 Nassau St., New York City.

A case of similar frugality with similar result on health, though the effect on longevity remains to be seen, is one that most fortunately has been made the subject of scientific investigation by a skilled observer, Professor Chittenden, Director of the Sheffield Scientific School of Yale University and Professor of Physiological Chemistry.* The case is of a subject (Mr. Horace Fletcher) who has for years, and entirely from choice, lived on two most frugal meals a day, consisting generally of some cereal and maple sugar. For seven days and while subsisting thus, without restriction, the subject was placed under laboratory observation, with the following result: First, appetite was fully satisfied; secondly, the income and the outgo of the body balanced properly; and thirdly—crucial test of adequate nourishment—the subject was able to do severe physical work with even exceptional ease. Ordinarily his exercise was simply the usual walking abroad, but during the seven days of the observation he was put through the exact daily routine of a college crew then under training at the same place. To the surprise of the director of the gymnasium, the subject did the unaccustomed exercises with ease and without the muscular soreness commonly developed under such circumstances. Even the endurance test of a long run was taken without distress.

* Physiological Economy in Nutrition. Russell H. Chittenden, The Popular Science Monthly, June, 1903.

The heart beat fast, indeed, but returned to normal rate quicker than with other subjects of the same age and weight.

Yet this subject, weighing 165 pounds, consumed during the week of the observation less than one-third of the commonly accepted standard requirement of nitrogenous aliment for hard workers, and only a little more than one-half of the assumed standard for non-nitrogenous requirement. Incidentally, the cost of the dietary in this case averaged eleven cents a day!

But what should set the civilized world to very serious thinking indeed, on this subject of frugality, is the epoch-making record of later and elaborate experiments by this same observer,* set on foot by the remarkable showing of the case just described. In these experiments three sets of subjects were taken, one composed of five university professors and instructors, including the observer himself, one of a detail of thirteen enlisted men of the army, and one of eight college athletes in training. All three of these groups of men were subjected to critical laboratory observation for continuous periods of many months, during which the proteid part of the ration was reduced to an amount ranging from one-half to one-third only of what had been customary. In the case of the first and third groups each subject made the reduction to suit

* Physiological Economy in Nutrition, Russell H. Chittenden. New York, Frederick A. Stokes Company, 1904.

himself, but in the case of the soldiers the dietary was prescribed. No curtailment was ordered for non-nitrogenous food, although many of the subjects, of their own accord, reduced this element of the ration also. The subjects pursued their ordinary avocations throughout the period of observation.

The general result of the experimenting was as follows: Some of the subjects, at the outset, especially such as were fat, lost some weight, but then, having got down to their bearings, so to speak, they held their new weight steadily as the others held their old. All maintained "nitrogen equilibrium", the output of nitrogenous waste dropping with the diminished supply of nitrogenous food. All maintained nervous and muscular vigor, and the soldiers and athletes positively gained in muscular strength, as determined by critical tests. All kept in good health, certain minor ailments, indeed, from which some had been suffering at the beginning, disappearing completely. Appetite was fully satisfied.

In the groups where dietetic freedom was given, some of the subjects, of their own accord, came to dispense with breakfast, taking in the morning only a cup of coffee, and some ceased to take meat. One, who had been a particularly hearty meat-eater, became a vegetarian. The director of the experiments, one of those who had abandoned breakfast, after the close of his own personal experimentation, continued the new dietary from choice as his regular standard, announcing "no desire to return to the more liberal dietetic habits of former years". Nine of the soldiers went in a body to a new station, and from thence, three months later, one of them wrote to the director, saying: "The men are all in first-class condition as regards their physical condition, and are all very thankful to you. We eat very little meat now as a rule, and would willingly go on another test." When beginning the experimentation these men were subsisting on an army ration allowing one and a quarter pounds of meat per day, apiece!

Here, then, in very fact, is proof of the pudding by the eating. Here is demonstration by an expert through many examples taken from different types of men and all mutually corroborative, that the sporadic cases of a Cornaro, a Bryant, or a Fletcher are not so crazy as they seem; that man really needs only from one-half to one-third of the amount of proteid food commonly supposed to be necessary; that, as a matter of fact, he is stronger, more vigorous, and far more active on a reduced proteid fare, and, especially, that there is no call whatever for a heavy proteid allowance because of the doing of hard muscular work.

There are some persons whose minds are so constituted that, to them, a scientific demonstration *is* "a scientific demonstration" and nothing more,—is, that is to say, a mere mystery of micrometers and fine scales, of figures and of tables, all of possible interest to certain queer old gentlemen in spectacles and ill-fitting clothes, but of no practical bearing on the affairs of life. If any victim of such delusion chance to peruse these pages, let him accept a challenge! Let him, for six months or even for three only, experiment on his own person with frugality and bide the result. The experience will do him no harm: of that he may rest assured. If he be the average trencherman only, let him simply cut in two, though not too suddenly, his allowance of animal food. If decidedly a *bon vivant*, let him reduce in all lines his indulgence in things good to eat. Butcher's meat once a day only, at the principal meal, is often enough, and even then need not exceed in quantity the equivalent of one small slice of beef. What animal food is taken at the other meals should be of the quality and quantity of relish only. The *mênu* for dinner should not be more elaborate than is represented by a plate of soup, a single course of meat with potato and one green vegetable, a salad or other light vegetable *entrée*, and a simple dessert, such as a fruit or a custard. The other two meals should be light snacks only. Let the experimenter follow this regimen and at the same time turn his back to the wine-cellar and his face to the front door, taking plenty of outdoor exercise, and surprisingly soon, *crede experto*, will he find that now he is not sleepy after meals, nor short-breathed on going upstairs; that he is ready at all times for work, physical or mental, and, to his unspeakable comfort, that he must betake him to his tailor to have his trousers taken in at the waist instead of let out. Indeed, if the experiment be carried out faithfully, such probably will be the feeling of a return to youth, that the experimental ration quietly will become standard, and the simple, single plateful of meat and vegetables secretly be extolled as a something better than the elixir of life! And in this experiment, what will surprise as much as anything will be the quality of appetite and digestion developed. The new dinner will give keener relish than did formerly a five- or seven-course banquet with its introductory cocktail and caviar, its intermediary sorbet and cigarette, and its terminal coffee and liquor—whiplash accessories all, to flog the staggering stomach to a successful carrying off of its cruel load! Let the challenge be accepted, and let the issue prove that this picture is no fancy sketch!

A considerable reduction of an excessive ration necessarily means, at first, that the plate must be pushed away while there is still some unsatisfied appetite, and many would-be reformers get disheartened and rebellious at the self-denial required. But perseverance will reap its reward. Appetite is only stomach-deep. It comes from emptiness, and it goes only with fullness. A heavy eater is sated by nothing short of a heavy meal, for the reason that his stomach has become overdistended from habit, and so does not feel comfortably filled until the customary load is received. But when, upon a diminished fare, the stomach gets down to its natural bearings, it accepts the smaller allowance as satisfying, and, indeed, comes to be distressed by a meal of the old dimension.

The keynote of frugality is the note struck by the Chittenden experimentation, namely, reduction of the proteid allowance. The old-time standard dietaries, such as that of the authority Voit, give the following figures for the daily ration, in foodstuffs, of the average man doing the average amount of muscular work:

Proteid..........	118 grammes*	(1821 grains,	about	4⅙	oz.)
Fat.............	56 "	(864 "	"	2	")
Carbohydrate....	500 "	(7716 "	"	17½	")

In the light of the Chittenden experiments, the figures for the proteid allowance might be reduced to fifty grammes, or 772 grains, equal to about one and three-quarters ounces, a quantity represented by the proteid content of nine and a half ounces of lean meat, or of seven eggs, or of twenty-seven ounces of white bread. Nine and a half ounces of meat is about the weight of a slice measuring seven by three inches and cut

* A gramme is 15.432 grains, and 437.5 grains make an ounce, avoirdupois.

a quarter of an inch thick. Twenty-seven ounces of bread represent somewhat less than two loaves, the standard loaf weighing a pound (sixteen ounces).

Reduction of proteids is, of course, effected most easily by cutting down the allowance of animal food, since such food is pretty much all proteid. Even if the rest of the dietary were to be practically non-nitrogenous only, made up, for instance, of arrowroot, sugar, and butter, a sufficiency of proteid for the day would be yielded by a meat allowance of a little over half a pound only. And in the case of the ordinary mixed dietary, it must be remembered that proteids peep out here, there, and everywhere in other foods as well as meats. Thus ordinary cheese is one-third part proteid; egg, one-seventh; beans, from one-eighth to one-quarter; and bread, from one-twentieth to one-tenth, etc. It is easy to see, therefore, how little meat is needed, with the ordinary dietary, to yield the allowance of fifty grammes of proteid, especially if the meat allowance be distributed among the three daily meals.

It is *possible* to get enough proteid out of an exclusively vegetable fare, as witness the case of herbivorous animals. But to do so requires the consumption of an inordinate bulk of substance, since vegetable foods are both deficient in proteids and prolific of indigestible and innutritious fibre. So it comes to pass that the herbivore is forever browsing, while the carnivore makes a meal—when he can get it!

True vegetarianism is the exception; for most so-called vegetarians merely exclude such animal food as is obtained by slaughtering. Such as is got by diversion they accept freely, and so gain egg, milk and cheese, foods highly proteid. With such animal addition to a vegetable fare, the due proportion of proteid is easily secured.

With wise reduction of the proteid allowance to proper standard, the rest of the dietary can pretty safely be left to take care of itself. A "sweet tooth", to be sure, must hold himself, or herself, in check as regards the pet passion, but, for the rest, instinct and appetite will guide surely enough. There is no harm whatever in taking butter or cream as may be craved; nor is there any special risk of growing fat in consequence, and as for farinaceous food, no one is likely to gorge upon bread or johnny-cake or even upon the most vociferously advertised breakfast cereal thrust upon the suffering market!

No hard and fast rule of diet can be made to fit all cases, a fact of common observation and of common sense that Cornaro himself was shrewd enough to recognize. Women require less food than men, and, weight for weight, young ages call for more than old; active outdoor exercise for more than an indoor occupation, and cold weather for more than warm. Then always individual idiosyncrasy must be allowed its way:

for what is one man's meat is another man's poison, in quantity as well as in kind. There are some persons, like the venerable Cornaro, who keep well and keep their weight on surprisingly little food, and are simply distressed in digestion by any attempt to increase the ration. Others, notably the thin, intensely nervous and intensely energetic, must have full fare, and even a goodly proportion of animal food, or they go to pieces with weakness. There is nothing surprising in this difference. Just as some move quicker and think quicker than others, so also, presumably, do they *whirl* quicker as to the maelstrom of the protoplasm molecule. In an astronomical observatory, account must carefully be taken of the *personal equation* of each observer, an "equation" carefully determined when the observer first enters service. This equation is the particular fraction of a second that elapses between the *seeing* and the *recording* of the passage of a star athwart the spider-line of the transit-instrument — a brief interval of time, to be sure, but one that must be allowed for in astronomical work, and one that is found to differ with the individual. So, since it is thus shown to be a fact that nerves vary in rate of conduction, the process of nourishment that underlies conductivity may surely be believed to vary also. The test of the proper food-allowance for each person must lie with himself. Twenty minutes, at the furthest, after a meal, one should be ready for work, physical or mental, according to the hour, and there should be no feeling in the region of the stomach, as a consequence of eating, other than the simple cessation of *active* hunger.

It may provoke a smile to be told that the amount of food required in any case will depend, among other things, upon the thoroughness of the **chewing.** But so it is, for the reason that well-masticated food means well-digested food, and well-digested food is the more completely absorbed. Accordingly a given amount of food thoroughly masticated delivers as much aliment into the blood as does a much larger quantity hastily bolted. Also it satisfies appetite quite as well.

With thorough mastication there also is less desire to drink while actually eating, a point of distinct advantage. By such avoidance there is no interference with the very busy business of the stomach while receiving food. Proper mastication itself supplies all the fluid necessary to be swallowed with the food, and any addition thereto is simply in the way. The farm-hand in the hayloft, sweating to keep pace with the fast-delivered hay pitched up from the wagon below, will gladly put his head under the pump when his suffocating job is done, but would revolt at having the hose turned upon him while actually plying the pitchfork. Food never should be washed down the throat.

Still another effect of thorough mastication is thorough digestion, a result that well repays the trouble of the chewing. The service that jaw renders to stomach is really quite remarkable, and is not appreciated as it should be. Many a case of dyspepsia for which pills and powders are taken in vain, is easily curable by the physician shrewd enough to get himself asked to dinner at his patient's house. Watching quietly the patient as he eats, the medical guest may see at a glance what is the matter.

A mouthful of food never should be swallowed. This sounds like nonsense, yet means exactly what it says, and means it in serious earnest. The proper way to dispose of a mouthful is to chew and chew upon the mass until, lo! there is no mass there! Little by little as portions have become thoroughly masticated and insalivated they have crept off and slipped down involuntarily. In such case there is no conscious swallowing analogous to the gulping of a draught of water. Over the arched portal of the palate nature writes for them to read who know her script, "Naught passeth here but pulp!"

A good workman insists on good tools, so a jaw that would do its duty demands good **teeth.** For deformities of the teeth the owner is not responsible, but for decay he distinctly is, in nine cases out of ten. Caries of the teeth, which is not caries at all, but simply a decalcification through the action of an acid, comes about as a natural consequence of the lodgment of bits of food between or upon the teeth. The starch in such food-particles is changed to sugar by action of the saliva, and then, by further action of certain busy-bodies of micro-organisms that the mouth has ever with it, the sugar is made to undergo the lactic-acid fermentation. The lactic acid so developed, strong sour acid that it is, then turns about and tears at its host—eats the lime from out the enamel, and, later, from the main substance of the tooth, thus producing the well-known cavity of decay.

Such being the action, the defeat thereof lies simply in marching off from the stage the star actor the moment his proper part is played. *Immediately* after every meal, in home routine, each participant should retire for five minutes and cleanse the teeth from adhering scraps of food, both by brushing and by passing between contiguous teeth a thread of floss silk, waxed. This item of toilet costs time, trouble, and vexation: items of dentistry cost cash, pain, and vexation. The items are contrary and opposite: which is the least vexatious?

Many persons brush their teeth only on rising in the morning, but in such case food lodged from the breakfast of one day is not dislodged until just before breakfast on the morrow, nearly twenty-four hours later. So, then, every day and all the day, in such case, upon wicket and postern of those white citadel walls a subtle foe is ever at work with jemmy and drill, seeking, and all too successfully, often, to force a way into the stronghold within. If the teeth be brushed once a day only, it should be in the evening rather than in the morning. And whoso elects, by a single daily cleansing only, to risk frequent caries, should continue into and through adult life the mother-enforced habit of childhood of periodical "open, please" at the dentist's command. One may discover for oneself beginning holes in shoe-soles, but not so easily those in the back crevices of teeth.

Connected with the subject of amount of food is that of **number of meals** per day and **times for eating.**

This matter is quickly disposed of, for varying conditions and individual preferences all have their say, and combine in making wide differences in practice. At the same time, the followers of different systems are equally healthy and well-nourished. Hygiene, therefore, need not here step in to do violence either to convenience, choice, or necessity.

In the **choice of foods,** it is wise, even when the purse is long, to educate the stomach to simple ways. It is, of course, possible so to coddle oneself as to be able to cope only with the daintiest and, incidentally, most expensive of dishes. But, in unexpected circumstances, fastidiousness, with its embarrassing "don't like" this, "can't eat" that, and "never touch" the other, makes great trouble for housekeeper and guest, both. Much more comfortable is he who, on occasion, can stomach any wholesome fare, however simple, from a rasher of bacon or a smoked herring for breakfast, to an honest mess of corned beef and cabbage for dinner. With the wealthy, the "proud stomach" is ordinarily wholly a matter of habit, generally due to a mistaken early indulgence in whims of taste. Children should be brought up on a simple fare, but yet be trained to eat anything that is wholesome. Then the future man enters the battle of life with a stomach ready for any emergency.

Genuine idiosyncrasies, however, must always be heeded. Perhaps the most common example of the kind is distaste for mutton. To many, indeed, mutton, however disguised, is no less than a gastric poison. With others, shellfish and also strawberries produce nettlerash, and with others still, sugar and even farinaceous messes develop acidity. To some, again, butter and animal fats generally are disgusting. In any case of pronounced idiosyncrasy avoidance of the offending article must be the rule, or nature will exact a penalty.

In the **making up of dietaries,** the first point that presents is the fact that the dietary cannot be constructed on chemical considerations alone. A diet of isolated proximate principles, taken in proper quantity and proportion as set forth in the foregoing pages, would theoretically be sufficient for nourishment, but nevertheless would not nourish. For a short time, an enthusiast might subsist on white of egg, butter, arrowroot, salt, phosphates, and water, but soon palate and digestive tract, both, would rebel, forcing the subject to come to his senses and take his food in natural shape. The digestive organs are equipped to handle food in crude condition, and not as sorted, sifted, and condensed in the laboratory of the manufacturing chemist. Even the indigestible portions of natural food have their function in giving bulk to the food-mass, and in provoking proper mastication and resulting insalivation. Also tastiness and variety are essential to prevent palling and even loathing.

Condensed and predigested food is highly valuable as a temporary makeshift when, for some reason, natural food cannot be taken; but, in condition of ordinary health, much the best are the foods that fathers provided and mothers cooked before the day when the manufacturing chemist first appeared upon the land.

In this same matter of condensed food, there is much misunderstanding and misrepresentation. It is impossible to "condense" food further than to remove indigestible matter and abstract water. That done, the foodstuff is already at its lowest terms, to borrow a phrase from arithmetic, and cannot possibly be got to weigh less. Dried albumin, pure oil, pure sugar, or pure starch cannot be condensed further. The foodstuffs can be made up into various mixtures, and be put up in various forms, but further condensation, in the meaning of reduction of weight, is physically impossible. The idea, therefore, of representing in a pill or a tablet the nutriment of a square meal is nonsense. There can be no more nutriment in a tablet than is expressed by the weight of the tablet itself.

There is sound philosophy in the custom of civilization to make of a meal a ceremony. For if the ceremonial aspect be observed properly—if it be forbidden to make the home meal the occasion for the home-grumbling—then amid talk and laughter will eating be slow, as it should be, and mastication thorough. So when at the family dinner-table appear only pleasant faces; when conversation is bright and merry, and when from one to other of the diners is a bearing as courtly as if each were "company", then does indeed "good digestion wait on appetite, and health on both."

In conclusion of the chapter, following are the main points of hygiene concerned with the different **common articles of food:**

Animal foods generally are characterized by a high proteid content, the solid portions of lean meat and of glandular substance, such as liver or kidney, being, indeed, pretty much all proteid; by complete absence of carbohydrates, except in the case of liver, and by the presence of more or less fat, albuminoids, and animal "extractives." As a class, animal foods are comparatively easy of digestion, and are distinctly most digestible when raw! Every minute of cooking, while it develops flavor, does so at the expense of digestibility.

Butcher's meats are fat and lean. Lean meat is three-quarters water and one-quarter only of solid matter. The solid matter is principally proteid with salts and extractives. These extractives are substances of obscure composition that can be dissolved out from meat by the action of boiling water. They are what give to meats their respective characteristic flavor. Meat-extractives contain no nutriment, in the common meaning of the word, but yet have dietetic value, being strangely stimulant to the nutritive processes. A starving animal fed with meat-extractives dies of inanition—that is, of consumption of its own living tissues—sooner than does a companion in misery fed on air alone! The well-known preparation, "Liebig's Extract", consists of meat-extractives and salts, and in its action illustrates well the peculiar virtues of such extractives. The "extract" contains no nutriment, and is stimulant only. It quickens appetite, promotes the digestion and assimilation of food, and, either directly or indirectly, brings about a comforting sense of well-being and good nourishment.

Meat is tenderest immediately after killing. But since man cannot eat tiger fashion, he must hang his meat until the stiffening of the muscles that takes place after slaughtering has passed away.

Although meat is most digestible when raw, it always should be cooked for eating, both for taste and for the destruction of any possible element of infection, parasitic or other. Except in the making of stews, where the meat and the water of cooking are to be consumed together, meat should be cooked by first exposing for a few minutes to a pretty high heat, and thereafter to a moderate temperature only, not to exceed 170° F. The point is, on the one hand, to keep the juices within the meat, and, on the other, not to heat the body of the meat so high as to coagulate firmly the albuminous elements. The brief initial exposure to high heat coagulates a thin outer layer of substance which thus seals the mass, and then the lower temperature cooks the deeper parts at a heat below the coagulation-point. A properly cooked joint, such as a leg of mutton, should have a swollen appearance and, on piercing with a fork, should exude red gravy. On cutting, the outer portion of the slice should be brown and firm, but the rest red, tender, and juicy. A joint that appears shrunken and shows the meat brown, dry, and shrivelled has been improperly cooked.

Butcher's meats are digestible in the following order: beef and mutton, about equal; then lamb and veal, and lastly pork. Salted and smoked meats are not so digestible as the fresh meat of the same kind, except in the case of the pig. Bacon is much more digestible than fresh pork. Mutton is the subject of much idiosyncrasy. Many persons dislike the flavor, and some are poisoned by the meat. The meat of wild animals is hard, whence the custom of keeping it to the verge of decomposition that it may soften.

Heads and **feet**—calf's head, boar's head, pig's feet, etc.—give some small strips of meat, but mostly yield gelatin.

Liver, kidney, and **sweetbread** offer a solid glandular substance, mostly proteid. Liver and kidney are dense; sweetbread of looser texture and more digestible. Sweetbread is of two styles, from different but similar organs of the animal. Of the two, "throat" sweetbread—the common article—is the more delicate. Liver is the one animal food containing a carbohydrate, glycogen, wherefore it must be eschewed in special dietaries excluding that kind of foodstuff.

Heart is all muscle-substance, denser, less digestible, and less tasty than ordinary meat.

Poultry and **game birds** give a meat that is lighter, less stimulating, and more digestible than butcher's meat, but one containing less fat and less nutriment generally.

The meat of **domestic ducks** and **geese** is harder, richer, and stronger-flavored than that of chicken or turkey and therefore not so digestible.

The flesh of **fish** is light and digestible, but deficient in extractives. The notion that fish is especially a "brain-food" because it contains phosphorus is nonsense. The phosphorus in the flesh of fish is in such combination that it cannot be made over into brain-phosphorus, and also the substance of fish is not particularly rich in phosphorus, after all! Broiled fish is apt to have an indigestible coating; so also, but in a less degree, is fried. But frying impregnates with indigestible fat.

Oysters and other edible bivalves make a delicate and digestible food, especially when eaten raw. The smooth, bulbous portion of the animal is the liver, and, like other livers, contains glycogen. Oysters, therefore, must be banned under circumstances where sugars must not be taken. The popular idea that raw bivalves may carry typhoid infection is, alas, all too well founded.

Crabs and **lobsters** are digestible when absolutely fresh—straight from the net or the lobster-pot. But when kept in air, as is the case in the markets, the animals are slowly dying from the unnatural condition, and the flesh becomes rank and unwholesome, even, it may be, poisonous. The meat is poor in nutriment.

Gelatin is the representative albuminoid of the dietary. Commercial gelatin and isinglass consist of something over three-quarters part gelatin, with the rest water and a little mineral matter. Gelatin dissolves in boiling water, the solution setting into a jelly on cooling. So small a quantity as one per cent of gelatin will cause the solution to set, and jellies served as food are ordinarily of only about two per cent strength. The nutritive value of jelly is, of course, in kind, simply that of an albuminoid, and, in degree, is very small because of the low gelatin strength of jellies. Jelly is exceedingly easy of digestion, partly because albuminoids are so generally and partly because, in jelly, there is so little substance. The inadequacy of jelly as a food should thoroughly be understood. Even so far as an albuminoid can replace proteid, it would take a quart of ordinary jelly to play substitute to the proteid content of a two-and-a-half-ounce slice of meat.

Milk, nature's one comprehensive food and drink both, for the mammalian nursling, contains representatives of all four categories of foodstuffs, proteids, fats, carbohydrates (sugar), salts, and water. All of these representatives are, of their kind, especially digestible and wholesome. In the stomach, preliminary to digestion, the proteids of milk coagulate. In the case of milk from animals that chew the cud, such as the cow, the coagulum is in the form of a dense, tough clot, whereas in other milks, including that of the human subject, it is in granular flakes. The boiling of milk does not clot the proteid, but gives to the milk a brownish color and a peculiar taste. By allowing boiled milk to stand for some time and then skimming, much of the adventitious taste can be made to disappear. Cow's milk varies in percentage composition, and from natural causes. In the case of pastured animals, the milk is richest in the late fall and early winter, and thinnest in the corresponding months of the summer season. But with cows uniformly fed this seasonal difference is not so marked. The evening milking is richer than that of the morning, and, in any one milking, the last portion drawn contains the most cream. A milk rich in cream is also correspondingly rich in the other constituents, so that the general richness is gauged most reliably by determining the proportion of the fat content. Four per cent is the standard.

Milk may be unwholesome from a variety of causes. The milk of the first three or four weeks after calving is peculiar and unfit for human use. Milk may be poisonous from poisonous herbs in the pasturage, or from any excitement or irritation of the milch-cow. The milk of diseased animals, milk that has soured, milk that is tinted, tainted, or of unnatural appearance or that deposits a sediment, should, one and all, incontinently be thrown away. Raw milk may be contaminated with disease-germs, as of typhoid fever, diphtheria, tuberculosis, etc. Boiling for ten minutes will kill all ordinary germs, but so also will exposure for thirty minutes to a temperature of 155° F. This latter procedure, called *pasteurization*, avoids the effect of boiling whereby the taste and quality of the milk are changed. Pasteurization, while it kills bacteria, does not destroy such ptomains as may already have been developed in the milk by bacterial action. Neither does it prevent the milk from souring if kept longer than three or four days. Milk sours readily, especially when warm, and also readily absorbs flavors from other things. Accordingly milk should be kept cold, without shaking, in closed and scrupulously clean vessels, and away from other and odoriferous food substances.

Milk is nourishing, but its ingredients are not in the right proportion for it to serve as an exclusive food for the human adult. For such purpose it is deficient in carbohydrates. Accordingly the proper place for milk in the dietary of man is as a proteid and fatty addition to a farinaceous fare, as in the case of bread and milk. Although a fluid, and eighty-eight per cent water, milk contains much nourishment, much more indeed than is commonly realized. It is estimated that a quart of milk represents as much nutriment as a pound of beef!

Cow's milk is of the following composition: * water, from eighty-seven to eighty-eight per cent; proteids, from two to three; sugar, from four to five; fat, from three and a half to four and a half; and mineral matter, less than one per cent.

Cow's milk differs from that of the human subject not only in the proportion of its ingredients, but also in their quality. So far as proportion is concerned, cow's milk can be brought roughly to the human standard by adding to it one-third of its volume of water, with half an ounce, each, of sugar of milk and of cream to each pint of the mixture.

Cream is the skimmings from milk that has stood for some time. The fat of the milk rises to the surface, so that cream is simply milk with more than its natural proportion of this ingredient. A good cream should contain forty-one per cent of fat.

Skim-milk and **buttermilk** are, of course, deficient in fat, in the one case, from removal of the cream and, in the other, from extraction of the fat in the shape of butter. These derivates are digestible and nutritious, each after its kind.

Condensed milk is whole milk or skim-milk evaporated down to about one-third of its volume

* For the figures of this and following statements of percentage composition acknowledgment is made to Dr. Robert Hutchison ("Food and the Principles of Dietetics", New York, Wm. Wood & Co., 1903).

and kept from spoiling by a heavy charge of cane-sugar. Condensed milk often agrees better than natural milk.

Koumyss is milk where, by special treatment, there have been produced simultaneously the lactic and the alcoholic fermentation of the sugar. The result is a milk-like fluid, pleasantly acidulous, effervescent, feebly alcoholic (somewhat over one per cent), and containing little grains of clotted proteid. The name "koumyss" properly belongs to the original preparation made by Tartars from mare's milk, but the word is now quite commonly applied to the imitation preparation manufactured from cow's milk. Cow's-milk koumyss was formerly known as **kephir.** From the fact that in koumyss the proteids are precipitated in granular form, they do not clot in the stomach. Accordingly koumyss is, at once, easier of digestion than milk and especially refreshing by reason of its acidulous flavor, effervescence, and slight impregnation with alcohol.

Matzoön is milk that has been acted on by a special ferment got from Armenia. As in the case of koumyss, lactic acid and alcohol are produced, but the alcohol in much less proportion. Also there is still present much sugar that has escaped fermentation.

Butter is not pure fat but contains water, a little proteid, mineral salts, and a trifle of milk-sugar. The proportion of fat is about eighty per cent. Decomposition of the proteid content promotes rancidity. Butter is commonly treated with salt as a preservative. Raw butter is very digestible indeed, whether solid or melted. Cooked butter may disagree by reason of the liberation, through the heat of cooking, of certain irritant fatty acids. Among fatty foods, butter most nearly resembles, in constitution as a fat, the fat of the human body.

Margarine ("oleomargarine") is an artificial butter manufactured from animal fats. It contains the same proportion of fat as butter, without the proteid and with less of the soluble and fatty acids. Its flavor is that of an average natural butter. It is now made from pure fats, and is in every way a proper and wholesome food.

Cheese is practically one-third part, each, of casein (a derivate of the principal proteid of milk), butter, and water. Dry flaky cheeses, eaten in moderation, are fairly digestible, but new, compact, and comparatively insipid cheeses are apt to disagree. Curds and cream cheeses are delicate and digestible. Cheese sometimes undergoes peculiar changes, developing poisonous substances. From its compactness, cheese contains a high percentage of nourishment, twice as much, indeed, as beef.

Egg, like milk, is a nature food, affording, as it must, the sum of the material out of which the germ is to build itself into a chick, bones, beak, claws, feathers, and all! The yolk contains most of the nourishment, the white being made up of twelve per cent, or so, of proteid with a little mineral matter, and the rest water. Yolk of egg is nearly one-half solid substance, containing about seventeen per cent of proteid and twenty of fat. In smaller proportion it contains also salts, especially lime salts, and phosphorus and iron in a readily assimilable condition. There is no carbohydrate in egg, since the developing chick has nothing to do but to keep still and grow, and so has small need for fuel food.

Egg is thus a highly nutritious combination of proteid, fat, and valuable building salts. From its lack of a carbohydrate element, its place in the dietary is naturally alongside of farinaceous foods, as in the classical breakfast combination of an egg and a roll. Like animal foods generally, egg is most digestible taken raw. The white, however, is more digestible when beaten up, since by this measure the cellular walls that encase the solution of proteid are ruptured, setting free the contents for easier attack by the digestive juices. If egg be cooked, the lighter the cooking the better, but yet hard-boiled egg, if finely minced, appears to be nearly, if not quite, as digestible as the soft-boiled article. Egg is readily and fully absorbed. Many persons dislike egg and many are even poisoned by it.

The shell of egg is so porous that, on keeping, the egg will grow lighter by evaporation through the shell. A fresh egg sinks at once in brine of ten per cent strength and then tends more and more to float on keeping. This same porosity of the shell permits entry into the egg from without of micro-organisms that will determine its decomposition. For preservation, eggs must be kept in the cold, and, in market, should carefully be set out of the sun. Preservation will be enhanced by coating the shell when quite fresh with a solution of albumen or of gum, or with a thin layer of melted wax or paraffin.

The average hen's egg weighs two ounces, and from seven to ten eggs are about the equivalent, in nutritive value, of a pound of beef.

Vegetable foods are exceedingly diverse both in general quality and in proportion of contained foodstuffs. As a class, they are characterized by containing a large proportion of water and more or less very indigestible matter in the shape of vegetable fibre or *cellulose*. Of the organic foodstuffs they contain proteids, fats, and carbohydrates, but no albuminoids. Proteids are present in the leguminous seeds in as high percentage as in meat, but elsewhere in the vegetable kingdom in much smaller proportion. Fats also are deficient, but carbohydrates—exclusively vegetable products—occur in all proportions from next to none to pretty much the whole of the solid content.

Reversing the case of meats, vegetable foods are most digestible cooked; and, as a rule, the longer the cooking (within reason) the better. Raw vegetable foods, especially such as are culled from near the surface of the soil, are possible carriers of disease-germs, accidentally lodged. Vegetable foods are digestible and absorbable, roughly in proportion to the amount of contained foodstuff. Vegetable proteids and fats are intrinsically digestible of their kind, and so are the carbohydrates, but in vegetable messes bulky from the presence of much cellulose and water, there is mechanical impediment to quick and thorough digestion and absorption of the foodstuffs. The proteids seem to suffer most in this regard.

The **cereals** are plants belonging to the order of the grasses. The seed contains nutriment for the sprouting germ exactly as does an egg for the developing nestling. The seeds of the cereals, or grains, contain representatives of all kinds of foodstuffs except albuminoids, namely, proteids, fats, sugars, starches, salts, and water. Weight for weight, they contain much more solid matter than animal foods. Thus lean meat is only one-quarter solid substance, whereas wheat is eighty-eight per cent solids. The percentage composition of the cereal grains ranges as follows: *proteid*, from seven to thirteen per cent, highest in oats, lowest in rice; *fat*, from one-half per cent to five and even eight per cent, highest in hulled oats and in maize, lowest in rice; *carbohydrates*, from sixty to eighty per cent, highest in rice, lowest in oats and maize; *mineral matter*, from one half per cent to two and a half per cent, highest in barley, lowest in rice, but the range of difference not very great; *water*, from seven to twelve and a half per cent, highest in maize, lowest in oats; *cellulose* (indigestible fibre), from one half to four per cent, highest in barley, lowest in rice. It thus appears that oats contain the most proteid and fat, and rice the most starch; rice, indeed, containing but little of other solid substance. Maize is rather poor in proteid but contains much fat, while wheat, rye, and barley occupy a middle ground, wheat containing the most proteid of the three and also being the most generally digestible of all the grains. Oatmeal and Indian corn are the most liable to disagree with a delicate stomach. Wheat and rye are peculiarly valuable for containing gluten, a certain mixture of proteids that determines the possibility of making bread.

Wheat is, of the two bread-yielding grains, the most generally valuable. The seed consists of three parts: a tough outer containing envelope, the *bran*; a mass of nutritious substance for use of the sprouting germ, the *endosperm*, and the germ itself. These various parts all contain the several constituents of the grain, but in different proportion. The bran is poor in carbohydrates, fairly rich in proteid and fat, and especially rich in cellulose and in mineral matter. The endosperm contains a moderate proportion of proteid (about ten per cent), hardly any fat, cellulose, or mineral matter, but an abundance of carbohydrate (seventy-four per cent). The germ contains little cellulose and comparatively little carbohydrate (thirty-one per cent), but is rich in mineral matter and in fat (thirteen per cent) and pre-eminently so in proteid, of which important foodstuff it contains over thirty per cent.

Now different flours contain these different parts of the grain in different proportion, from whole-wheat flour, made of the grain in its entirety, to a fine white flour ground from the endosperm alone. The bran is commonly rejected because difficult to grind, and the germ because its abundant oil is liable to become rancid, and its abundant soluble proteids, by a reaction upon the starch, to darken the bread in the baking. Of course this latter objection is no real objection at all except to the baker, who finds that he cannot sell a dusky loaf as readily as one whose crumb is of a virgin-white. The rejection of the bran and the germ makes waste, for both of these structures contain valuable nutriment. For the saving of some of this waste special methods of treatment have been devised. One treats the germ with superheated steam, thereby sterilizing both the oil and the ferment contained in the soluble proteids, so as to make the germ-contents powerless for harm. Meal made from such sterilized germs is then added to ordinary flour in the proportion of one to three. Such mixture is "Hovis flour". Another process attacks the bran. The bran is boiled under high pressure and the resulting extract filtered and evaporated to dryness. By the boiling, the cellulose is disintegrated and its constituents dissolved out. The powdered extract constitutes "Frame Food Extract".

Bread is made from wheat or rye. These two grains, and these only, contain that special mixture of proteids called *gluten*. Gluten is peculiar in that it becomes viscid on mixing with water, so that when the dough is interpenetrated with a gas and baked, it swells up into a vesiculate, sponge-like mass—bread. The gas for use in this process may be got in several ways. The oldest and still the commonest source is the dough itself through vinous fermentation of its sugar. Formerly the fermentation was determined by *leaven*, but now brewer's yeast is used instead. As usual in vinous fermentation the products are alcohol, carbon dioxide, and water. The greater part of the alcohol is volatilized and driven off by the heat of the baking, but yet a little remains, perhaps as much to a loaf as would be represented by a half-teaspoonful of whiskey. This fact should be noted by the teetotaler absolute, for if mince-pie is to be banned because flavored with brandy, yeast-made bread must suffer excommunication likewise!

Carbon dioxide may be generated in the dough by chemical means, through the action of an acid upon a carbonate, in the presence of water. Mixtures of the necessary chemicals for such reaction constitute "baking-powders". The powder is mixed, dry, with the flour, and then when water is added to make the dough, reaction takes place, with evolution of carbon-dioxide gas. The best baking-powder is a mixture of tartaric acid and acid sodium carbonate ("bicarbonate of soda"). This mixture yields a large volume of gas and its ingredients are wholly innocent. In other powders, tartaric acid is replaced by potassium acid tartarte ("cream of tartar"). This powder, however, yields only half as much gas as the first-mentioned. Powders containing alum are to be condemned.

In yet a third method of bread-making, water is saturated with gas and then mixed with the flour in air-tight chambers under pressure. When the pressure is released, the gas expands throughout the dough. This method requires special machinery and produces a bread rather dry and tasteless. Bread so made is known as "aerated bread."

Bread is forty per cent water and sixty per cent solid matter, all of which is nutriment, except an insignificant amount of cellulose. The several nutritive constituents are *proteid*, six and a half per cent; *carbohydrates*, fifty-one per cent and over; *fat* and *mineral matter*, one per cent each.

Weight for weight, bread contains more nourishment than almost any other food. In proportion of ingredients it is deficient in fat and in proteid. Accordingly the instinctive combination of bread with butter and of both with milk, egg, or meat is well chosen.

White bread is bread made from flour ground from the endosperm only. Brown bread may be bread made from whole-wheat meal ("Graham bread"), or from a flour to which has been added a certain proportion of bran or of ground germ. White bread contains the more carbohydrate, but *not* always the less proteid. It is by no means always certain, therefore, that a brown loaf is more nutritious than its white neighbor.

On keeping, bread slowly loses water and, in some unknown way, suffers the change constituting staleness. Heating in an oven restores the quality of freshness, although thereby the bread loses still more water. Overdry stale bread cannot so be freshened. Stale bread is not so tasty as fresh, but is easier of digestion, since it does not agglutinate in the chewing.

Biscuits, or **" crackers ",** are made by the baking of dough with little or no infiltration of gas. They contain but little water, and accordingly, weight for weight, contain more nutriment than bread.

Buckwheat does not belong to the grasses, but yet is analogous to the true cereals. In proportion of proteid, fat, and mineral matter it resembles rye, but it contains a low percentage of carbohydrates (a little over sixty-one per cent) and an exceptionally large proportion of cellulose (eleven per cent).

The **pulses** are similar in composition to the cereals, but are characterized by containing twice as much proteid, somewhat less starch, and comparatively little fat. The amount of proteid may range even higher than in meat (over twenty-six per cent in dry beans). The fat is deficient (about two per cent), wherefore the instinct to eat fat bacon with beans. Leguminous seeds need thorough boiling and are, at best, less digestible than the cereals. They can be eaten in moderate quantity only, without risk of upsetting the stomach.

Tuberous roots contain less nutriment than seeds, and that principally in the form of carbohydrates. But they contain agreeably flavored juices and especially potash salts, making them antiscorbutic. From their great deficiency in proteid they cannot be used as the staple of the dietary without some proteid addition.

The **potato** is the most important of the tubers, and its percentage composition illustrates well the poverty in nutriment of this class of food. Potato is over eighty-one per cent water and contains only a fraction of one per cent of either proteid, fat, or mineral matter. The main bulk of the solid substance is starch (fifteen and a half per cent of total carbohydrates). Though the amount of mineral matter is small, the salts are of potash and partly in the form of citrates, so that potato is distinctly antiscorbutic. Because of the insignificant proteid content, potato cannot constitute a principal element of the dietary. It must be regarded simply as so much carbohydrate, agreeably flavored and combined with useful potash salts. But its starch is particularly easy of digestion and absorption. The nutritive value of a potato will depend a great deal on the cooking, for the nitrogenous elements and the salts are easily dissolved out and lost by the action of water. For this reason potatoes are better steamed than boiled, or else cooked in their jackets. New potatoes contain more proteid than the old, for which reason they are waxy rather than mealy.

Turnips, carrots, parsnips, and **beets** are even more watery than potato. The last three are distinctly saccharine, beets much the most so of the three. The sugar-beet may contain as high as fifteen per cent of sugar, but much of this is lost in the cooking. The sugar is cane-sugar.

Onions contain but little nutriment of any kind. Their use is mainly for seasoning.

Leaves and **stalks** contain comparatively little nutriment, but are valuable for their fresh juices and salts. Also they help to give proper volume to the food. When thoroughly cooked, they are ordinarily digestible. The more tender among them may also be eaten raw, as salads. Since it is possible for exposed vegetables to lodge infectious dust, greens should be washed well before serving.

Fruits contain but little nourishment and that mainly in the form of sugar. The sugar is fruit-sugar, a different kind from cane-sugar, less sweet, more easily assimilable, and so much less obnoxious to the diabetic. But some fruits, notably apples, pineapples, and apricots, contain also cane-sugar. Besides the nourishment of the sugar, so far as it goes, fruits are valuable for containing potash salts of organic, fruit acids, which impart both an agreeable flavor and anti-scorbutic properties. Like all vegetable foods, fruits are more digestible when cooked. Unripe fruit is irritating from excess of acid and of cellulose, both. Some fruits, such as grapes, dates, figs, and bananas, contain enough carbohydrate to have a distinct food value.

The **tomato,** though served as a vegetable, belongs, of course, among the fruits. Tomatoes contain very little nutriment—not so much as apples—the only constituent present in more than a fraction of one per cent being carbohydrates (three and a half per cent). The fruit is ninety-four parts water.

Quite different from the succulent fruits, **nuts** contain a high percentage of nutriment and especially of fats (from fifty to sixty per cent) and proteids (from fifteen to twenty per cent). They contain but little carbohydrate (from nine to twelve per cent) and even less water (four or five per cent). From their composition nuts stand as a nutritious fatty food. They are, however, rather difficult of digestion. Chestnuts contain an exceptional amount of carbohydrates, and almonds of proteids.

Fungi contain little nutriment, and that mainly carbohydrate. They are esteemed chiefly for their flavor. They are not easy either of digestion or absorption. Some are poisonous, but very many more are edible than is commonly supposed to be the case.

Sago, tapioca, and **arrowroot** are prepared starches. They contain but an insignificant amount of nitrogenous matter. Sago is derived from the pith of certain palms, tapioca and arrowroot from roots.

Sugar is prepared from the sugar-cane, from beet-root, and from the sugar-maple tree. The crude juice containing the sugar in solution is purified and then, by evaporation, the sugar is obtained in crystals, which are still further purified. The sugar from all three of these sources is the same thing, cane-sugar, the peculiar flavor of maple-sugar coming from certain ethers.

Honey is the saccharine juice of flowers, collected by the bee. It is about twenty per cent water and the rest nearly all sugar. The sugar is the so-called "invert" sugar, that is, a mixture of grape-sugar and fruit-sugar in nearly equal proportion.

Chocolate is made of the ground nibs of the cocoa, mixed with cane-sugar, starch, and flavorings. The cocoa-bean contains one-half of its weight of a fat, "cocoa-butter", but in making the commercial powdered cocoa much of this fat is removed. The bean also contains some proteid. Chocolate is nearly one-half sugar. It is nourishing, but likely to pall in any but a moderate quantity.

CHAPTER III

DRINKING

Honest water which ne'er left man i' the mire
—SHAKESPEARE

NEARLY seventy per cent of the weight of the human body is made up of water. Excretion of water is constant, so that the loss by waste must be made good by a constant renewal of supply. Such renewal is effected in part by eating, for about one-half, by weight, of the substance of food as served upon the table is water. But over and above the water so taken there remains an average of about two and a half pints—three tumblerfuls—that must be supplied by drinking.

But while the quantity of three tumblerfuls is thus estimated as the correct daily average to be drunk, circumstances will alter cases very decidedly, and also a deliberate departure from standard requirement in either direction will work no harm unless carried to excess. For since any considerable change in either the volume or the specific gravity of the blood would be disastrous, nature makes a beautiful provision against the effects in such direction of either an undersupply or an oversupply of fluid. The loose tissues of the body contain water, so constituting quite a reservoir of the same within the system, and this stock can be increased or diminished within bounds without other effect than to augment or reduce temporarily the weight of the subject. Accordingly by spilling over into the reservoir in the one case, or drawing upon its supply in the other, the system nullifies the effect of any temporary excess or deficiency of consumption of fluid.

Underdrinking, like undereating, is rare, for thirst is distressing and water is plentiful and cheap. Overconsumption of fluid, however, is a common fault, and when carried so far as to pass nature's limit of adjustment is distinctly baleful. The subject bloats, gaining in weight, not by fattening, but by waterlogging. At the same time there is a tendency to overdistension of the blood-vessels, with a long train of disastrous consequences. Many of the woes suffered by tea-drinkers and by beer-bibbers come not from the intrinsic qualities of the pet beverage, but simply from the inordinate quantity of fluid poured upon laboring heart, arteries, and tissues.

Water undergoes no digestion, entering and leaving the system chemically unchanged. Unless taken in excess, its presence in the stomach along with food does not interfere with digestion. There is therefore no objection to a pint or so of drink to be taken with meals, although, as stated in the preceding chapter, it is better, as it is more natural, to withhold the drinking until the eating be done, and to avoid washing the food down the throat with drink.

As to the nature of the fluid by which the necessary water-supply is to be obtained, it may safely be said that the simplest and most natural way to supply water by drinking is to drink water, and every plant and animal other than man drinks nothing else. Innocent additions to drinking-water are, of course, unobjectionable except in so far as they tempt to the drinking of more water than is required either for the needs of the system or for the quenching of thirst.

Water may be taken hot or cold according to taste. Hot water, or other form of hot drink, distinctly stimulates the natural movements of the stomach during digestion, and thus aids the process itself. Iced water is simply a national fad. While the stinging stuff is not so deadly as extremists would have believed, it certainly is not so wholesome as water at a more natural temperature.

Shall the water be plain or artificially aerated? The question is a moot one. On the one hand, carbon-dioxide gas, like heat, stimulates gastric activity, but, on the other, it distends the stomach with gas, a circumstance that may be quite distressing to a weak heart. On the whole, nature's lead may safely be taken for guidance here as elsewhere, and water be drunk with only so much of sparkle as nature's own fountains provide. To a healthy stomach, at least, artificial stimulation by aerated water is wholly unnecessary.

Potable waters differ quite considerably in composition, and, within limits, (except as to the presence of disease-germs,) the composition does not signify. Distilled water is, of course, water and nothing else, but nature's waters are not distilled and always contain, in solution or suspension, something, and commonly many somethings, derived from the soil or the air through which the water has flowed or fallen. Broadly classed, these constituent things and their effects on the human system are as follows:

Soluble salts are dissolved by water as it courses over or through soil. These salts are intrinsically innocent, being, ordinarily, common compounds of sodium, potassium, magnesium, and calcium (lime). According to the proportion of lime salts, a water is "soft" or "hard". For obvious reasons, salts occur least in rain-water, more in river- and lake-waters, and most in waters that have percolated through soil and rocks—that is, spring- and well-waters. Certain springs have unusual and special saline ingredients, or common ingredients in unusual proportion. Such waters are called "mineral" waters, and have, each, their special characteristics. The quantity of salts present in natural waters may range from none at all, as in rain-water, to over a thousand grains per gallon, as in some mineral springs and artesian wells.

In ordinary waters it is only the lime and magnesia compounds that concern for drinking. In large proportion, making a water very hard, these salts are objectionable, but as ordinarily occurring they certainly do no harm, if indeed they be not positively beneficial. To go to the trouble of buying some specially "pure" bottled water which will differ from the perfectly wholesome tap-water in the adjoining pantry only by a grain or so per gallon less of some innocent salt is certainly the height of absurdity. A good potable water should contain not more than one and a half grains per gallon of lime salts.

Mud is not poisonous, and a wholesome water opalescent from simple mud in suspension offends only the imagination.

Living organisms, in shape of the fearful monsters shown in magic lanterns as inhabiting a drop of water, inhabit only the reeking, stagnant water of ditches and not such waters as are used for drinking. And at their worst they are in microscopic miniature only, so that they may wholly be disregarded. Even a stray wriggler from a well, obvious to the naked eye, would fall a quick prey to the fierce juices of the digestive tract of man.

Organic matter is the one kind of contamination of drinking-water that really is dangerous to health. Decaying *vegetable* matter may make a water sickening, but in such case the contamination commonly declares its presence by an offensive taste and smell. *Animal* derivates are far more dangerous, both intrinsically and also because contamination from such source may not affect the seeming purity of the water in the slightest, either to eye, nose, or tongue. Thus, while a water actually yellowed by vegetable matter may not be unwholesome, another, cool, clear, sparkling, and delicious, may be the purveyor of disease-germs and death.

Contamination from an animal source commonly means impregnation of a water with domestic outcastings, notably with sewage. Sewage impregnation may and does occur in the most eccentric of ways, but ordinarily it comes about either by direct discharge of drains into streams or by soakage from leaching cesspools and other vaults into the underground watercourses that feed springs and wells.

"Beware of the dog!" conspicuously proclaims the farmyard gatepost; but what sign warns the unsuspecting tramp, begging a drink of water at the kitchen-door, of the danger far worse than dog-bite that lurks in the sparkle of the cup so freely offered him?

> "The old oaken bucket,
> The iron-bound bucket,
> The moss-covered bucket
> That hung in the well!"

—And the hoary old horror hangs there still:

hangs not ten paces from where, in one direction, the hired girl is emptying slops into a leaching-drain, and, in another, a sentry-box outhouse is hiding its one-eyed head behind a green-slatted screen. Safer far will it be for the wayfarer to beg the price of a beer at the public house down the road. Then he will have no cause to reck if he hears Boniface remark to lounging Jehu beyond the bar: "Queer now, how that city chap up to the farmhouse got the typhoid fever, ain't it?"

To be even reasonably safe, a well should be, at the very least, sixty feet from any and all receptacles of animal refuse or outlets of drains, and in a direction not down-hill therefrom. But, except in the case of a decided declivity, the lay of the land affords no protection of direction. Subterranean water flows according to the dip of the stratification, which dip has no relation whatever to that of the surface of the ground. From geologic causes, rock stratification shows every conceivable deformity of tipping, buckling, and breaking, till even, as in the case of the Palisades of the Hudson, what was originally horizontal stands bolt-upright. Given, then, the combination of a well and a cesspool, and it is purely a matter of luck whether or not contamination will occur. An underground watercourse may chance to run directly from the site of a drain to that of a quite distant well, and on the other hand, as in a case the writer once met, a pump may peep from the ground within six feet of an old-fashioned leaching-vault and yet deliver a water innocent of guile. The only absolutely safe rule is—*beware of the dog!*

But the dog, in this case, has no business to be. The system, if it can be called a system, of the leaching-vault and the shallow well is simply an abomination—a relic of barbarism. A country-house ought to have a water-supply the same as a city house, the water to be taken from a spring or a *driven* well and pumped by a windmill into a reservoir whence it is distributed to the house. Then the house should have a proper drainage system and the sewage be cared for by the system of surface-irrigation, all as described in the chapter on the disposing of waste.

Unhappy seekers after country board should have a care as to the water-supply of the house in which they think to domicile selves and dear ones for the summer. When, in the weary rounds of the hunt, mother goes upstairs to inspect bedchambers, let father, always, slip around to the rear and note with critical eye the relations of pump or well to outhouse and stable. Let him also, quite casually, ask of any farm-hand who may chance to be about, as to possible cases of sickness, recently, in the house or neighborhood. Then when comes the family council around the corner, let any insanitation discovered outweigh tenfold all considerations of fresh eggs or airy rooms, or even of vine-clad verandas and views!

In the matter of the **purification** of water for drinking there is a vast amount of misunderstanding and delusion. First, as to nature's operations:

By **standing** in a properly constructed reservoir, an infected water tends to purify itself. The adventitious germs settle, and, conditions not being favorable for their development, in due time they die. Accordingly, contrary to popular notion, the holding of water in storage is a safeguard, *if*, to say it again, *the reservoir is a proper one*. By the very same token, and again contrary to popular understanding, **aeration** in a running stream, while it rapidly causes sewage to disintegrate and disappear, does not kill disease-germs. Such germs have been demonstrated to retain their deadly activity after a voyage of many miles down a navigable river.

For a third time contrary to usual belief, **freezing** does not purify absolutely, although it comes very near so doing. The freezing *temperature* does not kill disease-germs, for the typhoid germ has been known to survive a three-months' imprisonment in ice, and even the frightful cold of liquid air is not certain death to these hardy organisms. Purification by freezing is not at all by cold, but by the mechanical operation of crystallization, whereby all minute, particulate things in suspension in the water, be they bacteria or bits of twig, are forced outward by the coalescence of the forming crystals. Any one may notice how clear is a lump of evenly-frozen ice, and how dirty may be a mass where the crystallization has been disturbed. Could freezing take place always under ideal conditions, doubtless the mechanical purification would be quite perfect, but practically such is rarely the case, so that from five to ten per cent of a bacterial impregnation may remain in the ice when the contaminated water freezes, and remain in full pathogenic potency. Nothing is more deliciously absurd than the home high science that carefully provides a boiled or costly bottled water for drinking and then dumps into the pitcher a frozen mass of dirty pond-water, derived from heaven knows where! So-called artificial ice, honestly manufactured from distilled water, is, of course, entirely safe, but equally so, and also far more wholesome as to temperature, is water cooled by putting the pitcher on the ice instead of the ice into the pitcher.

Even **rain-water** may be impure. True that there is no typhoid or diphtheritic infection in the blue empyrean or in the clouds that roll thereunder, but there may be germs on roof or in gutter, in barrel or cistern, so that the rain-water which, falling, was pure, has, fallen, become contaminated.

Of man's methods of purification there are two and only two that are absolutely reliable under all circumstances and at all hands. Whatever may be the case on other planets, certain it is that on earth, under the atmospheric pressures prevailing in habitable parts, nothing can be **boiled** and live—boiled, that is, in water and for ten minutes. Boiled water, then, is safe water, although, unhappily, it is also insipid. Subsequent artificial aeration, however, will remove the objectionable flatness. Simple shaking with air in a partly filled bottle is a fairly efficient means of restoring sparkle.

Distillation, in its effects, much resembles boiling. It produces a water absolutely free from possibility of infection, but one that is flat and insipid. And distillation goes a step farther than boiling. For it leaves behind not only the natural air of the water and all impurities, but also the normal mineral impregnation, whatever it be. Distilled water is water absolute: such a water as nature does not offer, even in rain-water. Because of this fact there have been made statements to the effect that distilled water for drinking is unwholesome, and even dangerous to health. Common sense certainly cannot endorse any such scare, and maritime experience quite effectually overthrows it. The vessels of the United States navy use distilled water almost altogether and with wholly satisfactory results, The real objections to distilled water are the expense and the insipidity. The first item may be serious; the second can be overcome by aeration.

Passing to imperfect methods, **filtration** does not wholly deserve the confidence so commonly bestowed upon it. But there are filters and filters. It is possible to devise and maintain a filtration-plant on a large scale for the whole water-supply of a city, which shall be very fairly efficient indeed, and excellent results have followed such installation in many cases. It is, however, too much to expect that such filtration will sterilize absolutely the water passing through the plant. Household filters are only too often either faulty in principle or the victims of carelessness or neglect, whereby they become positively worse than useless—become actually breeding-grounds for micro-organisms. Whoso sets up a household filter should instal it with the pomp and ceremony due to a *Lar familiaris*, and as a veritable *Lar* the filter ever should be regarded—a thing to be worshipped and tended with the scrupulous care of devotion.

As effective a household filter as any, and one whose care is very simple, is the so-called "Pasteur-Chamberland" filter. In this filter, by the pressure of the water-main, the water is forced through the pores of smooth porcelain. An elongated tube of porcelain, closed at the bottom, is set in a jacket connected with the water-pipe. A rubber cap closes the jacket above, so that the pressure of the main drives the water through the substance of the tube from without inwards, whence it is delivered through a nipple in the rubber cap into an overhead reservoir. From this chamber it is drawn for use from a faucet. The filtration in this case is absolute, as has been shown by many tests, and as the writer proved to his own satisfaction many years ago when making some experimental investigations into diphtheria. Taking an infusion of diphtheritic membrane proved by inoculation upon an animal to be of deadly virulence, he drew it by means of an air-pump through the substance of an earthenware crucible. The filtrate so obtained was a clear, odorless fluid in which the highest powers of the microscope failed to reveal even the most infinitesimal speck in the way of a bacterium. And tested by inoculation, this fluid proved to be as innocuous as so much distilled water.

But though porcelain is thus proved to offer an impenetrable bar to the passage of bacteria, bacteria will appear readily enough upon the inner surface of a Pasteur tube that does not receive proper care! The seeming paradox is explained in a word: While germs cannot *pass* through porcelain, they can *breed* through it. Through the microscopic pores equally microscopic chains of industriously multiplying organisms will grow, until in from five to twenty days, according to temperature, a parent germ arrested on the outer surface of the smooth china wall will deliver a great-great-great-to-the-*n*th-power-grandchild on the inner surface, very much alive, fully equipped with the family ptomain and ready for business! It is, therefore, an absolutely indispensable feature of the use of a Pasteur-Chamberland filter that, at least once a week, the *candle*, as the tube is called, and the rubber cap be removed, brushed clean from adhering slime, and the candle boiled for half an hour, to kill all possible broods of germs within the pores of the porcelain. Furthermore, this *lararium* should carefully be inspected from time to time by the keen eye of the devotee, to see that the rubber cap is pressed tightly home and that the candle be not, perchance, cracked. A loose cap or a cracked tube will deliver a water that simply is not filtered at all.

Purification of an infected water-supply by **chemical disinfection** should not be undertaken in domestic economy. It is true that the Department of Agriculture of the U. S. Government has announced * remarkable results with cupric sulphate (blue vitriol) in harmless dose, not only in ridding reservoirs of offensive algæ, but also of sterilizing water infected with the germs of typhoid fever or of cholera; but the powerful agent employed should be used only by an expert. An amateur attempt to disinfect

* Bulletin No. 64, Bureau of Plant industry.

a well by copper sulphate might result in disastrous failure from an insufficiency, or in copper-poisoning from an excess of the chemical. No other disinfectant gives even promise of efficiency in a dosage that would leave the water safe and fit to drink.

Lastly, among methods for purifying water, must be mentioned, and with a smile, the popular scheme of adding a little whiskey or other liquor to a tumblerful of suspected water. If it were possible to exorcise one evil *spirit* by means of another, the procedure might have reason, but otherwise—mummery!

CHAPTER IV

DRUGGING FOR DELECTATION

Und das hat mit ihrem Singen
Die Lorelei gethan
—Heine

Action and reaction are equal and opposite. This truism of physics holds good also in physiology. Enjoy overnight some delectable drug-derangement of nerves, and pay for it in the morning by a wholly non-delectable counter-disturbance. Make a practice of drug-addiction and mark insulted nature's struggle to adapt her workings to the new, artificial conditions. True that here, as always, nature's powers of adjustment are marvellous, but a struggle is a struggle still, and fatigue comes faster to him who bears a handicap than to him who rides free.

The drugs more or less commonly used by man for neurotic delectation, alcohol, tobacco, tea, coffee, hemp, morphine, cocaine, and, exceptionally, ether and chloroform, differ enormously in their action both in kind and in degree of potency. It is hard to compare things so dissimilar, but so far as comparison is possiblc, cocaine would seem to be the most noxious in the long run, with morphine for a close second, while tea and coffee are distinctly the least disturbing, coffee less than tea. Indeed, so many thousands of the human race take these infusions habitually without either obvious derangement or tendency to increase the dose, that it seems almost cruel—especially for an old campaigner—to include "the cup that cheers but not inebriates" in the category of neurotic drugs that can make for mischief. But tea and coffee derange if taken to excess, and with many stomachs and nervous systems they, one or both, utterly disagree.

In a broad way, neurotic drugs are alike in this, that they affect, each after its own fashion, some balance of play of that marvel of delicacy and complexity, the nervous system of the mammalian animal. The system, then, must establish "tolerance" of the drug, meaning that the affected nerve-centres must make a new adjustment of relations to meet the new order of stimulation or depression. Such adjustment is never perfect—cannot be. Unfortunately it is the more immediately distressing effects of the drug that are "tolerated", so that the deluded habitué sails on his course complacently, considering that his system has now quite "got used to" his pet indulgence. Thus after a little the liquor no longer makes light-headed, the cigar does not sicken, the tea does not make tremble, nor the morphine stupefy. But when once tolerance is established it must be catered to else distress comes. That means that the drug-habit once set up must be maintained—the toper must have his toddy, the smoker his cigarette, the tea-sipper her cup, and the "dope-fiend" his deadly needle. The die is cast, the doom is passed, the shackles are welded, and the slavery is complete. And with regular indulgence, except perhaps with coffee, the tendency is ever downward to a deeper and deeper immersion. The original dosage now falls short of the original effect, so that a little more and a little more again is the call. Meantime the steady impregnation of the system with a poison slowly develops derangements and even organic degenerations for which there is not the semblance of a compensating tolerance.

Follower of Bacchus, are you getting fat and greasy-skinned? Does morning find your head dull and your stomach rebellious? Do your hands tremble, does your heart thump, and your breath come short? Do beads of sweat crown your brow on the least exertion? And as the years roll on, do purple broken veins peep out on nose, cheeks and chin, while under eyes and over ankles comes a doughy puffiness? Prometheus played with fire and angry Zeus sent an eagle to devour his liver by day, miraculously renewing the lost part by night. Whoso plays with *fire-water*, let him beware the swoop of the vulture *cirrhosis*, that relaxes not his grip by night or day when once the cruel claws are fixed!

Cigarette-fiend, do your thoughts scatter? Are you nervous, jerky, and depressed? Does your heart flutter, your appetite fail, your throat be dry, and your tongue be foul? Slave to the cup and saucer, is there a stitch in your side, and are you wakeful and twitchy, flatulent and dyspeptic? And you, pitiable victim of the hollow needle, are you drying up, body, mind, and soul, and are you lost to friendship, to love, to faith, and to honor?

Und das hat mit ihrem Singen
Die Lorelei gethan!

This does not mean *anathema maranatha* upon even an occasional indulgence. The talk is of hygiene, not of morals, and an odd cigar or glass of beer, or even a Saturday night "Scotch" at the club for good fellowship's sake, must, in the candor of common sense and common experience, be held to be harmless. It is *habit* that does the mischief, for the rolling stone will gather way as it goes down-hill, and the longer the hill the louder the crash at the bottom.

In his time, this writer, after the common fashion of men of city birth and breeding, has been accustomed to his coffee twice a day, his wine once, and his old army pipe *passim*. But one after the other he has abandoned all three of the luxuries as being utterly unnecessary for health, happiness, or even comfort, and now he can only wonder why folk go to the trouble, the expense, and the danger of the delectation.

Let the drug-habitué who may long to be "up from slavery" take heart and strike out for freedom, and freedom easily is his,—easily unless he be a victim to a narcotic alkaloid, or be one of those other unfortunates in whom a passion for liquor is a disease. To such, though freedom is attainable, the road lies through red-hot thorns and over burning sands—is, indeed, so hard, so hot, and so long that expert help is needed for the passage. But for an ordinary wine-bibber, or smoker, or tea- or coffee-drinker, the pull out from the habit is far less difficult than commonly is imagined, and readily can be accomplished through simple force of will by any one possessed of a back-bone worthy of the name and of an honest determination to attain the end. The best way is to quit wholly and at once. If it be wine, tea, or coffee that is the slavemaster, the struggle amounts to little more than a passing discomfort. If tobacco, there will probably be more of a wrench, for the reason that in tobacco-addiction the impregnation of the system is apt to be more or less constant throughout waking hours. The first day the cigar will be missed badly, the second day savagely, but thereafter, with diminishing intensity, the desire slackens, until by the seventh day the quondam smoker wonders how he ever came to put the thing between his teeth, and by the fourteenth he resents actively an impudent puffing into his face of choking fumes by some cub whose unmannerly mouth respects neither time, place, nor person!

The special points of hygienic interest in connection with the individual drugs of delectation are as follows:

Alcohol, in its action upon the animal economy, reminds of the meddlesome busybody characterized by an exasperated victim as being more *kinds* of a blanked fool than any fool he ever met! For alcohol can set on foot and keep going all at one and the very same time a whole series of different and even opposite commotions—commotions that, furthermore, are modified most extraordinarily by conditions. What a small dose does, a large one undoes; what a weak dose sets up, a strong one upsets; and what the start begins, the finish finishes! In its action as a neurotic, therefore, the drug does not belong to any one class, but to all at once. It stimulates, but also it paralyzes; it quickens, but also retards; enhances and at the same time enfeebles. In short, alcohol is more *kinds* of a neurotic than any neurotic that ever led a deluded nerve-cell a wild dance on a false promise of innocent delectation!

In the digestive tract, alcohol in small and properly dilute dose promotes the flow of saliva, quickens very remarkably the digestive movements of the stomach and equally vigorously stimulates secretion of the gastric juice. But in strong dose these effects of local irritation are reversed. The chemical processes of digestion are retarded and even arrested, and, if the strong dosing be habitual, there develop chronic pharyngitis and gastritis.

Alcohol is readily absorbed, undergoing no digestive change. In the economy at large, its influence falls especially upon the delicate nervous system, whose normal exquisite balance is rudely upset. The heart is driven to beat harder and faster, while at the same time proper nervous control over the circulatory system is weakened, so that the surface capillaries dilate unduly under the pressure of the blood, and the sweat-glands open and pour forth their secretion. Weakened also is the subtle influence that regulates the evolution of heat within the system, so that the body-temperature tends to fall. The functions of the great nerve-centres are markedly disturbed. In the brain a double and opposite effect is produced; there is excitement of *emotions*, but simultaneous progressive paralysis of the centres where reside the *intellectual* faculties, the perceptions, and muscular guidance and control. If the dose be excessive, the paralytic influence spreads over all; even consciousness and heart and lung automatism fail, and coma and death close the scene.

The final fate of ingested alcohol is what might be expected of a stuff of its kind. Alcohol is a non-nitrogenous, carbonaceous principle, closely allied to sugar in its chemical constitution. Sugar, indeed, is technically itself an alcohol. So what happens to alcohol is precisely what happens to sugar: it is consumed by oxidation in the furnace-fires of the animal economy, with, of course, the inevitable result of the liberation of kinetic energy available for dynamic purpose. In moderate dosage not more than one or two per cent of circulating alcohol escapes oxidation, although in intoxicating doses so much as ten per cent may slip away unchanged.

Three noticeable effects of alcohol that seem primary are really secondary only and are quite deceptive. First of these is the restoration of an exhausted brain to something like normal working power. This well-known effect is not due to any direct stimulus of the intellectual centres, but simply follows as a secondary consequence, on the one hand, of a temporarily improved blood-supply and, on the other, of an abrogation of the irritation and distraction of fatigue. If alcohol had the faculty of enhancing the intellectual powers, its action should be a benefit to those who must battle with their brains. A military general, then, or a court-room counsellor, or a debater, or even the driver of a fast "limited" express should be the better equipped for the task in hand by a glass of liquor. But every experience shows the reverse to be the case. If, in war, the Lord is on the side of the dryest powder and the strongest battalions, so also and most distinctly is he on the side of the cold-water commander. Liquor never yet won an issue, whether in war or in law, in logic or in love; and who would trust himself to a train whose engineer might be seen to board his locomotive straight from out a bar-room?

The simple fact is that when the brain is well nourished and the mind neither worried nor overworked the mind is already at its best. When in such prime trim, then, alcohol only impedes and perverts. But if the brain be exhausted from overwork, agitation, or lack of sleep, then an alcohol-irritated heart will, for the moment, the better nourish it, while an alcohol-paralysis of the sense of fatigue and distraction will clear the mental path of burs and brambles. By such means, then, enfeebled mental aptitude will provisionally be restored to the normal by alcohol-inflnence, but wholly in a roundabout way. This point should thoroughly be understood in order that an action, really useful in appropriate circumstances, be not misapplied.

The second of the secondary effects is one equally well-known and obvious and also one equally misunderstood. It is the comforting sense of warmth that follows an alcoholic draught, especially if the subject be chilled at the time. This sensation is sensation only and does not express at all actual conditions as to body-temperature.

Alcohol retards chemico-vital action and therefore does not elevate, but on the contrary actually lowers the heat of the body. The sensation of warmth comes about in this way: Alcohol paralyzes the skin-capillaries at the same time that it stimulates the heart. Consequently, for a double reason, there is a delightful outward rush of hot blood from the interior to the chilled skin, whence the blood had been driven by the cold. So, since the sensation of heat resides in the skin-nerves, the subject *feels* wonderfully warmed. What has happened, though, has simply been a warming of the skin at the expense of the spine, while at the same time the furnace-fire itself is undergoing a damping. The case is analogous to the taking of coals from a grate to spread upon the window-ledge. For the time being, the neighborhood of the window will be warmer than before, but meantime the grate-fire is reduced, and the general temperature of the room is falling. As soon as the coals on the window-ledge shall be dead, this fact will be unpleasantly manifest. In the same way, when the delusive glow of warmth from the alcoholic draught has passed away, the subject, if still exposed to cold, will experience a chilliness that will penetrate to the very marrow of his bones. This fact should be appreciated, for while alcohol is of excellent service to counteract a chilling after the subject is housed in bed or before a fire, it is positively dangerous during the exposure to the cold, as arctic voyagers know well. Some arctic commanders, indeed, are alleged to refuse to have any liquor aboard ship, so fearful are they of its misuse during cold.

The third of the deceptive effects is a feeling of physical well-being, of ability to do work with unusual ease and efficiency. Again the sensation is sensation only, a secondary consequence of a primary influence that is in the line of paralysis and not stimulation. Alcohol paralyzes the nerves of sense, and so abrogates all feelings of weariness or of pain. The subject seems to walk on air with exuberant lightness, but the ability to do muscular work and also physical endurance are distinctly and very decidedly lessened instead of enhanced, as has been proved by critical experimenting over and over again.

Chronic indulgence in alcohol beyond a very narrow limit tends to derangement of chemical workings and to degeneration of tissue, especially in the nervous system. Alcohol is quickly absorbed and easily oxidized, so that it is readily taken for vicarious sacrifice in the place of the slower-burning fats and starches of the food. Consequently the foodstuffs are spared, and, being spared, are turned into body-fat and stored. So it comes about that the drinker fattens, often, indeed, very rapidly and superabundantly. The poisoning of the nerves falls markedly on the so-called *vaso-motor* apparatus, producing, even in mild cases of regular indulgence, the characteristic red nose, short breath, and clammy skin. So characteristic, indeed, are these symptoms that any one who adds to tremulous hands a dusky red face, a sweating brow, and a panting, pursy chest can pretty safely, in spite of all denial, be set down as a drinker, albeit a secret and unsuspected one.

In severer grade, come serious degenerations constituting disease, physical, mental, and moral —moral, because, wholly apart from the degradation of drunkenness, there is a tendency, even in such drinkers as never are actually intoxicated, to lapse from the ethical plane of the temperate. The toper is not truthful, nor does he adhere to the highest sense of honor, as measured by the standard of self in ante-bottle days.

Without going into technical details, the foregoing picture gives a fair presentment of the various deeds wrought by alcohol upon the animal economy. And a review of the picture as a whole shows clearly that the influences of this extraordinary agent are so many and so opposite that they cannot be embraced within any single characterization. The point is important, for in all seriousness it may be affirmed that incalculable mischief has been done the human race by the wretched misnomer of calling alcohol a "stimulant". The idea of stimulus is that of a quickening and enchantment of positive capabilities and activities. In moderate doses alcohol does truly stimulate the digestive functions, and, in any dose at the outset, it stimulates markedly the heart and the emotional activity of the brain. But beyond the stimulation thus shown by a wriggling stomach, a bounding pulse, and a babbling tongue, the primary influence of alcohol is wholly one of slowing rather than of quickening, of enfeebling rather than enhancing, of dulling rather than of sharpening. In a word, alcohol is far more of a paralyzant than a stimulant, and always is it a degenerant, if such a word may be allowed, in its organic influence upon living substance. A proper recognition of the true relation of alcohol to animal life may be worth thousands both in dollars and in days to the deluded victims who imagine that in the wine-closet they harbor a friend in need instead of "an enemy . . . to steal away their brains".

Is alcohol a food? Upon this question there has been written and spoken a vast amount of sentimental nonsense. In the second chapter it was shown how hard it is to frame a comprehensive definition of what constitutes a food, for the reason that the things we eat fulfill many and diverse functions all of which are of importance, each in its own way. The only answer, therefore, to the question, is alcohol a food, is the statement that undoubtedly, and demonstrably, alcohol does what the non-nitrogenous foodstuffs do and suffers the same fate. Oxidation is oxidation; oxidation means kinetic energy, and kinetic energy means heat and power, no matter what the fuel that goes into the furnace-fire, so long as it will burn. And that alcohol will burn, every child knows to its cost who once has fooled with fingers about that innocent-looking lambent ghost under tea-kettle, as it leaps and laps so merrily!

In short, alcohol is just as much of a food as is its own chemical sire, sugar. Also it is a food of the same kind, but—

—Ah, yes, *but*! An ox and a bull are brothers. One is just as strong as the other; both can draw a plough and thus do farm-work. But the bull will bounce the plough zigzag all over the lot, toss the ploughman and smash the fence, so that the furrow gotten by his draught will be a crazy one and dug at a rueful cost. So alcohol: its food-function is yielded in the burning; but *before* the burning, while the alcohol is still alcohol, careering as such at large through the system, the savage stuff is a veritable wild bull, whose horns are in every tissue and organ for harm!

What is the place of alcohol in the dietary of man? Apart from therapeutic uses, the dietetic purpose of alcohol is, first, to give a tasty drink; secondly, to aid digestion; and thirdly, to promote good-fellowship—a triple purpose that in all three aspects is born of the artificiality of man's civilized life. Physiologically, alcohol has no more rationale in the drink of man than of a whale. As to the purpose, such as it is, the tastiness of a beverage is, of course, a matter *of* taste: the aiding of digestion is confronted by the inquiry, why eat so much as to make the stomach ask for artificial aid in the discharge of its duty, and the promotion of good-fellowship is a function whose call is, by the very nature of the function, occasional only. Surely, then, the answer to the question as to the place of alcohol in the dietary of man is,—no place at all for habitual use, and on legitimate occasions, always, of course, well within bounds.

One who may think to consume alcohol regularly will do well to ponder very carefully these two considerations: first, the ever-present risk of an ever-tightening grip of addiction, and, secondly, the fact, not appreciated as it should be, that in habitual indulgence mischief may be brewing all unseen and unfelt.

Now the most striking derangement wrought by alcohol is, of course, cerebral intoxication, but a point of utmost importance is that this same derangement is, at once, the very one that *varies most* and *harms least*. Accordingly, the degree to which alcohol "affects" a given subject in the matter of tipsiness is no criterion at all of the damage the poison may be doing to his system. A man may "carry" his load well; may walk and talk perfectly straight, but all the time the alcohol will be walking and talking through his tissues at the same rate as in the case of a weaker-headed fellow bibber whose outward aspect may be shocking. And as fatal in the one case as in the other may be the call of a sudden pneumonia or an apoplexy.

Assuming, however, that alcohol is to be taken regularly, the practical point comes up, where lies the line between temperance and intemperance? As just seen, such line cannot be drawn from outward effects, since these will vary with the individual according to idiosyncrasy or habit. The consideration, then, must be one of chemistry and pathology and not of mere symptomatology. As usual in such matters, there is no natural dividing line—no "jumping-off place", for all is gradation. The line, then, must be arbitrary, and no better one presents than that drawn by the English authority, the late Dr. Anstie, who made a special study of the relation of alcohol to the animal economy. This experimenter and observer, both, very shrewdly maintained that the line between temperance and intemperance should naturally be considered to lie at the limit beyond which alcohol escapes from the body unchanged. In other words, so much alcohol as the organism can wholly consume by its furnace-fires may be taken as the measure of so much as is safe (if, indeed, any can properly so be called) for habitual dietetic use.

Now in divided dosage from one to one and a half ounces (two to three tablespoonfuls) of absolute alcohol per day can be oxidized entirely by the economy of the average adult. Such amount, then, by the Anstie standard, will constitute the limit of a proper daily alcohol ration, if a daily ration is, indeed, to be allowed. The extreme of the limit is represented by the following measures of the common alcoholic beverages: ardent spirits, three ounces (six tablespoonfuls); fortified wines (sherry, madeira, etc.), two sherry-wineglassfuls; light wines (champagne, claret, hock, etc.), one "pint" bottle; strong malt liquor (ale, porter, etc.), three tumblerfuls; light beer or ale, four or five tumblerfuls.

Not only amount, but also strength, should be limited; for, as already has been stated, while a dilute potion stimulates digestion, a strong one impedes it, and, taken habitually, tends to inflame throat and stomach. Accordingly a wise rule is to reduce all alcoholic beverages, for the drinking, to ten per cent at the highest. This is about the strength of the average champagne, claret, hock, or other light wine. Ardent spirits, then, averaging, as they do, fifty per cent of alcohol, should be diluted fivefold, and strong wines of twenty per cent strength, such as sherry or port, should either be diluted twofold or else simply be sipped, while eating, in which case they dilute themselves sufficiently as they mix with the stomach contents. Ales and beers are already within the prescribed limit of strength.

In the case of the different alcoholic beverages in common use, hygienic regard must be paid not only to alcoholic strength, but also to the effects of other contents besides the alcohol.

Ardent spirits are about one-half alcohol, but also contain in small proportion more or less of other alcohols of higher boiling-point, to which collectively the name *fusel-oil* is given. In addition still are small quantities of various ethereal bodies. Now, as is well known, a liquor, when new, is unfit for consumption, but ripens by age, becoming not only of mellower flavor, but losing certain rankly noxious properties of the raw article. It used to be supposed that fusel-oil was responsible for the harsh effects of new liquor, but opposed to this theory are the points, first, that the oil is present in small proportion only; secondly, that it is not certain that the quantity lessens as the liquor ages; and thirdly, that there is doubt if the higher alcohols be any more poisonous than ethyl alcohol itself. However, the essential fact remains that ardent spirits should be at least two years old, and every additional year of age makes for yet further improvement of quality.

Liquors contain little else of account besides alcohols and ethers, being almost wholly free from acids and from sugar. Dietetically, they represent a diluted alcohol of special flavor, whose effects, particularly on the heart, are at once more kindly and more lasting than is the case with unmixed alcohol. These modifications of the influence are due to the ethers. By reason of their very simplicity of composition and character, spirits often are better borne than the more complex products, wines and beers. They are, however, dangerous by reason of their concentration, for, because of this circumstance, they are likely to be drunk both too strong and in too great quantity. Under the Anstie limit, two ordinary drinks of liquor represent a day's allowance of alcohol, but what "rummy", accustomed to taking his "booze" "neat", ever would dream of bidding Bacchus good-bye for the day over the second glass!

Liqueurs are practically ardent spirits heavily charged with cane-sugar and containing also much solid extract. They are fit only to be sipped in small quantity for their flavor. Absinthe is especially villainous by reason of containing the volatile oil of wormwood, a powerful neurotic poison, producing convulsions.

Wine is of two general kinds. In the one the fermentation is allowed to exhaust itself, while in the other it is stopped at a certain point by dosage with alcohol. Wines of the first kind, or "natural" wines, typified by claret and hock, contain a comparatively low percentage of alcohol—ten per cent, on the average—and little or no sugar. Wines of the other sort, "fortified" wines, so-called, typified by sherry, madeira, and port, contain twice as much alcohol, by reason of the addition, and also considerable of the original sugar of the must which, because of the arbitrary arrest of fermentation, remains in the wine unchanged. Both kinds of wine contain also fruit-acids, notably tartaric, in the form of the acid tartrate of potassium (argol). The natural wines contain more of this salt than the fortified, but yet the latter have more than their flavor would indicate, for the reason that the sugar present masks the acid taste. Red wines, fermented from must containing the skins and stalks of the grape, contain also tannic acid, becoming thereby astringent in flavor and quality.

Wines, like liquors, ripen by age, developing highly flavored ethers, to which is due the characteristic "bouquet" of the wine. Natural wines ripen much faster than the fortified, so that they are ready for consumption at a much earlier age. By the same token, they deteriorate much sooner, so that their lifetime is limited. In the case of natural wines, furthermore, there is not enough alcohol present to act as a preservative, so that a bottle once opened must be finished on the occasion. Otherwise it soon spoils like so much milk.

Champagne is a special form of wine whose manufacture involves many steps. It is of about the alcoholic strength of the natural wines, or somewhat stronger, and contains a variable amount of sugar, purposely added according to the taste of the prospective consumer. The wine is "sweet" or "dry" according to the proportion of sugar. A dry wine is the more reliable, since sweetness can be made to cover a multitude of "doctoring" sins.

Cider and **perry** are wines made by the fermentation of apple and pear juice, respectively. They contain about as much alcohol as light beer, together with a little sugar and acid.

Wine is a very complex body, and in the subtle blending of its many ingredients there appear to be born subtle potencies that defy chemical analysis for their explanation. In a broad way, wine stands for an admixture of diluted alcohol, ethers, sugar, and fruit-acids. The alcoholic effects are, of course, in proportion to the alcoholic strength, but in many ways these effects are modified by the other ingredients of the wine. Quite curiously, wine is less kindly to the chemical processes of digestion than is simple alcohol. Through its acidity, it restrains the normal ferment action of saliva upon starch, and for some obscure reason similarly holds in check the chemical activities of gastric digestion to a greater extent than is attributable to the action of the alcohol alone. The effect of light wines in this regard is less than that of the strong, and of sparkling wines less than of the still. In spite of this purely chemical restraining influence, the resultant effect of wine upon digestion may be to promote efficiency by means of a sharpening of appetite and stimulation of the flow of gastric juice.

The action of alcohol upon the heart is affected by the ethers of a well-ripened wine in the same way as by those of a sound liquor, as already described. Accordingly a fine old wine of rich bouquet is as valuable medicinally as it is expensive commercially.

As to the sugars and the acids of wine, neither of these constituents is of much account intrinsically, yet, as blended with the other constituents in wine, they seem to exert a peculiar influence. It is an old story that, for a gouty subject, a saccharine wine, like a sherry or a port, imbibed overnight, will mean "a red-hot toe in the morning", while yet the same amount of alcohol taken as whiskey and water will be without special influence. Sweet wines, like sweet anything else, easily excite acid dyspepsia in subjects so disposed, so that the dry wines are ordinarily the better borne.

Malt liquors range in alcoholic strength from about three per cent in the lighter beers to seven in the stronger stouts and porters. They are characteristically bitter from hops, and contain also from five to seven per cent of extract, made up mostly of *dextrine* (a carbohydrate), with a little proteid, sugar, lactic acid, and mineral matter. The amount of nutriment thus represented gives to a pint of ale the food-value, in solids, of a little over an ounce of bread. Malt liquors are appetizing by reason of their bitterness, but easily develop acidity, disagreeing with many persons for this reason. They tend to be soporific, the strong stouts especially so. Because of their low alcoholic strength, they may be drunk in comparatively large quantity without producing any marked alcoholic derangement, but this fact leads to their inordinate consumption and so to the deleterious effects of too much fluid in the dietary, as described in the foregoing chapter.

Tobacco is the typical neurotic drug. In constitutional action, although practically guiltless of the crime of alcohol of inducing organic degenerations, tobacco nevertheless readily commits the misdemeanor of deranging nerve-functions. Experimentally tested upon an animal, nicotine first excites, even to the point of convulsions, and then paralyzes. Upon the unaccustomed human subject, as in the case of a lad who rashly essays a first and strong cigar, the derangement is hardly less severe. The ambitious smoker is quickly laid out limp, with fluttering heart, trembling limbs, pallid, sweating brow, and horribly sickened stomach. But habit soon brings tolerance, and, as usual with narcotics, worse than tolerance—slavery. For just as a dog, originally shy of a new master, soon becomes attached and howls dismally at parted company, so the nerve-cells, at first so rebellious at the nicotine intrusion, come speedily to love the intruder and to revolt at his absence. Once formed, therefore, the habit is fixed.

In moderate indulgence, if tobacco does not hurt, it does not harm. This sounds silly, but really sums up precisely the facts in the case.

Except as to local effects, tobacco, considering its potency, is singularly free from radical influence. Accordingly, in any given case, if the tobacco does not obviously derange, the smoker need not fear that the weed is working any secret mischief with his organs or tissues. In this regard tobacco stands in marked contrast with alcohol. The stealthy boring of auger-holes in the bottom of a doomed ship, while yet the vessel sails fair upon a placid sea, is exactly the piratical crime only too often chargeable upon alcohol, but is one for which tobacco cannot honestly be indicted except perhaps on a single count. Quite occasionally, among those who use the weed excessively, occurs an impairment of vision, passing even, in extreme cases, to complete blindness. And such impairment is due to organic changes in the nerve-structures of the eye. But in a very great many of these cases, at least, there is strong reason to believe that alcohol, secretly taken along with the tobacco, is the real sinner. It is perfectly respectable, alas! to smoke to excess, but disreputable to "crook the elbow" to a corresponding extent. Accordingly the same subject who will smilingly admit his dalliance with My Lady Nicotine will stoutly deny all acquaintance with the tramp Silenus.

Locally, tobacco can make inflammatory mischief. The irritation of the smoke leads very commonly to a chronic dry catarrh of throat and air-passages. Also it is possible that the same irritation, like other irritations, may cause cancer of lip, tongue, or tonsil. But in such case it is simply a long-continued irritation *as* irritation that makes the trouble, and not anything specific in the tobacco as tobacco. An old foul pipe, held always in the one corner of the mouth, is much more likely to irritate the lip than is a cigar or a cigarette.

Constitutionally, tobacco-derangements are, as already said, ordinarily functional only. Even when severe, they disappear quickly and completely on removal of the exciting cause. The habitué, besides suffering from a scratchy throat, may be dyspeptic, with poor appetite, especially for breakfast, and tongue dry, foul, and clamorous for drink. Also he may be nervous, as shown by restlessness, tremulousness, depression, and deficient power of mental concentration. Worse yet, he may acquire the "tobacco-heart"—a heart that is irritable, palpitating, and intermitting in action, and sometimes the seat of pains, even, it may be, severe. Headache, vertigo, muscular tremors, and wakefulness also are possibilities. The claim that tobacco, taken during growing years, may "stunt the growth" is not altogether fanciful. Certain college statistics point to an inferiority in physical development under training in the case of smokers as compared with those who do not use tobacco.

As is well known, different subjects differ enormously in susceptibility to tobacco.

Delectation by tobacco is delectation pure and simple, for tobacco cannot assume the coquetry of alcohol of posing for a food while serving as a luxury. The pleasure derived from tobacco is not easy to define, largely for the reason that the confirmed smoker lights cigar or cigarette quite as much because, negatively, he is wretched without it, as because, positively, he is beatified by it. So far as positive effect goes, it is of the nature of a subtle soothing—a promotion of a feeling of general peace and comfort, physical and mental. It is very easy and very common to overdo the delectation, with the usual result of reversing the effect—making, instead of allaying, nervousness. By reason of idiosyncrasies, no general line can be drawn between an indulgence likely to be wholly delectable and one that may disturb. For this, every smoker must be the law unto himself. One who is conscious that he has passed what is, for him, the dividing line should, in common sense, let up, or if he have not the strength of mind to hold himself in check, quit the habit altogether. A victim of chronic tobacco-poisoning is not doing justice to himself or to those dependent upon him for support, for in such poisoning neither body nor mind works at its best.

As is the case with neurotics generally, tobacco is most baleful when the impregnation of the system is continuous. If only there may be a let-up, the poisoned economy, refreshed by the interval of freedom, is better able to resist any evil effects from the next dosing. A given amount of smoke consumed all within a few hours, while the rest of the day is wholly smokeless, will be much less likely to develop tobacco-poisoning than the same number of cigars distributed evenly through the day, whereby the blood is never wholly free from nicotine. In such case, moreover, the enjoyment will, by contrast, be the keener. Since tobacco belongs with *dolce far niente*, the natural time for the dalliance is evening.

The active principle of tobacco is the volatile alkaloid, *nicotine*, which is present in the dried leaf in the proportion of from two to six per cent. The acrid, offensive oily fluid that forms in old tobacco-pipes is not nicotine, although, like nicotine, it is highly poisonous. In the dry distillation of smoking, much, and sometimes all, of the nicotine is decomposed, but decomposed simply into closely allied principles of similar and equal poisonous potency with nicotine itself. As the smoke is drawn through pipe-stem, cigar, or cigarette, the products of distillation deposit in the mouth-end of the smoking contrivance, whatever it be. For this reason, the last portion of a smoking is stronger than the first, and an old, unclean pipe literally *outranks* a new one. One who is sensitive to tobacco, therefore, will do well to smoke only two-thirds of a given cigar, cigarette, or bowlful of leaf, and, if he use a pipe, to abjure the old and the dirty.

Intrinsically, the cigarette gives the mildest and the cleanest smoke. There is no ground for the notion that there is anything deleterious in cigarette-paper or that cigarette-tobacco is adulterated noxiously. The drawbacks to the cigarette are twofold: first, the very mildness of the smoke leads to inhalation of the fumes, whereby throat and lungs are irritated and the active principles of the smoke rush with full head into the blood; and, secondly, the handiness of the little roll tends to undue frequency of indulgence, with result of poisoning both to smoker and to the public atmosphere. So comes it about that the cigarette owns the smoker and the smoker owns the earth. The worst cases of combined tobacco-poisoning and public bad manners are commonly to be found among cigarette-fiends.

Other methods of using tobacco are by chewing, snuffing, and "dipping". The latter procedure, practised among the negroes of the South, consists in rubbing powdered tobacco upon the gums. Chewing impregnates the system more readily than smoking, while snuffing, dirty and deservedly out of fashion though it be, is the most innocent of the ways of using the weed.

Tea and **coffee** owe their delectable influence to an alkaloid which is practically identical in the two plants. This alkaloid, *caffeine*, is quite a perfect example of a pure nerve-stimulant, for under its influence normal nervous processes are quickened and steadied without any such distortion as is wrought by alcohol or tobacco. Of course, when such processes are already in perfect trim, stimulation means overexcitation and defeats its end; but if there be any flagging, the stimulus may be just what will put the tired function on its feet again. The stimulation of caffeine notoriously affects the cerebral functions —"cheers but not inebriates", as is so truthfully said. At the same time the play of heart and lungs is quickened and deepened.

As is the case with all true stimulation, overdoing is undoing. Overindulgence in tea or coffee brings unnatural reflex irritability, shown in general nervousness, twitching or trembling of the muscles, palpitation and intermittence of the heart, wakefulness, depression, and impaired power of mental concentration.

Caffeine is like nicotine in being innocent of organic harm. Any distress from overindulgence vanishes quickly when the cause is removed.

As usual with neurotics, subjects are very differently impressed by caffeine. Some can bear inordinate quantities of tea or of coffee without derangement, while others are upset by a single cup.

Coffee and tea, both, but especially green tea, contain tannic acid. Probably because of the tannic acid, infusions of tea or of coffee tend to retard the digestion of proteids. In a healthy stomach, the degree of this effect produced by the usual cup or two is insignificant, but in a weak stomach, or where the consumption of the beverage is inordinate, the influence may be sufficient to produce a distinct dyspepsia. Tea, in this action, is, as always, a worse sinner than coffee, and tea also is especially prone to develop flatulence. Many a dyspeptic, distressfully flatulent and with shooting pains in the back, side, or region of the heart, owes his—or her—misery wholly to the seductiveness of the caddy.

Cocoa also contains an alkaloid nearly identical with caffeine, but in the beverage prepared from cocoa the amount of alkaloid is too small to produce any appreciable effect. A cup of cocoa or of chocolate, therefore, represents simply a hot drink of characteristic flavor, with somewhat of nourishment from the solid ingredients of the bean, and, in the case of chocolate, from added sugar and starch.

Hemp, morphine, cocaine, ether, and **chloroform** do not merit detailed consideration in a book on hygiene. Their use, one and all, as drugs of delectation is to be condemned uncompromisingly. Such use, even in mildest manner and degree, is playing with fire of the most dangerous kind—an indulgence whose retribution may be a hopeless degradation, physical, mental, and moral. Morphine and cocaine, so commonly used as anodynes, are insidiously dangerous, except where the case is one of temporary and severe pain. In cases of pain not oversevere, especially where the trouble is chronic, the sufferer had better far "suffer and be strong" than invoke relief from an agent that under the mask of benefaction may bring the doom of a life-long blight.

CHAPTER V

SEEING

> Grandmother, what great big eyes you have got!
> So much the better to see you, my dear!
>
> —Old Legend

If lamps be eyes, then are the words of the wolf as true of rooms and halls as of her own dreadful head.

The bigger the lamp, the better the seeing, for in artificial illumination, as in all else of man's artifice, the closer the imitation of nature's own article of the kind in question, the better is it for the imitator.

The illumination under whose soft rays have come into being the eyes of diurnal animals, and for which, therefore, such eyes are by nature adapted, is broad daylight. And this illumination has the following attributes: *Quantity*, abundant; *quality*, diffused and steady; *color*, fairly white.

As to quantity, artificial illumination must ever fall far short of nature's model, for no light that man has yet discovered approaches in quantity the effulgence that comes to us from ninety odd millions of miles afar. Yet nature, with her usual marvellous power of adjustment, will adapt the vision of her wards for man's poor substitutes for sunlight, if only man will be generous in the production of such substitutes. But right here is the commonest fault of artificial lighting—there is not enough of it. The light should be so abundant that the eye views the page to be read or written at the same distance and with something of the same absence of effort that it does in good daylight.

With electricity cost is the only bar to an absolute sufficiency of illumination. The lights give but little heat, do not affect the quality of the air of the room, as is the fault of all other artificial lights, and can be set anywhere and in any number. The most beautiful artificial lighting is by an encircling of the room with a close-set line of electric bulbs along the cornice, so screened that the eye does not see the lights themselves.

With all lights other than the electric, the point of the vitiation of the air of the room has to be taken into account in the practical question of sufficiency of illumination. Open combustion, like breathing, affects the air both by consuming oxygen and by giving out noxious fumes. It will not do, then, to have the room so ablaze with light that the very splendor makes the chamber uninhabitable.

Now an idea of the voracity of combustion-lights for air can be gathered from the fact that an ordinary gaslight consuming three feet of gas per hour will affect the atmosphere to the same extent as will three pair of human lungs. Where the combustion is complete, as is the case with mantle gas-lamps and the acetylene flame,* the vitiation consists simply in loss of oxygen and gain of water and carbon dioxide,

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* *Mantle gas-lamps*, typified by the Welsbach lamp, consist of a Bunsen burner surmounted by a mantle, or other device, of specially prepared, incombustible mineral matter. As is always the case with the Bunsen burner, by virtue of its construction, it makes thorough combustion of the gas, giving a hot but practically non-luminous flame, with no soot. This hot flame then heats to incandescence the mineral matter of the mantle.

Acetylene is an inflammable gas wholly composed of carbon and hydrogen. When burned in a specially constructed burner, combustion is complete, the only possible products being carbon dioxide and vapor of water. The flame gives a light of intense brilliancy, perfect steadiness, and comparatively pure whiteness.

Acetylene is generated at once by the simple action of water on calcium carbide, a solid product of the heating of powdered coke and lime in an electric furnace. The gas is of an acrid, disagreeable odor, but burns without smell. So simple is the means of its generation that it can be made and burned in a portable lamp, or a generator can be installed in the cellar of a house, to be connected with the ordinary gas-piping.

Acetylene-gas can then be made the house-illuminant in place of illuminating-gas, with only the requirement of special burners. The contrivance makes it possible to furnish a gas-lighting for an isolated country-house. With properly constructed generators, there is no danger of explosion.

so that in such case there results neither odor nor distress (see the preceding chapter). But when combustion is incomplete, as in the case of oil-lamps and ordinary gaslights, Argand or other, genuinely noxious fumes are given off, that produce bad taste in the mouth, headache, and general oppression. From the point of view, then, of vitiation of the atmosphere, artificial lights divide into three classes: first, all forms of electric lights, wholly innocent of guile; secondly, mantle lights and the acetylene flame, producing deterioration of air, only; and, thirdly, all other combustion-lights, all of which more or less actively poison the atmosphere.

Sufficiency of illumination for a limited area, such as the surface of book or portfolio, can be secured with a comparatively weak light by the simple device of bringing the light itself sufficiently near. For, with approach of a light, the illumination increases not in direct proportion with the degree of approach, but with the *square* of such degree; that is to say, the amount of illumination is inversely as the square of the distance of the illuminating body. So if a lamp at a given distance be brought to stand at half that distance (twice as near), the amount of light received, as upon the page of a book, is not twice but four times as much as before ($2 \times 2 = 4$); if brought to within one-quarter of the original distance (four times as near), the illumination is sixteen-fold what it was ($4 \times 4 = 16$).

Accordingly, a single student-lamp standing near a reader's left elbow, where the flame is two feet from the book, lights the page as much as would four such lamps twice as far off, or as would the whole armament of a sixteen-burner chandelier eight feet away. Unfortunately, the heat from a lamp increases with nearness in the same proportion as does the illumination, a point that always must be taken into practical consideration. Roasting eyes cannot read, nor baked brains appreciate, the book, no matter how well-lit the page.

So far as concerns the first characteristic of **quality,** namely, diffusion, man's best efforts to imitate nature again fall short. In daylight, with the direct rays of the sun cut off, as by a cloud or other shade, the light is from everywhere, for it comes, literally, from the whole vault of heaven. The *sun* lights the *atmosphere*, and the *atmosphere* in turn lights the earth. Were the atmosphere, with its suspended dust and vapor of water, to disappear off the face of nature, there would be no such thing as daylight as we know it. In direct sunlight, indeed, there would be fierce light and heat, fiercer than anything we now know, but even at high noon the shadow of a rock would give the blackness of night. The very sky would be black, with the stars shining brilliantly beside the clear-cut disk of the fiery white-glowing sun.

The pleasant soft quality of diffused daylight, then, comes from this very fact that the rays do not slant all in one direction from a single illuminating point only, but come, literally, from all directions equally—from every point in the whole sunlit dome of sky. Imitation of nature in this regard must, therefore, be a practical consideration in a scheme of artificial lighting. A considerable number of small lights, dispersed, as in a chandelier with many burners, gives a far pleasanter light than the same amount of illumination derived from a single intense point of luminosity. The extreme unpleasantness of the arc-light, as the detestable thing is used for street-lighting, is due to just this quality. In lesser degree, the same kind of unpleasantness is experienced where the illumination is from a single strong lamp only, instead of from a hanging lamp with three or four well-separated burners of less intensity.

Whatever be the light and howsoever many lights there be, further diffusion should be sought by broad-spreading white or white-lined shades. Not only do such shades capture and turn downward rays that otherwise would be lost upward, thereby increasing the illumination, but also they afford a comparatively wide surface of luminosity, thus making again for the quality of diffusion. On the same principle, furthermore, a lamp-burner giving a wide flame is better than one where the flame is narrow, and an electric bulb with opalescent glass is preferable to one where the glass is clear. The loss of light in such case is insignificant.

Another point of wise imitation of nature's beautiful light is to have the whole room fairly well illuminated, even if it be a study-chamber with a reader at a desk as sole occupant. In a previous paragraph it was shown that for such purpose as desk-work a single near-by lamp would give enough illumination, yielding as much light on the desk as would a sixteen-burner chandelier hanging some eight feet away. Here, however, is the place to point out the fact that while the near-by lamp lights the *desk* sufficiently, it does not light the *room*, whereas the sixteen-burner chandelier would light everything within an eight-foot radius as well as it would light the desk—would, in short, light with practical equability the whole of a large room. And the point obtains that it is distinctly trying to the eye to be in the midst of unequally-lit areas, as, for instance, where a reader looks up from his well-lit page to face corners fit for the abode of bats or owls.

Of course this does not mean a sixteen-burner chandelier as a practicality. Such a monster would be intolerable from heat and vitiation of the air, apart from all consideration of æsthetics, cost, and weight. What is meant is that, no matter what the special desk-light, also there should be a fairly high-set light to illumine the room generally, so that the eye may not suffer from distressing contrasts. The writer remembers well how, in younger days, not appreciating the point, he devised, for microscopical work in which he was then engaged, a brilliant disk of light to fall on the centre of the work-table where fine needles and knives were to play, the rest of the room being carelessly left wholly unlit. But after a very few evenings of work under such conditions eyes began to snap. Thereupon, realizing his mistake, the microscopist simply lit the gas, and that was the end of the pain.

Connected with the present subject is the matter of the **position** of the working light. Nature's vast lighted dome is, except early and late in the day, most luminous overhead, and accordingly, in imitation again, overhead should hang or stand man's miniature substitutes. Yet how often is this most simple and obvious item of propriety disregarded! Nothing is commoner than lights low down, where they shine directly into the eye, and, in desk equipment, set also in front, instead of to one side of the sitter, thereby delivering into the eye a very disagreeable and trying glare of reflection from the white paper of book or writing-pad.

The test of proper position for a working light is that the worker, on lifting eyes, but not head, should not be able to see the light itself. The light, then, should be either slightly behind and to the left, so that the beams come over the left shoulder, or slightly forward, still to the left, but now so high up that in the position of the head at work the brows screen the light from the eyes. The position slightly behind is the better, both intrinsically, and also because in such position the light can be closer to the worker and thus be made to give more illumination, as already explained.

In the matter of **steadiness**,, artificial illumination, for once, can equal nature's model. But again there is great difference among lights. Incandescent electric lights, the acetylene flame, and gas-lamps with enclosed incandescent mantles are absolutely steady; oil-lamps are fairly so, while the naked gas-flame and the candle are abominations of unsteadiness through flickering. Neither of the last-named lights is fit for working purposes.

Lastly, in the matter of **color**, artificial lights differ again. Taking sunlight as a standard of practical whiteness, the *arc-light* appears, by contrast, white, faintly tinged with violet; the *acetylene flame*, white tinged with yellow; the *Welsbach light*, greenish white; and all other lights —incandescent electric, illuminating-gas, oil, and candles—different grades of pronounced yellow.

The practical outcome of all this analysis is as follows: For the "dim religious" lighting of churches, Wagner operas, drawing-rooms, and other places where eyes are not called upon for critical work, it makes little difference what, how much or how little, be the illumination so long as the ever-important point be observed that the lights do not shine directly in the eyes. Why, in deliberate disregard of this point, the modern housekeeper puts candles on her dinner-table and short lamps on her parlor-stands is answerable only by the usual excuse of the slave to fashion, "Others do and so we must".

In a common sitting-room there should be a central pendant or chandelier, carrying either four electric bulbs, four oil-burners, three Welsbach lights, or, if acetylene-gas be installed as the house-illuminant, two or three such burners. If standing lamps only are available, the centre-table should have one very large and tall one, acetylene preferred, with wide-flaring shade, white-lined, and on the mantelpiece should be two other, smaller lamps with translucent white shades, or else a few candles, to give a certain amount of general illumination. In the "den" or study of a single desk-worker there should be a somewhat low pendant, carrying either three electric lights or oil-burners, or two Welsbach lights or two acetylene burners. Then the desk should so be set that the light streams over the left shoulder of the desk-occupant. If a standing lamp must be used, it should be one of fairly good size, with broad white-lined shade, and should stand (if necessary on a pile of books) so high that the flame is certainly not lower than the top of the sitter's head. It should be set to the left. Then, on mantelpiece or top of book-stand should be a candle or two or a small lamp with plain white shade for the defeat of dark corners.

Among portable lamps, the acetylene-lamp is easily king by reason of its combining great intensity, perfect steadiness and whiteness of flame, with a minimum of heating and vitiating of the air.

As to **the eye itself:** It may surprise many and perhaps shock a few to learn that, considered purely as an optical instrument, the human eye is a pretty poor affair—so poor, indeed, that were an optician to fill an order for spectacles with lenses as faulty as those of the eye, very quickly would he find his goods thrown out of window and himself shown out of doors! Fortunately, however, for suffering humanity, man can, in this case, himself correct the grosser errors of nature by a simple contrivance built out of two pieces of glass, two strips of tortoise-shell, and a metal spring.

Both the science of the oculist and the art of the optician have advanced by great strides of late years, as the multiplying number of glass-windowed faces to be met with on the street abundantly testifies. And for the feminine sufferer from ocular defect there is particularly joyful news—nose-clips now are wonderfully improved! No more, then, need the boon of glasses be refused because of the disfigurement of spectacles, for hardly does the nose exist that can utterly defy the art of the modern optician to fit an eyeglass, and a becoming one at that, as eyeglasses are.

Not only do proper glasses change poor to good sight, but also they cure painful vision, give back lost use of weak eyes, and put to flight the multifarious and distressing reflexes, ranging from sick-headaches to convulsions, that often accompany that common but subtle malady, unconscious eye-strain.

The normal eye, at rest, is adjusted for distant vision, and changes its focus for the viewing of near objects by the action of a little muscle in the eye itself. This muscle, in contracting, increases the curvature of a certain elastic lens, the *crystalline lens*, an all-important element of the lenticular system of the eye. This lens, semisolid in childhood, hardens progressively with the march of years. Accordingly a time is bound to come when, in the natural course of things, the little eye-muscle can no longer squeeze the lens to the proper curve for the reading of an ordinary printed page, held, as such page must be for the seeing of its size of type, some thirteen or fourteen inches from the eye. The condition so determined, one as natural as the coming of wrinkles or gray hairs, is called **presbyopia,** "old-sightedness", and is neutralized by the wearing of convex glasses for near vision, in substitution for the now impossible increase of convexity of the crystalline lens.

Eyes may be optically faulty in three ways, as follows: First, the eyeball may be too deep. Consequently the image of *distant* objects comes to sharp focus on a plane short of that of the retina. The image of *near* objects, however, falling, as it does, farther back, may lie just on the retina, the nearness for such sharp focus depending on the degree of the overdepth of the eye. An overdeep eye, therefore, may give good vision for objects within a certain range of distance, and, at the limit of such range, give sharp sight without the need of any focalizing effort. But for objects beyond the limit of distance, vision will necessarily be indistinct. This condition is **myopia,** "near-sightedness", and is corrected by concave glasses for distant vision, the concavity neutralizing what is, relatively, an overconvexity of the eye-system. The myope, since he sees near objects distinctly even with the eye at rest, does not need glasses for presbyopia as does one of normal eye Myopia may be acquired and progressive, and when of high degree may be accompanied with disease of the eye-structures, producing an impairment of vision beyond the benefit of glasses. Children should not be permitted to hold objects too near the eye, nor to read in dim or improperly adjusted light, for fear of superinducing the condition.

Secondly, the eye, instead of being too deep, may be too shallow. The image of distant objects now comes to focus behind the retina, and, of course, the image of near objects falls farther behind still. The consequence is a tendency to indistinct vision for all distances, worse for the near than for the far. The word "tendency" is used advisedly, for the over-shallow eye holds within itself a means more or less effective for counteracting the fault. By action of the focalizing muscle, the optical strength of the crystalline lens can be increased, thereby shortening the focal length of the eye-system, enough, it may be, to meet the requirement of the too shallow ball. Such muscular action, then, the victim of the defect in question instinctively puts into operation, and continuously, during waking hours. So long as the power of the muscle is able to meet the required unnatural strain, vision is good and the condition is unrecognized. But with increase of years there comes a time, sooner or later according to the degree of the fault, when the inevitable hardening of the crystalline lens is too much for the poor overtaxed muscle. The muscle either cannot effect the necessary adjustment, in which case vision is indistinct, especially for the near, or can do so only by painful effort, whence result pain either in the eyes, the brow, or the back of the head, or severe general headache, or various reflex disturbances, it may be of most incongruous character. Furthermore, the extra strain on the focalizing muscle puts an associated extra strain on the orbital muscle that turns the eye inward, thus tending to produce squint. The condition of an over-shallow eyeball is known as **hypermetropia,** or **hyperopia,** "oversightedness" or "far-sightedness". It is corrected, with heaven-descended relief from suffering and with restoration of lost use of the eyes, by convex glasses for far and near vision, both, in order to give to the eye-system the shortened focal length necessitated by the shallow ball.

Thirdly, the curvature of the *cornea*, or "sight" of the eye, may not be truly spherical, but, like that of an apple, be greater in one meridian than in that at right angles thereto. No eye is absolutely free from this defect, but ordinarily the fault is so slight as to be inappreciable except on critical examination. When considerable, however, it affects vision more or less seriously, lines lying in one direction appearing sharp, but those at right angles blurred. Thus in the case of a slatted fence, the slats may be seen distinctly, but the horizontal top and bottom strips indistinctly, or *vice versa*. This condition is **astigmatism,** and is corrected by glasses with cylindrical instead of spherical curvature, the set of the glasses being adjusted to the meridian direction of the fault. Astigmatism is of different kinds: one meridian may be normal while the other is myopic or hyperopic; or both may be abnormal, representing different grades of myopia or of hyperopia, or the one myopic while the other is hyperopic. According to conditions, correcting glasses may have to be of compound curvature, cylindrical on one surface and spherical on the other.

Besides these optical defects of the eye, there may be faulty action, absolute or relative, of the muscles of the orbit that move the eye in different directions. Certain conditions of such faulty action may be neutralized by *prismatic* glasses, while others may require the services of the surgeon.

Because of mixed difficulties, a subject may need one strength of glass for the near and another for the far. To dispense with the nuisance, in such case, of constantly shifting glasses, the versatile Benjamin Franklin, himself a victim of the need in question, devised the "bifocal" glass, wherein the upper portion of the lens suits for far vision and the lower for the near. The arrangement is natural, since the requirements for near vision are for reading or writing, in which case the eyes are directed downward. At the present day bifocal glasses are in four styles. The simplest and cheapest is the original Franklin style, where each glass consists of two half-segments of different focal length, set together in the frame, straight edge to straight edge. Such a glass is cheap and durable and permits of change of either segment to suit changes in the eye, but the scheme necessitates a frame and the lower segment is unnecessarily high and wide, thus encroaching on the field of vision that should belong to the upper one, where, alone, an extensive field is wanted. The next style is the commonest, where the extra power for near vision is obtained by a small accessory half-moon lens cemented to the lower aspect of the main glass. This arrangement permits of change of the accessory glass to meet changed ocular conditions, since the small "paster" is easily removed and another substituted. The objections to the style are that the double lens is somewhat unsightly, and that where no frame is used, as is now so largely the fashion, the cement is liable to become cloudy and to soften, producing blurring and possible moving or detachment of the paster.

In the third style of bifocal, the main lens is split into two thin slices, upon one of which, at the inner aspect, is hollowed a place for reception of the small accessory lens. Then the two slices, with the accessory lens sandwiched between them, are cemented together. The result is a beautiful glass, where the accessory lens is wholly invisible to the onlooker, and where, also, the line of demarcation between the two portions is imperceptible to the wearer—a great advantage. This style of glass, however, is expensive, does not permit of change of the accessory lens, and also is open to the intrinsic objection to all cemented glasses, if no frame be used, of "coming undone" or of blurring.

The fourth style of bifocal is the exclusive manufacture of a certain optician of New York. In this style the half-moon of curvature for near vision is ground directly on the face of the one glass. Instead, therefore, of a glass made of two or three pieces cemented together, the glass is a single, solid lens, carrying the two curvatures in different portions. The line of demarcation shows somewhat, but not nearly so much as in the case of pasters, and the glass is absolutely free from all the annoyances inherent in cemented glasses. Like the foregoing style, this glass is expensive and also permits of no change, but the comfort of it is as solid as is the glass itself.

Refractive errors are so common, so distressing when not corrected, and so easily neutralized by glasses, that the oculist (not the optician) should be consulted upon any sign whatever of either failing or painful vision. In the case of children, the eyes should be examined periodically by an expert, the same as the teeth. In many States such periodical examination is required by law in the case of pupils of the public schools. If a child present any symptom pointing to possible ocular defect, then most particularly should it be haled to the oculist at once, grandmothers and wiseacres to the contrary notwithstanding.

Suspicion of refractive trouble arises when the eyes are persistently red and watery; when the child contracts the brows on reading, or looks at the page aslant, or narrows the slit between the lids, or holds the book unduly near; when it complains of blurring or of pain in the eyes, the brow, or the back of the head, or of general headache, or even when it is stupid over its lessons and blunders at the blackboard. And suspicion may turn to conviction if the youngster begins to squint, be it never so little or momentarily only. Those who dearly love to give gratis advice on subjects they know nothing about will say that the child will grow out of the habit of squinting. It will not, but on the contrary will grow into it, worse and worse.

Adults should consult an oculist whenever experiencing any trouble whatever with the eyes, whether blurring of vision for the near, or indistinct vision for the far, or feeling of strain or actual pain on using the eyes, be the pain in the eyes, the brow, the top, or, as often is the case, the back of the head. Also, though they be not immediately referable to any use of the eyes, unaccountable nervous derangements, such as frequent and severe headaches with nausea, should excite suspicion of possible refractive trouble. Many an obscure case of nervous disorder that has for months or years resisted the potterings of the family physician has surrendered at once to a pair of spectacles.

The eye, besides being an optical instrument, is an organ of a living animal body, as much so as is the brain, of which it is simply an outlying conning-tower. As in the case of other organs, the condition of the eye is subject to the laws of physiology and pathology, and the condition as an organ is indissolubly linked with the condition as an optical instrument, and *vice versa*. The optician, educated to the mechanical art of grinding lenses, may know enough of optics to appreciate ocular errors of refraction *as* errors, but the physician and the physician alone can appreciate them as errors of an animate eye and not of an inanimate opera-glass.

In the matter of **care of the eyes,** the keynote is common sense. It ought to be the height of platitudinous impudence to mention that the eye is a delicate organ, a wondrous instrument and a priceless boon, but considering the outrageous abuse to which this same organ and instrument and boon is subjected, it would seem necessary to make the remark. There need to be mentioned but to be condemned such practices as reading lying supine, in which case, for an organ in active function, the blood is flowing the wrong way; reading in a vibrating carriage or car; reading through a veil or by an insufficient or fading light, or using the eyes critically in an atmosphere hot, foul, dusty, or smoke-laden, whether from chimney-flue or tobacco-pipe. Having eyes, it is well to keep them. An artificial *tooth* looks and works nearly as well as the original, but an artificial *eye* looks bad and sees, alas! not at all.

Great damage used to be done to the eyes of children in schools, but, with the advance of understanding in matters ocular, the evils formerly common are now rare in the better grades of schools, at least. The child should not sit directly facing the light, nor at a desk either too high or too low. The proper reading distance is fourteen inches for ordinary type, and desks should be adjusted to correspond. Of course this is troublesome with children of all sizes and all growing all the time, but trouble, like other intimates, should not be regarded. Because of the softness of the crystalline lens in childhood, the child can easily focalize upon objects quite close. Accordingly children tend to hold the book unduly near, or to double up over their writing, thus bringing the face within a few inches of the object viewed, The action is injurious, producing an improper squeezing of the eyeball that tends to develop near-sightedness. Whenever observed, the fault should carefully be corrected, the more since it leads to deformity of the spine as well as of the organs of vision.

The light of a schoolroom should always carefully be made sufficient and be properly placed, all according to the principles already set forth. The typography of text-books should be clear and black, on dull paper, and not be finer than what is known as "long-primer" ("or ten-point") type It should be leaded sufficiently to give at least one-tenth of an inch of clear space between adjacent lines. The size of page should not be larger than an octavo, in order to save the eye from strain in making too wide an excursion from side to side in reading. Watch should be kept for cases of inflamed or "sore" eyes, since ophthalmia and granular lids are contagious. Towels should not be used miscellaneously.

A healthy eye needs no **wash** other than the washing given to the face in ordinary routine. Let the sponge or cloth wash the *lids*, and the *lids* wash the *ball*. The tears, which naturally bathe the eye, contain salt, making them of a different specific gravity from water, so that water upon the eyeball acts as a foreign fluid. Accordingly the practice of plunging the face into a basin of water and opening the eyes therein is senseless. If the eyes be inflamed, they should simply be washed in the ordinary way with cool or lukewarm water, or with a saturated solution of boric (boracic) acid, filtered to remove undissolved particles of the substance. Boric acid is not a sour acid and dissolves but slightly in water, so that a saturated solution is not so formidable a thing as it sounds to be in the statement. The peculiar injection of the eyeball that occurs in *iritis* (inflammation of the iris) must not be mistaken for that of a common catarrh, or "cold" in the eye. Such injection makes a pale pink zone of fine texture close about the cornea, and is not accompanied by either swelling or secretion. It is important not to confound the two conditions, for the treatment in the respective cases is utterly different and an iritis is a serious matter, and, as it happens, one where *early* proper medical care is of vital importance.

Motes or **cinders** in the eye ordinarily are easily removed if taken in hand at once. If on moving the eyeball from side to side beneath the closed lid the point of scratchiness seems to go with the ball, the offending mote is probably stuck to the cornea; but if such point seems fixed, then, as is most commonly the case, the little particle is lodged upon the inner surface of the upper lid, more likely than not just under the edge where a shallow longitudinal groove makes a trap for intruders. If the mote be upon the cornea, the eye should be kept gently closed, without rubbing, until competent aid can be found for the picking off; but if beneath the lid, the subject can himself effect the removal in the majority of cases by the following simple procedure: Getting a hold with the thumb and forefinger upon the lashes of the upper lid, pull the lid slightly away from the ball, and then, drawing it downward over the edge of the lower lid, wipe it from side to side against the lower lashes. These lashes, moistened by the tears, operate as a soft, wet brush and generally remove the foreign particle at once, if the lodgment is quite recent. Later, the speck will become embedded and then will not come off so readily. In such case the lid must be everted and the intruder brought to light. Let the subject direct the eyes downward and resist an instinctive tendency to raise the brows. Then the operator, drawing upon the upper lid in the manner just described, turns it up over a match or toothpick set lightly against it about three-eighths of an inch above the free edge. Then with the corner of a clean handkerchief or the moistened bulb of the little finger he easily removes the foreign body. One accustomed to this little operation can evert by use of a finger-end instead of a match or toothpick as the fulcrum of leverage, but the method with the smaller object is easier and less likely to give pain.

CHAPTER VI

HEARING

And silence, like a poultice, comes
To heal the blows of sound
—O. W. HOLMES

THE hygiene of hearing is stated in a series of "don'ts".

First, don't hear! Don't hear any more din than is unavoidable! Din is wearing upon the nervous system, even when the nerves, through custom, are unconscious of the noise. Let there be a sudden transition from noise to silence, and there is felt a restfulness that by the very measure of its sweetness attests the strain from which pounded ear and brain were unconsciously suffering.

There is little doubt that city din is a powerful ally of city hurry and worry in making for nervous breakdown. And a masterly retreat from a foe that cannot be defeated in battle is ever good warfare. Accordingly it is wise to recognize city noise as a thing seriously to be shunned on occasion. In selecting an office, where there is an elevator to nullify altitude, one should be chosen on an upper floor rather than on a lower; home should be made on a quiet side street in preference to a thoroughfare, and, where choice is possible, a room in the rear of the house should be taken for bedchamber. Then, for the summer vacation, the big hotel with its hurly-burly that is but a translation of city noise itself should be passed by, and the precious weeks utilized to give ear a rest as well as brain in some quiet spot beside the "liquid lapse of murmuring streams".

Secondly, don't **poke** anything into the ear other than the cloth-armed end of the little finger! Hairpins are of innocent use *on* the head of woman, but *in* the head of man, woman, or child they make a dangerous dagger, even when stabbed blunt end foremost. And things called "ear-spoons", sometimes to be found in toilet-sets, never should extract anything more closely related to the human economy than stuck ends of broken corks in medicine-vials. In a healthy ear no more wax forms than is needed for nature's purpose. In natural course, the wax works to the fore gradually by itself, and comes away imperceptibly in superficial washing by a cloth over a finger-end. The deeper portion of the ear-canal takes care of itself; needs no washing and is better without.

If a plug of hardened wax have formed, it is to be removed by syringing and by no other means. A hard-rubber ear-syringe is to be used, such as can be bought at any drug-store. These syringes have a widening nozzle that guards against a possible too deep introduction. The injecting fluid is to be simply water of such warmth as is comfortable to the ear, which will be a temperature that feels warm to the finger without being hot. With the left hand the operator seizes the ear and draws it upward and backward, thereby straightening the canal. Then, directing the nozzle of the syringe along the rearward roof of the canal, he injects gently at first, but with gathering force, the subject holding a vessel to catch the return-flow. The injecting is to be continued patiently until the mass is dislodged. The procedure can be hastened by first instilling into the ear a few drops, warm, of a solution of peroxide of hydrogen—one part of the commercial article to three of warm water. Such an instillation will in a very few minutes soften the wax, which then will come away quickly, upon syringing. After the operation, the ear is to be wiped well, and the subject is to stay in a warm room until the deeper parts of the ear shall have dried.

If an **insect get into the ear,** don't be alarmed by the terrific buzzing and clawing, and don't try to dig out the intruder with a hairpin or other instrument. Simply smother him with a few drops of oil and then syringe out the harmless remains. If a child have pushed a bean or a pebble into the ear, yet again no poking; but if the foreign body be too large to be shaken out

—head tipped over and ear worked coffee-mill fashion—and jammed too tight for removal by syringing, take the little one to a surgeon, and still be not alarmed, nor imagine that there is any desperate haste in the matter.

In case of **earache,** don't drop sweet oil and laudanum into the ear, but understand that the trouble is generally an acute suppuration that will relieve itself only by a bursting of bonds, and for which the means of temporary alleviation is by heat, heat, and yet again heat. The upturned ear is to be filled with warm water, as hot as the ear will bear comfortably, and to be kept so filled by constant renewal, while a compress of hot flannels or a hot-water bottle covers the whole side of the head. Meantime, if the pain be intense, as often is the case in the nocturnal seizures of children, an aurist is to be summoned. For on the one hand the condition may be serious, and, on the other, relief may be had from a simple little surgical procedure.

Don't imagine danger from the curing of a **chronic discharge** from the ear. The notion of danger in such case is simply an ancient bugaboo, utterly baseless. It may be that the trouble is irremediable, but if indeed curable, cured it may be without harm, and cured it should be without delay.

Don't use **nasal douches** of any kind, except by order of a physician! The practice is liable to set up disease of the middle ear.

Don't **wear cotton** in the ear as a protective! Such measure simply makes the ear oversensitive and more likely to inflame than otherwise.

Don't **bore holes** through the lobes whereby to hang ornaments, like a sailor or a savage! The deed is barbarous and may demand retribution in the shape of blood-poisoning. Neither imagine that such boring will strengthen the eyes. It will no more affect the sense of sight than that of smell.

Don't **box** a child upon the ear! Or if, the deed done, the child scream with pain, don't in sudden repentance kiss the place to make it well! If the ear-drum happen to have been thinned by disease, either the boxing or the kissing may, by concussion, split it. And while rupture of the drum is not always the dreadful matter commonly supposed, it certainly is not a justifiable punishment for childish peccadilloes.

Don't **lift** a child by the ears! Dislocation of the neck may be the frightful consequence.

In case of **frost-bite,** don't apply heat, but cold! The principle of treating frost-bite in general is to restore the arrested circulation as gradually as possible. Quick thawing may kill the tissues. So, if frozen stiff, the part is first to be rubbed with snow and then dressed with iced-water compresses for ten minutes or so, and then with cooling lotions in a cool room. A frost-bitten part appears white, hard, and cold.

Lastly, don't **dive!** A cruel injunction, perhaps, for one may dive a thousand times without harm. But the thousand-and-first night may be one of screaming agony, and the thousand-and-second tale be poured into an ear that, alas! heareth not nor ever will again.

CHAPTER VII

CLOTHING

Nothing is thought rare which is not new, and follow'd: yet we know that what was worn some twenty years ago comes into grace again.—BEAUMONT AND FLETCHER

ONCE upon a time, many and many a century of centuries ago, a something simian, presumably tropical, shed his fur as being superfluous, and so foredoomed middle-clime man to the expenditure of much brain and pocket energy, both, in search for a suitable substitute.

Nature clothes animals with hair, a material that is simply filamentous skin, so similar is it in texture to the parent substance from which it grows. Since nature, with eons for experimenting, arrives always at a wonderful adaptation of means to ends, it is well to examine this unique product of hers, which is as suitable for the camel, loping over burning sands, as for the seal flopping among ice-floes.

Wool, as a type of fine, curly hair, fitted for the weaving of soft fabrics, is, like hair in general, *hygroscopic*, that is, it absorbs moisture greedily and exhales it slowly, only. At the same time, by reason of its stiffness, it holds moisture without collapsing. Consequently, woollen underwear, when damp from the moisture of the body, does not become sodden, nor does it chill from quick evaporation. Furthermore, it does not easily become offensive, but when dried and brushed after a wetting is quite in its original condition. Being naturally curly and stiffish, wool weaves easily into a porous fabric, which, by the fact of its loose texture, is especially warm for its weight. So it comes about that a thick woollen undergarment, in winter, is wonderfully warm, and, in summer, one thin and fine is deliciously cool, dry, and sweet.

These qualities make wool peculiarly fitted for underwear. The drawbacks are the cost and the tendency of all-wool goods to shrink on washing. So far as concerns the cost, it is to be remembered that an all-wool fabric will long outwear one of cotton or linen, so that although the initial cost is greater, the expense, in the long run, is not excessive. The shrinkage by washing can be nullified. First, the natural gray fabric is to be selected in preference to the bleached, in which case the shrinkage will be less; secondly, the garment is to be ordered a size too large, by which trick the shrinkage simply brings to proper fit; and, thirdly, the "lady" who so shrinkingly presides over tub and ironing-board is to be chosen with care, as one who will follow directions exactly and faithfully. When washed according to the directions that come with the goods—with ammonia-soap, lukewarm water, and no fierce scrubbing—all-wool garments, if made of material already shrunken, shrink but little in the washing.

There are flannels and flannels. There is the common red flannel of the stoker and the stevedore, which to offer for underwear to the sensitive skin of the well-to-do would be as ridiculous as impudent. But also there is the exquisite all-wool "stockinet", made expressly for underwear, whose soft and supple feel is to the skin as is the skin to the flesh beneath. Once habituated to this material, with an appreciation of its intrinsic merits, the wearer is little tempted to experiment with others.

Still not all cutaneous nerves are tuned to the same key, and there are many persons, especially among women, who cannot bear, or believe that they cannot bear, the feel of wool upon the skin. Such dainty skins need not worry; the matter is not serious. If the proof of the pudding be in the eating, the proof of the clothing lies in the wearing. It is perfectly possible to be healthy and long-lived in linen or in silk, and any one habituated to such material and well and comfortable in its enfolding has no call to change from considerations of theory. The one important point about underwear is that it should be *loose-meshed*, so as to be porous. That condition fulfilled, the material may vary according to taste and habit.

Many persons are repelled from the use of all-wool underwear from the scratchiness of the garment when first assumed. The milder degrees of scratchiness come from stiff hairs and disappear after one or two launderings. The severer grades are due to small fragments of burs which elude even the most thorough carding of the wool, and so remain in the fabric to torment the tender-skinned. It well repays the time and trouble, always, before donning a new article of woollen underwear, to bring to bear upon the garment the searching services of good daylight, a magnifying-glass, and a pair of tweezers.

One mistake in underclothing is common. A subject wears wool or merino by day, but at night changes into a robe of cotton and, in this chilly attire, creeps between yet chillier bed-sheets of linen. That means that just when the system is most relaxed it must brace its forces to withstand a change of raiment from the intrinsically warm to the inherently chilly! Many a case of nocturnal cold feet or of restlessness and wakefulness is due to nothing else than just this foolishness. Those who would know real comfort in sleeping will wear a woollen night-robe and a long one, capable of covering the feet when knees are bent, and also will make the bed, too, to wear wool, in the shape of sheets of such material, light and fine, but deliciously warm, or, if not that, at least a blanket under the sheet, between it and the ticking.

The nearer an article of clothing is to the skin and the snugger the fit, the greater the warmth-value, so to speak. A thick undershirt, a pair of knee-protectors, and a "sweater" under the coat are fully the equivalent in warmth of a thin undergarment and a massive overcoat of many times the weight. Theoretically, underwear of a single grade of thickness should be worn all the year round, the necessary seasonal variations in clothing being made wholly in the over-garments. Many persons follow this scheme, but the same necessitates heavy overclothes in winter whose weight and drag are oppressive. By warm underclothing, on the other hand, two advantages are gained. Indoors, the fire-fiend at the furnace-door can be required to repress his ardor, and, outdoors, weight can be made to give way to warmth, and the vast swathings of an "ulster" be exchanged for the hardly-to-be-felt supple clingings of a Cardigan jacket. The writer has tried faithfully the one-grade scheme, but now, for winter service, has returned with great satisfaction to a warm shirt and a cool room, a knit underjacket and no overcoat at all, so long as the thermometer kindly keeps above the ten mark on the Fahrenheit scale. Indoors, of course, a thin coat is to be worn. Then, for outing, the exchange to the thicker coat of the regular suit meets the requirement to be clad warmer for the street than for the fire-side.

The common instinct to wear dark clothing in winter and light-colored stuffs in summer is well founded. Dark surfaces absorb heat, white ones reflect it, so that the color of the clothing really makes a substantial difference in the resulting warmth or coolness, as the case may be. In the writer's younger days it was the style for men to dress, in summer, in suits of drilling, light gray or snow-white. O that the delightful fashion might return!

In general, the European dress is, for men, far heavier in proportion than it is for women. And the fact that women, in their much thinner raiment, are perfectly comfortable, shows to what degree thickness of clothing is a matter of habit. Manner of life and idiosyncrasy also bear on the case. A vigorous, hearty subject who takes much active exercise will defy cold in an attire that would mean misery and chills to a thin dyspeptic. The general tendency, for men, is toward too much clothing, with resulting predisposition to "colds". And among the many layers of masculine attire the linen shirt is an uncomfortable and superfluous absurdity. The nuisance can be shed by the following simple scheme, and Dame Fashion be none the wiser save in the matter of necktie: For winter wear, let the undershirt be cut high in the neck, with a band to carry the collar, and long in the sleeves, with band again to take cuffs. Then by day when a high-cut vest is worn with the business-suit, a scarf of that former style where the tie spreads over the whole of the triangular space exposed by the flare of the vest, and, by night, a dicky for evening-dress, perfectly keep the secret of the shirt. Thus a single and soft garment replaces the customary combination of merino undershirt and linen dress-shirt. For summer wear when the vest is laid aside, the equipment is a gossamer undershirt and an all-wool *neglígé* overshirt of exquisite texture. This combination affords a costume that, whether for office, veranda, tennis-court, or quarter-deck, cannot be criticised for appearance, and cannot be approached for comfort and cleanliness. These various garments, including the necessary scarfs of old style, are to be had of merchants who make a specialty of all-wool underwear.

Long trousers are even a worse abomination than the linen shirt. Having no support at the bottom, they make a dead drag from above that must be met, save in the case of the slender-waisted, by suspenders. And the suspender is an invention of the evil one, leading, as it does, to round shoulders and to shallow, diaphragmatic breathing, of which more anon, in the chapter on physical exercise. The true nether rig is, of course, the belted one of a bygone century—the knee-breeches of our great-grandfathers. Translated into knickerbockers, this comfortable and sensible dress is still permitted for summer outing, and even in winter is occasionally to be seen about the knees of certain *park-cranks*, whose gray hairs give privilege.

Two parts of the body take special clothing, the head and the feet. Nature clothes the head with a covering at once beautiful and sufficient, a covering so perfectly adapted to its purpose that it is an absurdity to overlay it with any device of man. That, for those who retain their hair, a hat is no more necessary than a nose-ring is proved by the case of women, whose hats are not hats at all, and of Indians and latter-day equestrians, who go bareheaded without complaint. But if the hat is to be, it should be soft. True that by inexorable decree the "stove-pipe" must accompany the frock suit, but except on the state occasions for which this ugly rig is ordained, why not the soft felt hat instead of the stiff? Such hat, though not ultra-fashionable, is always respectable, and is far more comfortable and far less likely to lead either to baldness or to merry races down the road of a windy day than is its hard, but no hardier, brother of Derby fame.

The importance of proper **footgear** hardly can be overestimated, for if the underpinning be faulty, of what good is the superstructure? How peculiarly exasperating is it, when perfectly healthy and full of business, to be laid off in a wheel-chair or doomed to stumble along on crutches because of some miserable affection of the foot! And more often than is commonly imagined, such troubles come from improper shoeing.

The normal foot is a beautiful example of engineering skill. Trussed exactly right for support on heel and ball, it is provided with five prehensile members to grip the earth and give spring in progression. Then upon this delicately balanced structure sits heavily the Fiat of Fashion, and in the stupidity of dense ignorance orders that the truss be tipped up from behind and the prehensile members bunched and bound from before. So the truss must be strained and perhaps broken down by its improper setting, and progression be changed from a spring by the natural grippers to a heave from the forward end of the strained truss itself.

But though in the past much damage and unspeakable discomfort have come from improper footgear, it is a satisfaction to note that the present tendency of awl and knife is toward shoes built on the lines of the human foot rather than on those of wooden monsters of misrepresentation of that structure. In the writer's boyhood, not only were there no rights and lefts to boots, but the suffering feet were obliged, in the wearing, to shift right to left and left to right on successive days, lest forsooth the symmetry of the beautiful piece of gear should come to be distorted into somewhat of the lopsidedness of the foot itself!

There are still, however, two common errors of pattern. Let any one whose foot has not been deformed by bad shoeing walk barefoot across the floor, observing the foot as he treads, and he will notice that the great toe, in gripping the ground, stands somewhat apart from its next neighbor, and makes of the inner edge of the foot a straight line from toe-tip to heel. Such line should, of course, be preserved in the shoe, but almost never is this is the case, the shoemaker contracting the forward end of the shoe somewhat on the inside as well as upon the outer aspect. The snug-fitting portion of the shoe should be that abaft the ball, so that the very snugness there will tend to spread the toes, which then should be given proper room for the spraddling.

The second fault is the old story of the heel. Nature, in her planting of the human foot, has made no mistake needing correction by man, and an artificial elevation of the heel is utterly without reason. The evil consequences of this act of violence—for it is nothing else—multiply in geometrical progression with each "lift" that the wicked shoemaker tacks on to the growing pile.

Overshoes, if really necessary, are a necessary evil. Donned to keep the feet dry, they often have the reverse effect, bathing the foot in moisture of its own making. And considering the excellent waterproof shoes now to be had, with or without insoles of felt and linings of woollen cloth, there is little need for overshoes except to cover the thin gear that must go with evening-dress.

"It is time to begin forming her figure", so, many years ago, the writer once overheard a dressmaker to say, in conscientious discharge of duty. And forthwith a blooming adolescent was called in from the tennis-field, a strait-jacket was produced, and a lissom form, free of motion and firm of poise, was made to enter upon a life-imprisonment that it might thereafter grow to be "formed" in deformity, with proper development arrested, movements hampered, and muscles wasted.

"It is time to begin forming his head", similarly might remark the Flat-head Indian father as he applies the cruel boards; and "It is time to begin forming her feet," might murmur the high-caste Chinese mother as the yet more cruel boot is fastened upon the foot of the long-to-be-suffering child.

Well is it for the present generation of women that in the pendulum-swing of fashion the wasp-waist is no longer "in style", so that the corset has ceased to be the instrument of torture of former days. But yet anything that restrains, in just so far as it does restrain, restrains also natural development; and anything that "supports", also, by the very measure of such doing, substitutes artifice for nature, to the waste of nature's means, ursurping for a strip of steel what could be done far better and with far truer grace by a strip of muscle. Modern woman needs to re-learn what was well known to her sister of ancient Greece, that beauty of figure comes from nature's development *of* the figure, with clothing following, not forcing, the curves.

If, nowadays, the corset of the grandmother has relaxed something of its cruel grip, what of the shoe of the granddaughter, with its pinched toe and its rampant heel? Let answer the gait—the hobble of a satyr replacing the glide of a nymph—now everywhere to be seen upon the street! Is the arbiter of fashion mad, to imagine beauty in distortion, grace in effort, or is it simply that fashion means novelty, and so, since nature is ever the same, even shape and carriage must be wrenched and twisted to meet the merciless call for change?

And if the granddaughter must be arraigned for follies of fashion, how is it with the grandson? With stiff hat killing the hair, with long trousers and lasso braces dragging down the shoulders and flattening the chest, how about the modern man?

O for the day when, following the hoop-skirt and the coat-of-mail, to the scrap-heap shall go corset and high heel, high hat and suspender, and the Venus of Milo and the Belvidere Apollo live again in the flesh!

Clothing should be for warmth and protection only. And the simpler the style the greater the comfort; the more natural the lines, the truer the grace.

CHAPTER VIII

BATHING

For cleanness of body was ever esteemed to proceed from a due reverence to God, to society, and to ourselves

—BACON

"AH, now, doctor, what are you about, ripping the clothes off my Johnnie, just as I'd got him sewed up for the winter!"

Yes, there be they that sew themselves up for the winter; others for the week, and others for the day only. And truth compels to say that health is not wholly denied to the dirty. The pig lives as well as the cat: the Eskimo, who never washes, seems as hale as the south-sea islander, who is eternally tubbing it in a veritable "life on the ocean wave".

Nevertheless the daily ablution is distinctly to be advised both for cleanliness' sake and for proper discipline of the skin, as set forth in a foregoing chapter. For such discipline cold water is peculiarly efficacious, again as already described, and also cold water will meet every need of washing, though hot water may remove the more epithelium. But the epithelium, or scarf-skin, must not be trimmed down too fine. Such trimming, like close cropping of the hair or biting of the nails, deprives the underlying parts of a natural protection. Incessant ablutions with very hot water make the skin unduly tender. The writer knew once of a case where an enthusiastic novice at the Russian bath got the soles of his feet so thin and sensitive that he could not walk, and actually had to go to bed till his skin should grow out again!

If the bath be taken hot, it should be hot enough to warm the bather all through, and should finish with a sudden, stingingly cold douche or shower, to bring proper reaction to the relaxed nerves and blood-vessels. Under such douche, the skin reddens with rush of blood, and a most exhilarating glow is felt. A good rub-down then completes the bath, and the bather issues forth with nerves fully braced.

The so-called Russian bath is after this same plan. The bather enters a chamber of hot air surcharged with vapor, and here he swelters till he can stand it no longer. Then he takes a delicious plunge into a tank of cold water, followed by a cold shower-bath, and comes out with skin cool on the outside but glowingly warm within. A vigorous rubbing and massage then conclude operations.

A Russian bath is wonderfully invigorating and exhilarating, but once a week is often enough for the indulgence,—the bath supplementing, not substituting, the daily morning tub—and the bather should not make the mistake of staying in too long. Many heat up and cool off a number of times in succession during the same bathing, but this is unnecessary for the purpose of the bath, and risks an undue strain upon heart and nerves. Subjects with weak heart or in delicate health from any cause should consult the family physician before indulging in this form of bath.

The so-called Turkish bath is the same as the Russian except that the air of the bath-chamber is dry. Being dry, it can be raised to a much higher temperature than can be endured with moist air, but in dry air the bather does not so quickly or so readily break out into the desired profuse perspiration. The temperature of a Turkish bath may reach 140° F. or even higher.

The sea-bath—most inspiring of all—is unique in that it combines bathing with vigorous exercise. For even the pitiable non-swimmer, gripping fast by the life-lines and staggering beneath the blows of the breakers, makes muscular play a plenty in the tussle with old Neptune. The danger, apart from that of drowning, through folly, is that in the fun of the thing the bath is unduly prolonged. Before one realizes it, the lips are blue, the teeth chatter, the skin becomes goose-fleshed, and the bather wakes too late to the fact that he is thoroughly chilled. Hence the rule for sea-bathing is:—Go in with a rush; stay in till warm; come out while still warm. To some, however, the initial feeling of cold never is succeeded, as should be the case, by a glow of warmth. Such unfortunates must respect their idiosyncrasy, while they are subjects for pity. Sea-bathing is not for them.

In the daily tub belongs **soap** along with the water. And the particular brand of soap makes very little difference, so long as it be a respectable member of the saponaceous fraternity. There is, in fact, nothing like the difference between soaps that vigorous exploitation of special examples would fain have the public to believe. A miserable cheap soap, strong of alkali and rank grease, is, of course, to be avoided, but an honest Castile soap, or any nice soap of the drug-stores, may be used indifferently. The wonderful virtue of this soap or that, because of some special trait of constitution or of medicinal impregnation, is simply gammon. The writer once met with an exquisitely dainty woman who habitually used no fewer than ten different kinds of soap upon different sections of her anatomy, because of special virtues of each, suited to the part. Upon expostulation she reduced the ten to six, but below that limit she could not lessen the differentiation and consider her sacred skin properly cleansed.

After the bath, stout subjects who are liable to chafe will derive great comfort from the use of a dusting powder, and of such powders those whose basis is talc are preferable to those made of some form of starch.

To prevent **chapping of the hands** the simplest device is, while the hands are still wet after a washing, to rub over them a few drops of pure glycerin, and then wipe very dry. Pure glycerin applied to the *dry* skin is too unctuous and is irritating, but when the hands are wet, the moisture present effects just the right degree of dilution. If a bottle of glycerin be kept on the washstand, and the procedure described practised regularly every time the hands are washed, in winter, the skin will quite surely keep supple and soft. If, however, the preventive fail, some toilet cream may be used. Such creams contain oils or gums, and are commonly effective and wholly harmless.

For painful **cracks of the finger-ends,** a good treatment is to fill the crack with burnt alum and then paint over with flexible collodion.

Beautifiers of the complexion are quite innocent so long as they contain no lead.

The toilet of the **hair and scalp** requires a special word. There is no reason why these parts should not receive soap-and-water attention along with the rest of the body, but ordinarily once a month, instead of once a day, is often enough for a shampoo unless the hair be so thin as to expose the scalp. If there is much dandruff, the shampooing may be more frequent—once a week or oftener. The fear that shampooing will unduly remove the natural oil of the hair is groundless. The invigorated scalp speedily renews the supply. Daily cleansing and stimulation of the hair is effected by dry brushing, which should be vigorous. Though brushing brings out loose hairs, there is no cause for alarm. The hair-follicle does not die because the hair is pulled out, but immediately grows a successor, very likely more vigorous than the one lost.

If senile baldness begin to appear, whether at the proper age or prematurely,—alas! The causes of baldness are probably complex, and the tendency among hat-wearing men to lose the top hair has now come down through so many generations that heredity doubtless is a genuine factor in causation. In prevention nothing more can be done than to wear soft hats only, to stimulate hair and scalp by massage, thorough brushing, and shampooing. Hair-tonics, like liniments, serve far more by virtue of the "elbow-grease" of their application than through any medicinal action of their often ridiculous ingredients. One common practice is to be avoided, the wetting of the hair-brush to make the hair lie smooth. Such wetting tends to rot the hairs as it does the bristles of the brush. The wetting by shampooing is different. In such case hair and scalp are, or should be, wiped dry after the operation. Cutting the hair and shaving have no effect toward making the hair grow, and singeing the ends of the hairs to hold in the oil is nonsense. The hair is not a tube, as many suppose, but a solid structure. A form of baldness accompanied by much dandruff, with heat and itching of the scalp, is a disease, and requires medical treatment, although such treatment as is practicable does not promise for much.

The unnatural and uglifying procedure of **bleaching** or of **dyeing** the hair may bring a not wholly unmerited retribution. Peroxide of hydrogen, the agent used for producing champagne-colored hair, removes the natural oil of the hair along with the pigment, thus making what should be glossy locks appear dry, lustreless, and dead. Hair-dyes containing lead may develop lead-poisoning, and those containing salts of other metals may stain variously. The most noxious of hair-dyes are those containing *pyrogallic acid* and the *chloride of paraphenylenediamine*, which may produce inflammatory affections of the skin as terrifying in appearance as their own names.

Nature commonly makes the color of the hair to conform, æsthetically, with the complexion, and the silver threads that honor the silver-wedding day unbecome no one.

CHAPTER IX

DISPOSING OF WASTE

All things must come to the earth by and by
Out of which all things grow
—OWEN MEREDITH

A TREE, a squirrel, and a nut: the nut goes down the squirrel and the squirrel goes up the tree. The *shell* is simply dropped: it goeth where it listeth, and the squirrel recketh not.

A finger-bowl, a man, and an orange: the orange goes into the man and the man's fingers go into the bowl. Then the bowl goes to the sink, and the sink goes to the soil-pipe; the soil-pipe goes to the drain, and the drain goes to the sewer; the sewer goes down the street and whithersoever, beyond, the city-fathers have ordained. Also the peel goes to a plate, and the plate goes to a pan; the pan goes to a can and the can goes to a cart; the cart goes to the corner, and whithersoever, beyond, again, the municipal authorities direct.

The wild animal, whose home is the whole range of the forest, disposes of his waste by dropping it to earth and moving himself off. Man, similarly, must return his waste to nature for final disposal, but, since his domicile is fixed, must move the *waste* off, and not *himself*, and this item, simple in theory, has, for its provision in practice, taxed human ingenuity to the utmost.

Life has been on earth for untold centuries, but throughout the whole duration of this vast eon nature has been disposing of waste—of dead bodies and outcastings from the animal kingdom, and of dead leaves, withered stalks, and fallen trunks from the vegetable kingdom. The amount of matter thus handled yearly is incalculable; that during the centuries since life began, inconceivable. Yet is the lap of nature—the surface of forest, plain, and stream—as sweet and beautiful to-day as in the year when first grass grew and insects crawled.

The scheme of nature for this stupendous and never-ending task is simple; the waste of living things is mostly organic substance; such substance, then, is to be disorganized and returned to its primary mineral or gaseous condition. Then the inorganic products so resulting are to be reabsorbed by plant-life, and by the mysterious potency of vegetable protoplasm are to be rehabilitated into organic substance. And by this eternal cycle of integration and disintegration of its substance, life is possible upon earth so long as sunlight shall endure.

Now, this wonderful operation of nature that so busily but so silently goes on about us forever at every hand, how is it accomplished? At a dance-party, the daughters of the gracious hostess constitute a floor-committee, of watchful eye, to forestall all fading of "wall-flowers" by introducing hovering bees in black and white. So also nature: in the surface layer of soil, where entangled oxygen from the atmosphere is abundant, the silent dame marshals her floor-committee—a countless host, whose function it is to introduce to every waiting molecule of dead organic matter a molecule or group of molecules of some special element, for future partner, that the eternal dance of decomposition may merrily go on.

A countless host, indeed, this floor-committee of nature, for its members are numbered by the million, billion, trillion, or "any old" number that defeated imagination may put forward at a guess. And the members, what are they—ants? If size be a matter of pride, then proud indeed would be such an individual to be thought an ant, for to such a one an ant is as is behemoth to the ant! No, this floor-committee is made up of beings far too small to be kenned by the unaided eye of man. These beings are not ants, but *microbes—bacteria*, those strange, ever-busy, most minute of organisms with which the invisible world teems in countless swarms.

This statement of a microbe doing an office friendly to life may startle some readers, with whom a bacterium is a thing of bad reputation.

In the minds of many the only idea of a bacterium is that of a "germ" that produces dreadful disease—a thing to be disinfected on sight. Such an idea is hopelessly narrow. The case is exactly like that of a civilized community. The enormous majority of the members are law-abiding, good citizens, busy at a life-work that redounds to the good of the community: an insignificant minority, only, constitute a criminal class whose desert is indeed prison or death. The law-abiding bacterium is an all-important agent of nature in determining chemical activity on earth. Without bacteria there would be no life; without bacteria the very bread and butter of this morning's breakfast would not digest!

Nature, then, disposes of waste by chemical conversion on or near the surface of the earth, through the agency of the bacterial swarms there present. If the waste is in particles exposed freely to air, certain bacteria which, like mammalian animals, require oxygen for their thriving, attack it and decompose it to simple mineral compounds. If, on the other hand, oxygen be deficient, as where the waste is in mass and buried away from free circulation of air, then the conditions favor the propagation of another and different class of nature's invisible scavengers, a class that loves not oxygen and even is poisoned thereby. The hosts of this class constitute nature's *pit*-committee, as contradistinguished from the *floor*-committee, and might not inaptly be styled "The Noisome Sons of Suffocation," since their attack upon organic matter yields not the simple products forged by the "Sons of Air," but a complex series of offensive and poisonous intermediary compounds. These "Sons of Suffocation," in short, determine *putrefaction*.

Just as low characters love bad company, so, as hangers-on to the sons of suffocation, will be found, ever, the criminally disposed in the community of Microbia. For the bacterial germs of disease are also of the kind that thrive in the absence of free oxygen. Accordingly the conditions that favor *putrefaction* favor also the breeding and dissemination of *typhoid fever*, *diphtheria*, *et id omne genus*.

These facts give the key to the proper disposal of his waste by man. Such waste is *not* to be accumulated in vaults, there to putrefy and breed foulness and disease, but to be delivered *immediately*, while *still inoffensive*, to the laboratory-works of nature upon the very surface of natural soil. In this statement the words "still inoffensive" are used advisedly, for, though it may surprise to read, it is a fact that the fresh effluent of a house-drain is in no wise offensive. Basins, sinks, and tubs give only water, and water in such quantity that the solid matter of the sewage is only as one to five hundred of the fluid. Moreover, such solid matter, under the influence of abundant water, speedily loses its characteristics: offers no odor, and, breaking down, becomes wholly unrecognizable. If the lid be raised from the "flush-tank" (of which more anon) of the sewerage system of a country establishment, there will be seen only dirty water—nothing worse than a milky fluid having a faint odor, as of laundry-water. If, then, this wholly inoffensive effluent of the house-drain be delivered upon the surface of the soil before putrefaction begins, and if the delivery be so adjusted that full time shall be allowed for the forces of nature to dispose of one quantum before the next arrives, then, by order of Dame Nature, without further to do by man, and without any fussing whatever with chemicals, disposal will take place, *tuto*, *cito*, *et jucunde*, and the sewage will disappear, as such, as completely as by fire. The water sinks away into the earth, purified in the passage, and the solid particles of organic matter, deposited upon the soil, are instantly set upon by the ever-ready surface bacteria, with the result of speedy conversion into so much phosphates, nitrates, sulphates, carbon dioxide, and water—material ready for appropriation by plant-life.

So thorough is the natural disposal of waste that, with proper intermissions in the delivery, to allow time for nature's operations, a given area of ground can be used indefinitely for disposal purposes, just as, on the large scale, nature, herself, uses the general surface of the earth. Moreover, field-areas thus put to the receiving of waste are thereby fertilized and can be cultivated with profit.

The disposing of waste by immediate, intermittent delivery upon the surface of soil is preeminently the system for the country establishment, but also is applicable to the waste of large cities. The city of Berlin, with its nearly two million inhabitants, disposes of its sewage in just this manner. Cities by the sea, such as New York, adopt the cheaper method of discharging by sewers directly into tide-water, and cities by large rivers very commonly discharge into the river. In such case, very much as by the action of soil, the sewage comes to disappear by disintegration and oxidation in the water. Accordingly rivers of the size of the Ohio or the Hudson will so dispose of the sewage of a large city, such as Albany, that the down-stream water a few miles below will be as sweet and potable as that upstream. Unfortunately, however, one possible constituent of sewage escapes this otherwise nearly complete purification, and that constituent, too, the very one most dangerous to human life, namely, the living "germs" of infectious disease. These pestiferous mischief-makers will carry their mischievous potency through miles of running water, far beyond the point where has disappeared utterly all other organic companionship. By reason of the menace to health thus resulting, the discharge of sewage into rivers is certainly not commendable, and the discharge, by country establishments, village or individual, into *small streams* is not only not commendable, but most emphatically condemnable

A practical system for the disposing of waste consists of two parts: first, the scheme for getting the waste out of the house (house-drainage); and secondly, that for carrying it to the place of delivery to the hands of nature (sewerage). In a country establishment, the householder is in charge of the system " from start to finish ", but in the city he is responsible only for the house-drainage. In a city establishment, when the effluent turns the corner into the public sewer, it passes from the jurisdiction of the householder into that of the municipality.

First, then, as to the item that concerns city and country householder alike, namely, the system for house-drainage:

A gala day, as the writer remembers it, was that one in the early forties when New York, with blare of trumpet and flutter of flag, made herself proud over the freedom of faucet and bowl, as the fair Croton made its first rush through eager pipes. But the child that on that day dabbled and splashed for joy in the newly-installed bathtub, little dreamed he that within the generation it would be his stern duty to stand by and order every inch of that pretty plumbing, from topmost tap to sewer-connection, ripped out and cast away as a very abomination of insanitation! For there, in fell potentiality, was the ventless waste-pipe, to be sucked dry of its water-seal by siphonage: the pan-closet, with its mid "chamber of horrors"; the blind, unventilated soil-pipe of lead, to be eaten through from within by corrosion and from without by rats; and the loose-jointed and buried drain, to sag, break, and leak all unseen and unknown, thus discharging much of its contents into the subsoil of the house, instead of into the sewer.

Since the days when such stupidities were installed, mighty have been the strides of sanitary engineering, until, at the present day, the bathroom is the very pride of the house, the purest and sweetest chamber beneath the roof!

The system for the drainage of a modern house is as follows: The backbone of the system is a tight-jointed iron pipe reaching from two feet above the roof straight down through the house to the cellar, and thence, by an incline forward, out to the sewer in the street. This is the pipe that carries off all waste from basins, bowls, sinks, and tubs within the house. The vertical portion constitutes the "soil-pipe"; the horizontal portion, the "house-drain". The soil-pipe part is commonly four inches in diameter and is open at the free end above the roof, the opening being grated and protected from the weather by a return-bend or a cowl. The house-drain portion is *not* embedded in the cellar-floor, but is above-ground till it reaches the street, running along the house-wall, fully exposed for inspection and repairs. It trends forward on a down grade of at least half an inch to the foot. Under the front pavement the drain makes a short, sloping dip down and up on a curve of easy lines, thus forming a "trap". This running trap is always full of fluid and so interposes a water-seal to keep out air from the sewer. In order to ventilate the piping an air-shaft reaches from the drain, on the house-side of the trap just mentioned, to the outer air, the opening being most conveniently placed at the curbstone, where it is protected by a grating. By this arrangement, the drainage system is freely open at both ends to the air, from curbstone to roof, while access of sewer-air is cut off by the running trap. Since the air of the house itself is commonly warmer than that of the street, the draught is upward, fresh air coming in at the curb and passing out at the roof.

Just as sewer-air is cut off from the soil-pipe by the main trap in the house-drain, so soil-pipe air is cut off from basin and sink within the house by a trap of similar principle in the local waste-pipe of *each fixture*. Then to complete the protection, each local waste-pipe has an air-vent in the shape of a pipe reaching upward from the distal arm of the local trap and opening into the soil-pipe above the point of delivery of the uppermost waste-pipe of the house. This air-vent saves the local trap from siphonage when, by the down-rush of a discharge from above through the soil-pipe, there is an air-pull upon all lower openings into the soil-pipe as the piston-like six-gallon discharge goes by. The air-pull now simply pulls down air from above through the back air-vent, instead of pulling out the water from the trap, as would be the case if there were no such saving air-communication.

Lastly, the rain-leaders lead straight down to the cellar, either within or without the house, as the case may be, and deliver into the house-drain with an interposing running trap.

In some cities, and very commonly abroad, the running trap between the house-drain and the sewer is omitted together with the curb-stone air-shaft. In such case the sewer ventilates itself through every house soil-pipe. The argument for this arrangement is that the safest defense from foul sewer-air is not to have the sewer-air foul, and it is contended that by free ventilation through plenty of perforated manholes, on the one side, and each house-top, on the other, the air in both sewer and house-drain is nearly as pure as the air of the street itself. Of course, in any such scheme every house must depend for its safety on the reliability of its own plumbing, both as to design and condition.

Plumbing is tested by volatile oil of peppermint or by smoke. A little of either agent is introduced, with proper precautions, into the piping, and by its oozing at any point, as made manifest by sight or odor, discloses the fact of a leak.

In a house with modern plumbing, proved by peppermint to be in good order, there is no danger from sewer-air, and consequently no objection at all to plumbing-fixtures in chambers. But such fixtures should be open, that is, with all pipes freely exposed. There should be no encasing woodwork to harbor horrors and invite vermin to become fellow lodgers. In the bath-room, the bath-tub should be of glass or porcelain, standing free on its own squat legs, like a headless hippopotamus, and exposed on all sides. Floor and wainscot should be of material that can be washed, such as marble or tiling, and, though it has nothing to do with the plumbing, a small chimney-flue opening into a little fire-place beneath the window, wherein is set a cosy little gas-log, will afford inexpressible comfort. For shrinking skins, such a warm friend close at hand robs the shower-bath of half of its cold-shoulder unkindness.

In a country establishment which must dispose of its sewage, and which does so by direct delivery upon the surface of soil, it is advisable to exclude storm-water from the drains in order that the effluent may be always a fairly constant quantity. Accordingly, in such an establishment, the rain-water leaders do not deliver into the house-drain, as they do in a city house, but independently, at any convenient place, on the ground itself. The effluent is nothing but the purest of water, so that it is unobjectionable save for its wetness. Also, since the house-drain delivers by an open mouth into a tank (of which more anon), such drain does not need the running trap and air-vent present in the city plant. With these modifications the scheme for house-drainage in a country house is the same as that for a city residence.

And now for that all-important concern of a country householder, the system for the sewerage:

The *principle* is, of course, that already elucidated, namely, the delivery of the drain-effluent in intermittent, strong gushes, directly upon the surface of soil. The *scheme* is simplicity itself. A field is selected for the disposal-area, convenient to the house and not necessarily far removed therefrom. The field must be on a gentle slope trending down from the direction of the house. Then, coursing from house to field, the house-drain leads to a tank into which it pours its contents from above, and through a basket-screen; the tank discharges through a pipe into a triple set of branching outlets, and the outlets deliver by open mouths directly upon the surface of the disposal-area. A fan-shaped apron of tiles beneath each mouth insures even distribution of the effluent.

"The house-drain leads to a tank"; why this complication? Why not continue the drain, as a sewer, directly down to the point of divergence of the branching outlets? The question is apt, but the answer is sufficient: the tank is the *heart* of the system, without whose rhythmic throb the system, *as* a system, would languish and die!

Mention has several times been made of the need of an *intermittent* delivery of the sewage, in order to give *time* for the forces of nature to dispose of a given discharge. A constant dribble, or, worse yet, a constant flood, always in the same place, would soon saturate the soil, overwhelm kind nature's floor-committee, and, undergoing putrefaction, would carry into the ground and to the watercourses beneath, polluting foulness. Accordingly the tank is installed, whose function it is to establish exactly the intermittency of sewage-flow indispensable for the working of the system. And this the tank does, automatically and unfailingly, by a simple application of the principle of the *siphon*. The tank, instead of delivering into its discharge-pipe by a straightaway connection, does so through a siphon-arm. The consequence is that there is no discharge at all from the tank until the contained fluid rises to the level of the bend of the siphon; but, the moment that level is reached, with a rush the entire contents of the reservoir pass out in a strong flood.

The tank is planned of such size, according to circumstances, that it will fill and discharge once daily: then, by means of a gate where the discharge-pipe branches, one set of outlets, only, is in use at any one time. Accordingly, by a double means, abundant time is afforded for each given section of disposal-ground to do the disposing assigned to it.

The disposal-field is perfectly sweet. The basket-screen through which the house-drain pours its effluent into the tank catches all extraneous matter, such as bits of paper or of rag, and operates to comminute sewage masses, so that what the tank has to discharge is simply a milky fluid with more or less of fine particles of solids in suspension. The outlets of the discharge-pipes emit no odor. Except when comes the gush of a discharge, one may walk dry-shod within a few inches of the open mouths and not even know of their existence. An area of one-tenth of an acre will serve for a household of twelve persons, and may be kept in use for its purpose indefinitely. The more the use, the more abundant the development of bacteria, and so the better equipped becomes the soil for its disposal-function. The field may wave with corn or wheat: the sewage is converted into salts, the salts into corn, and the corn into man, thus exemplifying the never-ending cycle of life. The system is available for any climate where man builds permanent domiciles, operating perfectly well even through the severe frosts of a Canadian winter.

This system for the disposal of sewage is what is known as the **surface-irrigation** system. Under certain conditions of soil and topography a modification of the scheme is advisable, so that the delivery is not by open-mouthed outlets on a slope, but by open-jointed tiles laid underneath, but near to the surface of the ground. In this case the delivery plant is entirely concealed, and the disposal field may be in near proximity to the house and in full view, all without the least danger of offense. This **sub-surface** irrigation system, as it is called, entails some modifications in the sewerage plant, notably the requirement of a "settling-tank" antecedent to the flush-tank; but these modifications of detail do not affect the principle, which is the same for this system as for that already described.

No other scheme for the disposal of sewage can compare with these methods by surface or subsurface irrigation, respectively. These irrigation-schemes leave nothing to be desired; one or other is possible in any locality or soil; neither gives offense in any part or at any time, nor does season or weather in any way affect the working. The construction is the acme of simplicity, so that there is nothing to get out of order. The development of these systems to their present perfection of detail is largely due to the genius of the late Col. Waring, the eminent New York civil engineer, and the systems, as described, are commonly known as the "Waring" systems.

"If the hill will not go to Mahomet, Mahomet will go to the hill." If the sewage cannot be put upon the soil, the soil must be put upon the sewage. And that is to say that, in country houses not provided with running water to serve as carrier for sewage, the decomposing action of soil upon human outcastings still may be secured by installation of the **earth-closet** for its special function. The regular earth-commode is best, whereby the delivery of the earth is done automatically; but in the absence of the special device efficient service can be got by a pile of dry earth, a shovel, a coal-hod, and a cart. The earth for use in the earth-commode must be *dry*. The action is the same as that in surface-irrigation. The earth, after use, if kept dry and freely exposed to the air, decomposes the contained sewage completely, so that after some weeks such earth is nothing *but* earth again, and may be used anew in the commode. Care and attention are necessary to keep an earth-closet plant in good order, and the rule must be absolute that the closet is to be used for none other than its proper purpose—is never to be made a dumping-place for slops of any kind. At best, the earth-closet is but a poor substitute for a water-carriage system, but it is the *only* substitute that should be allowed.

What may be called the Cesspool-and-Company system for the disposal of waste is to be mentioned only to record the fact that it has been tried and found worse than wanting: has been convicted, indeed, of murder in the first degree, and, failing a recommendation to mercy, has duly been sentenced to the extremity of the law. May execution not be delayed! The organic world casts its effete material, always, upon the *surface* of the ground: at the *surface*, therefore, accommodating nature sets her laboratory for the disposal of waste. Yet in the face of this plainest of "pointers", behold stupid man digging a deep pit in which to *accumulate* his waste, and carefully to *hoard* it, close to himself and to his water-supply! So held, the stuff is subject to each and every of the conditions most conducive to the full development of its worst and most offensive possibilities. Indeed, if one should set out deliberately to plan the annoyance, sickening, and death of an enemy by turning upon him the bale of his own outcastings, such plotter could do no better than to copy what the writer has seen with his own eyes, and within the year, in country districts not fifty miles from the border-line of the great and enlightened city of New York itself.

In a deep pit for the holding of waste is present that combination of conditions that especially makes for noisomeness, namely, *wet accumulation away from air.* The contents of the pit, then, are foredoomed to putrefaction and to the fostering of any disease-germs that may happen to be present. If the bottom of the pit be simply the soil in which the pit is dug (" leaching " cesspool or vault), the products of putrefaction sink into the earth, to pollute or infect the first underground watercourse they may chance to meet. If the pit be tight, as by cementing, then comes the horror of the cleaning out, prefaced, very likely, by the antecedent horror of an overflow!—But, enough: let the veil be drawn while a prayer goes up for advent of the day when *to deposit organic matter in a pit* shall be an offense indictable under the law!

In this connection a word will not be amiss as to **the function of the bowels.** If there be sluggishness there, then in the human body itself is exemplified the very condition of accumulation just arraigned, and the febrile derangements from self-infection in such cases attest well the poisonous nature of the products evolved. The bowel-function should receive attention daily, and regularly at a stated hour, most naturally after breakfast. Regularity is all-important, and easily can be acquired by systematic essay at the appointed time. In case of sluggishness, medicine should be avoided as much as possible. Laxative foods, such as fruits and the coarser cereals, a glass of water on rising, active exercise and abdominal massage are all effective aids to the function. Among foods, prunes are specially serviceable. If medicine be required, as often is the case in the sluggishness of the aged, common and cheap Epsom salt will serve quite as well as an expensive, imported aperient water from over the sea. From a saltspoonful to a teaspoonful of the salt, according to case, may be dissolved in half a tumblerful of hot water, and the draught taken immediately on rising. So administered upon an empty stomach, a little goes a great way, and a natural effect is due shortly after breakfast. Taken hot, the draught has no taste whatsoever and is not likely to disorder the stomach. The medicine does not lose its influence by habitual use. An **injection** is proper for occasion only. Frequent resort to the procedure all too easily establishes an intolerable slavery.

Garbage is either to be delivered for removal to a cart, or else cremated upon the premises. If to be removed, it should be deposited in a tight can with a lid, and the lid should be kept in place. On no account is garbage to be mixed with the house-ashes. The ashes go for the filling-in of lands and, of course, should be kept undefiled. If the family is small, so that the amount of garbage is within the range *of* the range, the stuff may easily be incinerated in that domestic crematory as fast as it accrues. An attachment to a kitchen-range for just such purpose has been invented.

Ashes, being inorganic and inoffensive, may be accumulated in open receptacles, and delivered for removal, or, in a country establishment, may be used about the premises for any appropriate purpose. Sprinkling the ashes before dumping will tend to allay the nuisance of dust in the handling.

In the way of fate, **Azriel summons,** and son or father, mother or wife is called upon to dispose of the remains of a loved one gone. Here, for once, the scheme of nature may not be copied: what life has left may not itself be left on the hillside to be the prey of scavengers of the wilds or of the soil. But if civilization forbids nature's way of disposing of the dead, no less must Hygieia's voice be raised against civilization's own favorite method, that by earth-burial.

Stated as a hard material fact—the only aspect of the matter with which hygiene is concerned—interment of the dead is another case of *the deposit of organic matter in a pit*, there to be the subject of underground putrefaction, with all its attendant dangers. Modern efforts to defeat the forces of the soil do not defeat but only hold in check for awhile, so that a "city of the dead", even as peopled in this latter day, is ever a silent menace to the contiguous city of the living. The danger, of course, can be minimized by proper selection of the site of the one city with reference to that of the other, and by proper administration, but it is impossible to foresee the future development of living communities; and to disturb, by relocation, the peace of a city of the dead is as shocking to sanitation as to sentiment.

In view of these facts, a substitute for the interment of human remains that shall be free from the objections intrinsic to the procedure, is distinctly a desideratum of hygiene. And hygiene has not far to look, for right at hand is a process for the disposal of the dead, as old as history, and one that, as practised with modern appliances, is at once absolutely sanitary, absolutely effective, convenient, and of unlimited practicability.

Organic matter in mass is to be reduced to the inorganic condition. Two agencies will do the work: the one will take months and years, the other minutes. The one will work in a roundabout way, through a process yielding, in mid-stage, offensive and poisonous products; the other in a manner direct and, as practically applied, innoxious. The one will require for its laboratory a considerable and ever-widening area of ground, the other nothing but a moderate-sized building. *Both will effect precisely the same ultimate result*—the disorganization of organic matter, and its retroversion into simple and stable inorganic compounds. The agent whose method is slow, clumsy, roundabout, offensive, and noxious is *the bacterium;* the one whose way is direct, swift, sweet, and innocent of bale is that which a beautiful mythology represents to have been stolen from heaven for the benefit of man on earth.

As administered by modern institutions for the purpose, the gift of Prometheus is made to return to nature that which is her own, after a manner that should not shock even the most tender sensibilities. Quite to the contrary, indeed, the every suggestion here is of purity and light, as opposed to the reverse association inseparable from the thought of interment. In the symbolic drapery of a robe the sacred burden is borne to a shining door; then what is of ether goes to join its fellows among the glad winds of heaven, while what is of earth waits to sleep upon the open lap of the common mother of all.

"Dust to dust", in verity, not in mockery, and at some sweet spot loved of the loved one, where waving grass and spreading shade soothe to peace, is reverently strewn what may not pass into the sunshine above. And when, in the fecundity of earth, is born at that spot a flower, how sweet the thought that in the perfumed petals lives anew something of what was mortal in the life that has gone before!

CHAPTER X

DISINFECTING

The glorious sun
Stays in his course and plays the alchemist
—SHAKESPEARE

IF the body is to be kept clean, so also is the house, and ordinarily the means is the same in either case—bodily removal of the dirt. But in the case of the domicile there are occasions when noxious matter is either elusive, inaccessible, or not immediately removable. In such case, then, it is proper, but wholly as a makeshift, to attack the enemy *in situ*, by chemical means.

If a vigilance committee is out against an illicit distillery, there are three things possible to do. As the most effective procedure, the "moonshiners" may be killed! Or, their lives spared, they may be tied hand and foot so that they cannot ply their trade, or they may be allowed full liberty to work, but the product of their labors be destroyed as fast as manufactured. Now noxious matter, like liquor, is made by the agency of living things, and, according to circumstances, it is possible either to destroy the life that is making the mischief, or to stop the mischief-making though the makers' lives be spared, or to change the mischief made into a something no longer mischievous. Incidentally, in the latter case, if the mischief be malodorous, the bad smell disappears in the metamorphosing.

Here are distinct and dissimilar operations; why should they be identically styled? But such is the case, and whether the deed be wrought on the mischief-maker or on the mischief made, the operation is equally called *disinfection*, a name that may not even fit the case at all!

"Disinfection" is properly the abolishing, in infectious material, of its power to infect. But it may be that in the matter to be disinfected there is no infection at all, but only aggregated nastiness. However, there is no use quarreling with names, and the terms disinfection and disinfectants have come to stay. It is only important to understand that disinfection may mean entirely different operations, according to conditions, and that disinfectants, in different cases, may work to the same end in entirely different ways. By the same token, there is no one best or most powerful disinfectant. Conditions calling for disinfection are so dissimilar that an agent applicable to one case may be wholly inappropriate for another.

Broadly stated, these same conditions fall into two categories: first, the presence, or suspected presence, of a mischief-maker; and, secondly, the presence, whether or not obvious to the senses, of a mischief made. Often enough the two conditions exist together. The mischief-makers are the microscopic plant-organisms that manufacture poisons causing disease, each after its kind, while the mischiefs made may be these same manufactured poisons, or substances containing them, or, on the other hand, may be simply foul and ill-smelling organic matter having no relation at all to specific disease.

"Disease-germs," or simply "germs", as the organisms producing infectious disease are commonly called, may be present in air, in the form of a microscopic dust, or in water, in suspension, or as household contamination in the home of the infecting subject. Foul but non-infectious organic matter may in the same way contaminate air, water, or household appurtenances.

"Disinfectants" are numerous and incongruous. It is unnecessary even to enumerate them all, first, because their name is legion, indeed, and, secondly, because all styles of disinfection can be accomplished by use of some one or ones of the following-named agencies: **fresh air**; **sunshine**; **heat**; **formaldehyde gas**; **sulphur dioxide gas**; solution of **mercuric chloride** (corrosive sublimate); solution of **carbolic acid**; **chlorinated** preparations; solution of **potassium per-**

manganate; solution of **cupric sulphate** (blue vitriol) and **lime.**

Fresh air and **sunshine** commonly go together, and are disinfectants of the highest power and value. Thorough airing of a chamber recently vacated by one ill of infectious disease, and thorough airing and sunning of infected bedding and clothing, actually will kill lingering disease-germs more efficiently than chemicals. The objection is that, in crowded communities, the disease in question may be spread in the very process of destroying its seeds.

Heat, if sufficiently high and long continued, is certain death to everything living, disease-germs included. The boiling, for an hour, of infected articles, makes sure disinfection. On the large scale, heat is applied in the shape of superheated steam *in vacuo*, in specially constructed disinfecting plants. Such steaming is peculiarly reliable, because it penetrates thoroughly through even bulky masses, such as the substance of a mattress or a roll of clothing. Ordinary cotton and woolen fabrics and mail-matter are not affected by steaming, but leather, silks, satins, furs, and articles of rubber or such as are joined by glue, are injured. The steam is heated in a confined chamber to the temperature of 230° F., and the exposure is continued for fifteen minutes.

Formaldehyde is a colorless gas, pungent and irritating. A forty per cent aqueous solution is known as **formalin.** The gas is a powerful germicide, and since it is easily made and does not injure even the most delicate fabrics, it is the best gaseous disinfectant known. The drawback with it is that it does not penetrate, but acts only on exposed surfaces. Consequently, everything to be disinfected by the gas must thoroughly be exposed—clothing hung on lines, mattresses picked apart and the hair spread about the floor, etc. The gas must be applied in strong dose and the exposure continued for twelve hours. Accordingly, the chamber to be disinfected must be sealed, all but one keyhole, by strips of paper pasted with starch paste over all cracks, such as those of doors and windows. Next, when all contained articles are duly exposed, the last door is shut and sealed on the outside, all but the keyhole. Then, by use of a specially-constructed formaldehyde generator, the gas is applied through the keyhole. When the charge is delivered, the hole is sealed and the chamber left, without opening, for twelve hours. Then the operator, with face protected by a wet sponge, enters and quickly rips open a window, after which room and contents are thoroughly aired. Other methods of applying the gas are by generators to be left in operation within the room, but such methods are slow and uncertain as compared with the one described.

Sulphur dioxide, the gaseous product of the burning of sulphur, is unpleasantly familiar to most throats as the suffocating fumes given off by a sulphur match. The gas operates after the manner of formaldehyde. It is probably not so potent as formaldehyde, and like that gas it acts superficially only. It is effective only in the presence of moisture, and has the drawback of bleaching and of injuring colored and gilded wall-papers, and delicate fabrics such as silks and satins. Its advantage is that it is cheap and handy, requiring no special apparatus. To apply the gas, the chamber is prepared precisely as for application of formaldehyde. Then a tub of water is set in the middle of the room and in the tub an iron pot to receive the sulphur. Or a pair of tongs may be spraddled across the tub and on the legs a metal plate set for the sulphur. The sulphur may be what is known as "sublimed sulphur"—a powder—which then is best mixed with one fortieth part of powdered charcoal to secure easy combustion, or roll sulphur may be used, broken into bits and wetted with alcohol. Also so-called "sulphur candles" are in the market, especially prepared for use in fumigation. The proportion of sulphur should be three or four pounds for each one thousand cubic feet of air-space to be fumigated. When all is ready, the sulphur is fired with a teaspoonful of flaming alcohol, whereupon the operator instantly vacates the room and shuts and seals the door behind him. As with formaldehyde fumigation, the chamber is to be given a twelve-hour stew in the gas, and afterward is to be aired thoroughly with all its contents.

Chlorine is another possible and powerful gaseous disinfectant, but it is dangerous and disagreeable, and bleaches strongly. It has no possible advantage over formaldehyde or sulphur.

In cities where there may be a board of health, fumigation of a vacated sick-chamber is done by the authorities, and, naturally, is thus much better done than by amateurs.

One point in connection with disinfection by fumigation should thoroughly be understood. An impregnation of air strong enough to kill a germ must necessarily be strong enough to kill also a human being. Consequently, absolutely futile are such procedures as the placing of saucers of carbolic acid under the sick-bed, or the burning of pastilles or of little bits of sulphur, or sprinklings and sprayings with chlorinated lime or soda, all while the patient is still in the room. All that can be accomplished by such means is an imperfect *deodorizing*. A room cannot be *disinfected* until the occupant is out of it.

Mercuric chloride (corrosive sublimate) is the king of germicides to be used in solution. The salt is a deadliest of poisons to all forms of life, and its very potency makes it dangerous for domestic use. Its true place as a disinfectant is in the sick chamber or the operating-room in care of the professional medical man or nurse.

Corrosive sublimate is a crystalline solid, making a colorless, odorless solution, which, however, has a very acrid, metallic taste. Such a solution, of the strength of one part of the salt to one thousand of water, is very serviceable for immediate disinfection in the sick-chamber, as of soiled clothing, towels, etc.

Carbolic acid, in spite of its extensive vogue, is both overrated and misunderstood. The acid is a germicide pure and simple, and has no effect whatever on foul substances or odors. All it can do when applied to malodorous matters is to mask the bad smell by its own worse one. Even as a germicide, it is not to be compared with mercuric chloride. But a five per cent solution (saturated aqueous solution) may be used as a sick-room disinfectant in the same way as the sublimate solution just described. Carbolic acid is a crystalline, deliquescent solid, of a strong, characteristic smell, and makes a solution that turns pinkish on keeping. The stuff is poisonous and, in concentrated condition, produces mortification of the parts with which it comes in contact. Its solutions are objectionable by reason of their odor.

Chlorinated preparations are *chlorinated lime*, commonly miscalled "chloride of lime", and *solution of chlorinated soda*, "Labarraque's Solution". These preparations, on exposure, are slowly decomposed by the carbon dioxide of the atmosphere, yielding free chlorine gas. This gas, in turn, acts on moisture, decomposing water, appropriating the hydrogen and setting free the oxygen. Newly liberated oxygen is like a boy newly released from school, active, aggressive, and up to mischief generally. Accordingly "nascent" oxygen, set free from water by chlorine, seizes instantly upon anything within reach that is oxidizable and—and marries it on the spot! Then self and spouse become a staid couple to whom the pranks of unmarried days are now forgotten and impossible. In such roundabout way, chlorinated preparations act as *oxidizing* agents to convert foul matter into different, inodorous, and innocent substance. But for *fumigation* the yield of chlorine by these agents is utterly inadequate. One result of the oxidation wrought by chlorinated preparations is to bleach and to attack metals, an effect that should not be forgotten, lest some colored fabric or steel tool or utensil inadvertently be ruined.

Chlorinated lime is a whitish powder, granular, and of characteristic odor. It is partially soluble in water, and decomposes in air, as just described. It is an effective deodorizer and sweetener, and may be used freely in bulk, to deodorize the foul matter of vaults and other receptacles not metallic. A three or four per cent solution makes an effective detergent wash, but should not be used upon colored or delicate textile fabrics. The preparation is cheap.

Solution of chlorinated soda is practically a duplicate of chlorinated lime in solution. It is a pale greenish fluid of similar smell to the lime preparation. Its mode of action, properties, and uses are the same as those of chlorinated lime. The solution may be used in full strength to deodorize vaults, drains, etc., or, in a fivefold or tenfold dilution, as a detergent wash about the person.

Potassium permanganate (chameleon mineral) is also an oxidizing agent and a very powerful one, acting by the ready disengagement of a portion of the oxygen of its own acid radical. Its applicability is restricted by the fact that, except in weak solution, it will stain even marble and porcelain, and will act on metals. The salt occurs in deep purple, nearly black, acicular crystals which dissolve readily in water, making a rich violet solution. Such a solution is an instant and powerful deodorizer, by its prompt oxidation of organic matter. Solutions for use should range in strength from one-fifth per cent to four per cent. A weak solution made empirically to give only a delicate lilac tint does not stain, and makes both a handy and an elegant detergent wash for hands, basins, brushes, etc.

Since the permanganate is itself decomposed in its oxidizing operation, it loses color in acting. Accordingly, in purifying a fluid mixture, the permanganate solution may continue to be added so long as the characteristic tint is promptly discharged. When the color persists, the fact shows that all oxidizable matter is now oxidized. The treatment then may stop. This point of behavior gives a ready test of completeness of action by permanganate, which is wanting in the case of other deodorants.

Potassium permanganate is entirely too costly to be used where large quantities of a chemical are needed, but yet the crude, commercial grade of the salt is not so expensive, and is effective. A quantity of the crystals equal to a thimbleful may, with benefit, be dropped into the traps of plumbing fixtures, and the resulting solution allowed to stand a little while before discharging. Such treatment will quickly abolish smells. Similarly, a drop or two of a fairly strong solution will instantly kill the offensive odor of a diseased tooth. For such conditions, where the quantity of deodorant required is small, permanganate is admirable.

Cupric sulphate (blue vitriol) and **lime,** in combined aqueous mixture, have lately been made the subject of extensive experimentation.* The report of the experiments sets forth remarkable results, both in the destruction of the larvæ of mosquitoes and in general deodorizing, obtained from a preparation consisting of one pound, each, of copper sulphate and newly slaked lime in

* Dr. A. H. Doty, Health Officer of the Port of New York. *The Medical Record*, January 21, 1905.

ten gallons of water (equivalent to a little over one and a half ounces, avoirdupois, to the gallon). The reporter, indeed, states that in his opinion the preparation, as a deodorant, is "the most valuable and practical agent we possess at present for this purpose. Its action as a deodorant is rapid and permanent, it is practically harmless, cheap, and easily made, and seems to comply with the requirements of a typical deodorant. Furthermore, its range of usefulness is extensive, as it can be employed equally well for deodorizing solids or fluids."

To make the preparation, the copper salt is first dissolved in a portion of the water by suspending it in a cotton or linen bag just below the surface. In this way, solution is accomplished more easily than by throwing the salt bodily into the water. The lime is slaked by pouring upon it, with stirring, the other portion of the water. The lime preparation is then added gradually to the copper solution, with constant stirring. The addition produces a precipitate, in which the deodorizing virtues especially reside. Accordingly the mixture always should be stirred well when applied. In a well-covered receptacle, the preparation will keep indefinitely. To deodorize solid masses, the mixture is used in full strength, but in operating on liquids one part is used to each thirty or fifty of the body of fluid under treatment.

It would then seem that at last there has been found the ideal purifying agent, cheap, harmless, handy, thoroughly efficient, and universally applicable. It remains to be seen what is the germicidal power of the preparation, but the indications point to a high potency here also.

Cupric sulphate, or sulphate of copper, is in beautiful deep-blue crystals, making a solution of similar tint. The salt is commonly known as blue vitriol, and must not be confounded with *green* vitriol, which is an iron sulphate (ferrous sulphate). The ancient name of "copperas", originally applied generically to the "vitriols" (metallic sulphates yielding glassy crystals), is now most confusingly used to designate the *iron* and not the *copper* sulphate. The confusion is worse confounded by the fact that copperas (ferrous sulphate) is itself a deodorant of no mean power.

Lime (calcium monoxide), commonly also called "quicklime", is a familiar substance, occurring in hard, white or grayish masses. On exposure to air, lime greedily absorbs moisture and becomes *slaked* lime (calcium hydroxide), a soft bulky white powder. Lime proper, or quicklime, is by itself a potent deodorizer, and being harmless and cheap may be used freely, in bulk, for sweetening the contents of drains, cesspools, and other vaults, etc. Quicklime is the material to be used in the above-described mixture of cupric sulphate and lime. It is to be freshly slaked for the making of the preparation.

Other disinfectants, more or less serviceable, are, among germicides, a long list of cousins of carbolic acid, and, among deodorants, dry earth, metallic sulphates, notably ferrous sulphate (copperas), and zinc and other chlorides.

From this summary, the application of the commoner disinfectants may thus be stated, in review:

For **true disinfecting,** that is, for rendering innocuous air or articles bearing the infectious principle of infectious disease, thorough *airing and sunning* make a method quite generally applicable and efficient if it can indeed be thorough. *Boiling* is efficient and is applicable, in domestic practice, where the infected articles are small enough to go into the pot, and are of such kind as not to be injured by the process. On the large scale, as can be done by the health authorities of a city in a specially constructed plant, *steaming* at high heat *in vacuo* is preeminently the method of disinfection, surpassing all others in reliability, since under the conditions present the steam penetrates thoroughly through masses of substance such as mattresses or bundles of clothing. Certain specified articles, however, are injured by the heat and moisture. For the general disinfection of a sick-chamber and its contents after vacation by the patient, *formaldehyde* gas is best, because most efficient while least injurious to fabrics or furniture.

The gas must be applied with understanding of the superficiality of its action. Where the special apparatus necessary for formaldehyde is not obtainable, the fumes of burning *sulphur* make a good substitute. For immediate disinfection of soiled articles in the sick-room, *mercuric chloride* (corrosive sublimate) is thoroughly reliable and generally applicable. Because of its highly poisonous nature, the disinfectant solution should be in the care of a skilled nurse. Solution of *carbolic acid* may be used as a substitute for the mercurial, but is hardly so efficient and offends by its rank and penetrating odor.

For the decomposition and subsequent deodorizing of noisome and malodorous matter, the aqueous mixture of *cupric sulphate* (blue vitriol) and *lime* would appear to be the most generally applicable preparation, being at once highly efficient, inodorous, innocuous, and cheap. *Chlorinated* preparations are efficient but objectionable because of their odor. *Potassium permanganate* is instant and powerful of action, but of restricted applicability by reason of staining and acting on metals. Its cost precludes its use on the large scale.

A final word as to disinfection is to remind that the true way to be rid of a nuisance is to turn the offender out of doors, and not to keep him, whether locked up, tied, gagged, or murdered, *still in the house*. Disinfection is a makeshift.

CHAPTER XI

EXERCISING THE BODY

> There is no Theam more plentifull to scan,
> Than is the glorious goodly Frame of Man
> —Du Bartas

Go to the concourse of nations at any world's fair and observe there the children of the wilds—our own red man of the plains, the Samoan of the woods, the Bedouin of the sands, or the huge Patagonian of the rocks and wastes. Note the erect, free bearing, the steady eye, the clear skin, the clean limbs, the thin flanks, the quick, lithe movements, and the firm, elastic step. There stands the splendid animal, man, in the glory of perfect physical development. When your eye is filled with the delight of the picture, turn and gaze right and left at your fellow gazers! And " it is to laugh ", or rather it would be were it not also so much to weep! For here, edging its way to the front, comes the round shoulder overhanging the flat chest and the scrawny, shambling limb, while there, protesting the passage, looms solidly the huge, protruding paunch.

Why this contrast of picture? The answer is simple: The children of the wilds live close to nature, after the scheme of nature's intending. Theirs is the open sky with sun from morn to eve, the freedom of the free winds of heaven, simple food and simpler drink, and also, and especially, theirs is the life of incessant active play of muscle and sinew.

For active play of muscle during waking hours is a fundamental feature of nature's scheme for vertebrate existence, since by such means alone can the wild animal get his food and shun his enemies. By muscular action not only are the muscles and joints themselves kept strong and limber, but all the vital processes—play of heart and lungs, circulation of the blood, evolution of body heat, assimilation, nutrition, secretion, and excretion—all are stimulated to greater activity and thoroughness of working.

Now it is a general law of mechanics that, to be kept in good running order, a machine must be kept running. The wheel that turns not, clogs at its bearings; the bolt that slides not, sticks in its seat. This law is true also of the animate mechanism—the living organism—with the added feature that the more the machine is kept running (within proper limits), the better developed becomes the machine itself.

Muscular play, then, muscular play must be a regular item of the daily life of man, if man would keep his machinery in good running order.

And nature here as always is kind. Whatsoever is right and proper for the better maintenance of that mystery, life, is shrewdly made enjoyable that it may tempt to the doing. We are hungry, and oh, the perfume of the orchard! We thirst, and ah, the babble of the spring! We would repose, and oh and ah, the soft silence of the moss-bank or the slope of nodding grass!

Even so, and even so to that artificial creature, civilized man, muscular play yields to its votaries a delight of indulgence. Not more impatiently waits the hungry man for the dinner-bell than does the tennis-champion for the summons afield, the rider for the call to horse or to wheel.

Following nature's model, exercise should, above all else, be out-of-doors, and should imitate, in general character, the scrambling, swinging, swaying, and somersaulting antics of our own arboreal ancestors of the dim past. That is, it should be varied, calling into play all muscles equally, should be active, exhilarating, and pleasurable. Also it should, if possible, engage the attention, thus exercising the faculties of mind along with those of body. To many, the idea of exercise brings only visions of the gymnasium, with its dull tasks of dumbbells and parallel bars done heavily and monotonously in smelly air at a place inconvenient of reach. The gymnasium is good enough in its way, especially in winter when outdoor possibilities of exercise are curtailed, or where, for some special purpose, it is desirable to grow brawn as a pig grows fat. But right here comes up a point that is very commonly misunderstood. Exercise develops muscle, it is true, but such development is a *consequence*, not the *aim*, of the exercise. Except in a few strenuous occupations, such as baggage-smashing or prize-fighting, a big biceps is of no special use, and may, indeed, be a nuisance by interfering with the proper movements of the arm. Unhappy Hercules, that cannot reach to brush a spider from the back of his neck! No, the purpose of exercise is the quickening of the vital activities through muscular *play*, in both senses of the word, and not the mere building of muscle-mass through muscular *work*. Especially does muscular play promote the important function of the circulation. This it does in a twofold way: first, by quickening and deepening the action of heart and lungs, whereby the blood is driven more forcibly down the arteries; and, secondly, by speeding the return current through the veins, by virtue of a peculiar anatomical arrangement. In the veins of the extremities are numerous valves, opening only in the direction of the blood-flow, which, in the veins, is towards the heart. When a muscle contracts, it presses upon contiguous veins, thus shutting the valves below the area of pressure, and so perforce driving the blood forward on its way. Muscular action thus becomes a factor of prime importance in maintaining the venous circulation of the extremities, where the blood must flow up-hill. This fact is attested by the stagnation of circulation in a moveless limb, as in the case of one in splints because of a broken bone.

Of available active exercises, **sparring** perhaps fulfills most nearly the theoretical requirements. It is a magnificent sport, calling into play, and most actively, every muscle of the body and every faculty of the mind. Also it exercises the keeping of one's temper under provocation, a feature of genuine worth. Its drawbacks are, first, its unpleasant conspicuousness if practised out-of-doors; secondly, the difficulty of getting always two well-matched opponents; and thirdly, the ease with which the game becomes over-strenuous. Before it is realized, the fun waxes fast and furious, and severe exhaustion, always to be avoided in exercise, or an untoward happening to eye or nose, results.

Fencing closely resembles sparring in activity and in the exercise of the mental faculties, and has the advantage over boxing of being suitable for women as well as for men. It is a pity that this fine exercise is not more cultivated in America. The drawbacks are, first, that, as in the case of boxing, the game requires two players, and secondly that the muscular play is overmuch along one set line of motions.

Next, and with the enormous advantage of general practicability, comes the noble exercise of **tennis,** a game that cultivates equally activity, agility, and attention. True that it takes at least two to make a game, but nearly every one plays tennis, women as well as men, so that, given a court, players will flock to it as certainly as will mosquitoes to the players. Other ball-games, from baseball to billiards, have more or less of the same general quality.

Golf, though not so active as tennis, yields more exercise than one would think, and is especially valuable for those who, from age or other absorbent of spryness, find themselves unable to chase bouncing balls over a field at a faster pace than a walk.

Of exercises to be taken alone, **horseback riding** heads the list for the calling into play of the muscles generally. Like all lonely exercises, riding lacks the engaging of the attention that goes with games of competition, but it makes up for the deficit by the glorious exhilaration of swift and easy motion among the smiling beauties of nature. The only drawback is the horse—the horse that will cost, eat, go lame and grow old, to say nothing of stable-room and care.

A formidable competitor of the horse is that other steed, the **"Pegasus of steel",** the steed that stables in the basement-hall, is easily groomed by the rider himself, and subsists on a ration of one smear of grease or graphite and six drops of oil a week. But with all these advantages, the horse of steel is inferior to the horse of flesh in one particular—it exercisee only the lower part of the body.

A humble but yet worthy rival of both steeds is that other steed still, **shanks' mare.** Walking exercises the upper part of the body less than does horseback but more than does cycling, and is an exercise by no means to be despised. It is cheap, requires only good shoes and good legs, and is possible in any place and any season. It lacks the exhilaration of swift motion. In city walking, wonderful comfort is given by rubber heels to the shoes. In walking, the whole shock of the step comes on the heel, and the rubber armament brings down the hard jar of stone to something like the elastic spring of turf.

Riding, cycling, and walking have in common two great advantages over games—they can be practised alone and all the year round, either out-of-doors or in a rink. Riding and walking beat cycling in outdoor availability, since, though the tire never tires, yet hoof and heel mind not mud.

Running is, intrinsically, a fine exercise, but is a hard one, taxing lungs and heart pretty severely. Out-of-doors it has the disadvantage of exciting comment and dogs.

Skating, however, is a polite exercise, and is a glorious one, when and where it can be obtained.

For summer exercising, **rowing** and **paddling** hold place with cycling and supplement well the latter, the oar or paddle exercising the arms as the wheel does the legs. Rowing should be practised only by those who know how, which does not mean every one who can ply the sculls without catching crabs. Proper rowing shows head erect, back straight, and shoulders squared. He who, at the oar, gives the picture of a cobbler at the awl, simply does not know how to row.

For a summer day's outing nothing can surpass a good ride awheel, followed by a good turn at the paddle or the oar and then a swim. **Swimming,** especially in salt water, is, for the fortunate ones to whom it is available, a very king of exercises, combining the virtues of the cold bath with an exercise that tries the muscles generally, and also, and especially, promotes deep breathing. Because of the healthfulness of open-water bathing, the glory of the exercise and the good stead to be afforded in emergencies, swimming is an art that should be taught and learned as a matter of duty by all, male and female alike. And childhood is preeminently the time for the acquisition of the art. Few indeed are the localities where there is not at least a ten-foot-wide still pool in some brook, where the parent can instruct his little one in the frog-like ways of his own long bygone amphibian ancestor. A child who never has been frightened of the water by wicked forcing or ducking will take to immersion naturally, and easily can be taught to swim.

If there is at hand a bridge or a pier reaching out into water deep enough, an excellent plan is to suspend the little pupil by a line held by the teacher above. The line should have a noose at the end with a stop-knot on the body of the line at the proper place so that the noose may encircle the child under the arms without binding. The teacher then, holding the child in the water by the line, walks along with it as it paddles, and directs the movements. The line does not interfere in the least with the swimming motions, and the child, confident of support, strikes out freely. Then gradually the stroke gains power, and the teacher slacks the hold to correspond, till soon, without knowing it, the little dangling spider is supporting itself—has learned the never-to-be-forgotten art of swimming.

Lastly, there is an exercise that is unique. This exercise lacks utterly both the engaging of attention and the exhilaration of swift motion. Yet it has invaluable qualities. First, it costs nothing, is available for all ages and both sexes, and is possible for all seasons and weathers. Secondly, it is elastic and adaptable, and can be made to supplement the deficiencies of other exercises, notably to exercise especially breathing and the abdominal muscles, of which more anon. The exercise is daily morning or morning and evening **home-gymnastics** for ten or twenty minutes (according to perseverance, endurance, and the endurance of perseverance) with the arms, legs, and lungs of the exerciser for apparatus. Yes, even so short a sitting—that is, standing—as ten minutes a day at such exercise will accomplish substantial good,—ten minutes easily to be spared by man from money-getting and by woman from money-spending for investment in bright eyes, clear skin, full chest, lithe limbs, supple joints, and a splendid appetite for breakfast!

For home-gymnastics, apparatus may be used if desired, according to convenience and taste—light dumb-bells, Indian clubs, spring or weight-pulls, etc., but also perfectly effective work can be done without any appliances, by simple rhythmic movements of body and limbs in various directions, and by making opponent muscles to bear against one another, as by putting extensors under strain when contracting flexors, and *vice versa*. And for special exercising of breathing and of the abdominal muscles, certain movements without the use of apparatus are especially fit. A working list of movement-exercises on which to ring the changes will be found at the end of the chapter, but also the gymnast can amuse himself by inventing new ones. So long as unnatural and straining movements are avoided, no harm will result from a full exercise of ingenuity as well as of muscle. Twenty times is enough practice for any single motion.

A special advantage of home-gymnastics is that the exercising can be private, and accordingly can be done with the gymnast in the garb of Adam, in which simple attire muscular movements can be made with perfection of ease and freedom.

In general, as common sense dictates, exercise never should be carried to the point of fatigue, nor should those exercises that are intrinsically severe be undertaken by the delicate or the elderly. Nothing "blows" like running, wherefore running and games requiring running, such as ball-playing, should be shunned by the weak-hearted and the white-whiskered. Too much or improper exercise is worse than too little: too little negatively deprives of benefit, too much may do positive harm for life, as by producing enlargement of the heart or other organic disease. Valuable lives have been lost in just this way.

When, for any reason, exercise cannot or must not be taken, much of its benefit can still be obtained by having it practised by another vicariously—in short, by **massage.** One who has, with his own eyes, seen the effects of massage, and has, in his own person, experienced its delights, hesitates to write of it for fear of seeming to indulge in hyperbole. Not only does massage effect remarkable cures, in certain conditions of disease or of local disability, but it is, in general, an agent of great efficiency to relieve from fatigue, to promote sleep, and to maintain and restore muscular power and activity.

Massage is more than mere rubbing. It embraces also kneading, percussion, and movements, passive, assistant, or resistant—embraces what is called the "Swedish movement cure" as well as massage, in the restricted sense of the word. Being a matter of manipulation, it cannot be taught by description. One duly instructed should alone be employed for its practice. Properly done, massage is incapable of harm.

A special need for exercise comes about as a consequence of man's unique vertebrate peculiarity—the peculiarity of standing with the body upright, balanced on the nether limbs only. Now while, in his evolution, man has come to differ profoundly from his fellow vertebrates as to head and limbs, yet as to trunk he holds still and fairly closely to the type of the four-footed animal. Nevertheless, when we compare the carriage of body of the average sedentary "lord of creation" with that of his dumb cousins of the fields, we are struck by a singular difference. The trunk of the animal gives always the showing seen so markedly in the case of the greyhound—a well-rounded, protuberant chest sloping inward to a flat and sunken lower body—while the figure of sedentary man, more commonly than not, presents an aspect precisely the reverse. Then, again, the animal may be seen to breathe by expanding the rounded chest and still further flattening the sunken flanks, while the picture of man's respiration is just the opposite.

Which is the better carriage, which the better way to breathe? The following facts make answer and in no uncertain tone:

In the first place, the scheme of the vertebrate structure was evolved originally as a system for a horizontally held trunk, as in the case of all fishes, reptiles, and birds, and of all mammals before the comparatively recent coming of the anthropoid ape and man. Such general carriage of body, then, as may be natural for the horizontal trunk must be held to be the typical carriage for the vertebrate *as* a vertebrate.

Secondly, the erect animal can with very little trouble hold himself and breathe after the fashion of the four-foot, but the latter cannot, *while horizontal*, imitate the acquired ways of his upright master except by an unnatural effort. For let any one make the experiment of converting his own self, for the moment, into a four-footed animal. Let him move about, on a bed, on his hands and knees. Instantly he will notice that, as he progresses in imitation of an animal's walk, involuntarily he throws out the chest and retracts the abdomen, and breathes mainly by expanding the thorax. He will observe, in short, that he is bearing himself exactly as does the natural four-footer, and that he does so because, under the circumstances of the attitude, he cannot do otherwise without a strain.

Thirdly, those examples of the erect vertebrate that are best developed physically—examples of athletic man—themselves instinctively adopt the carriage and style of breathing of the four-footed animal.

Fourthly and most cogently, the more markedly the erect animal reverses the methods of the horizontal in the matter of the holding of the figure and of breathing, the more surely does he bring down upon himself physical woes unknown to the happy horizontalian. Under the vice of a faulty carriage and shallow, diaphragmatic breathing, the shoulders tend to droop, the unexpanded chest to flatten and the disused muscles that line the wall of the abdomen to degenerate, weaken, and relax. As an inevitable result, the lower body, deprived of its natural support by action of its own muscles, tends to give way under the downward pressure of its sagging contents, whence result, in turn, mechanically-derived afflictions for man and woman practically impossible for the horizontal animal. Also, if there is a tendency to corpulence, the growth is along the lines of least resistance, which is under the weakened abdominal walls, producing the deformity of protrusion, so common to be seen in sedentary men and women past middle life.

The proper carriage of the body for man is, then, most indubitably that of the Greek statues, namely, back straight, head erect, shoulders squared, chest expanded, and lower body flattened by inward pressure of its own muscles. And proper breathing is by a general expansion, primarily of the chest and secondarily of the abdomen, instead of by the common but vicious method of simply forcing down the diaphragm while the chest is hardly moved at all. Expansion of the chest, by the very act, puts the abdominal muscles under stress, so that, in proper breathing, downward pressure of the diaphragm is met by tension of the abdominal walls. Sagging is thereby forestalled and at the same time the abdominal contents undergo a gentle massage, to their benefit.

Such carriage and such style of breathing should be acquired as a habit. To fix and maintain the habit, let be practised those movement-gymnastics listed at the end of the chapter as especially exercising the function of breathing and the abdominal muscles generally. Also let the subject practise at any and all times of the day, as often as he please and the oftener the better, the simple act of drawing long, slow, deep breaths, through the nose, of course, by the procedure above described.

No respiration, no matter how deep, fully changes the air within the chest. The newly-drawn air mixes with the residual air in the lungs by diffusion, exactly as an incoming tide in a landlocked bay mingles its waters with what has been left by the ebb. But in the shallowness of diaphragmatic respiration there is always an unduly large body of residual air, especially in the far-off corners of the lungs, such as the apices (just where consumption finds its best breeding-ground), with resulting tendency to stagnation. Deep breathing, then, is of an especial value in flushing out these hiding-places of possible disease. In the forced breathing required during exercise, both methods are instinctively practised at once in order to get all the air possible. So the panting animal, expanding the chest to the utmost, takes quick breaths by active play of the diaphragm.

It is hardly possible to extol too highly the benefits of the habit of body formed by correct breathing. Proper holding of the person and proper style of breathing underlie all physical development and form the basis of every true system of physical training. Correct carriage quickens digestion markedly, gives good " wind " and unspeakable ease and freedom of movement. Furthermore, it prevents and will greatly help to cure the deformity of a protruding paunch.

In cases of this same deformity, overeating and sedentary habits commonly are factors as well as faulty bearing of body. For cure, let the subject follow faithfully this régime: first, temperance in eating, as set forth in the second chapter, although ordinarily no restriction of individual foods is necessary, and fats need not be barred. Secondly, active outdoor exercise, and for the purpose in hand nothing is better than cycling. Thirdly, daily massage of the abdomen for ten minutes. After a lesson or two from an expert, the subject can perfectly well do the massaging himself. Fourthly, and most important, determined cultivation of the habit of correct carriage and breathing, and exercise of the abdominal muscles. And of these exercises, number nine on the list at the end of the chapter is especially efficacious, as the soreness of the abdominal muscles after the first few essays will distinctly demonstrate. By this régime, if faithfully carried out, it is possible in a surprisingly short time quite to change the figure of a Silenus into one of an Apollo.

A chapter on exercise would be incomplete without some notice, though really they deserve none, of two commonly given reasons for refusing the cult of the muscle. The first is, " I haven't the time for exercise." Let one who gives this excuse for physical sloth answer, and candidly, this simple question: Do you like exercise? The reply almost certainly will be, "Well, I don't know; I never have tried it systematically." Exactly so; *take* time, then, to try it; trying it, you will learn to love it; loving it, you will *make* time to practise it!

The other excuse is that ancient and strange delusion that there is something inherently incompatible between brain and muscle, such that the one cannot fully be developed but at the expense of the other; that large intellectuality does not and cannot go with powerful frame and muscular activity, and accordingly that there are the two types of man, the thinker, with big head and little body, and the thug, with big body and little head.

Such silly talk is about on a level with that which avers solemnly that fish is "brain-food" because it contains phosphrous, that egg is "bilious" because its yolk is yellow, and that if a dog bite a boy, dog must die, since otherwise, if at any time dog should go mad, boy would go mad too!

There is but one body, in the full sense of the word, and of this body the head is simply one of many parts, all of which are fed by the same blood, driven by the same pump through the one set of pipes. One part is nourished when all are nourished; starved when all are starved. As already shown, active muscular play is an important factor in maintaining good running order for the whole machinery of the system, and by this good condition brain and brawn profit alike.

Mens sana in corpore sano. The adage is as sound as the soundness it preaches, and of its truth examples teem. Let two out of our own history suffice. Probably no more striking instances are on record of large intellectual grasp—of true mental vigor—of brains that were perfect thinking machines, running ever smooth and true, than in the case of the two fathers of our country, Washington and Lincoln. And the bodies that carried these great minds, were they after the type of the weazen bookworm who never leaves his study but for a short saunter? Rather to the contrary, Washington stood six feet three and Lincoln six feet four; both were redoubtable athletes in their youth, and both brought to the strain that was to try men's souls, frames of iron, big of bone and well nourished alike in muscle and in brain.*

WORKING LIST OF MOVEMENT-EXERCISES

For Home-Gymnastics

These exercises may be done from ten to twenty times, each, most conveniently while stripped, either just before or just after the morning bath. Five or six of the movements, selected, will make a morning exercise.

Many of the movements listed are the invention of

* It was the lot of the writer to be one of the two army surgeons detailed to make the autopsy on the body of the martyr president, and he can testify of his own observation to the powerful muscular development and perfect physical condition of the lamented dead at the time of the "deep damnation of his taking off." The tall figure on horseback was a familiar sight in Washington, as Mr. Lincoln would take his daily ride.

Mr. Edwin Checkley, the physical-culturist, to whom indebtedness is acknowledged for their suggestion.*

Slow, exercising breathing and the abdominal muscles:

Standing: (1) Hands clasped over lower abdomen: exhale, then inhale slowly and fully by expanding the chest, at same time pressing inward and upward with hands. When lungs are filled, bow forward, bending from hips only, back and knees kept stiff. Recover, exhaling slowly but without relaxing hold of hands.

(2) Arms akimbo: exhale, then fill the lungs and exhale by a series of sharp, sniffing jerks.

(3) Arms at side, palms in: exhale, then swing arms stiffly outward and upward till the backs of the hands tap overhead, inhaling deeply the while by expanding chest. Recover, exhaling.

(4) Arms at side, palms back: exhale, then swing arms stiffly forward, upward and overhead, inhaling. Recover, exhaling.

(5) Same, but recover by swinging arms outward and downward, palms out and down.

(6) Hands over breasts: exhale, then shoot arms forward, palms down, and then swing outward and slightly downward, palms down and out, swimming stroke, inhaling. Recover, exhaling.

(7) Arms overhead, thumbs locked: swing arms and body as one system forward and downward, knees stiff, till fingers tap floor or shins (according to age and stiffness of subject), exhaling strongly. Recover, inhaling deeply by expanding chest.

Lying supine: (8) Arms down over body, palms in, thumbs locked: exhale, then swing arms stiffly upward and over till finger-tips tap floor overhead, inhaling. Recover, exhaling.

* A Natural Method of Physical Training. By Edwin Checkley. Brooklyn, N. Y., Wm. C. Bryant and Co., 1895.

(9) Same position, but with toes braced under heavy piece of furniture: swing arms overhead same way, but in the recover, upheave body (by the purchase of the toes), reaching forward till the finger-tips tap the shins. (Severe at first; practise a few times only at the beginning.)

Lying prone: (10) Palms spread on floor by shoulders: straighten arms, thereby upraising body, supported straight and stiff from hands and toes. Recover. (Severe at first; practise a few times only at the beginning.)

Sitting upright: (11) Arms folded behind back: bow forward till body presses thighs, exhaling. Recover, inhaling.

Slow, exercising neck and trunk:

Standing: (12) Arms akimbo: bow head strongly forward, then backward.

(13) Same: bow head and body as one system, from hips up.

(14) Same: revolve head sideways (motion in azimuth), first one way, then the other.

(15) Same: similarly revolve head and body as one system, as if pivoted at hips.

(16) Arms at side, palms in: hunch shoulders up and down, together.

(17) Same: hunch alternately.

(18) Same: work shoulders together forward and backward.

(19) Back to wall, arms to side, palms in: move head forward and back, face forward, shoulders held to wall.

(20) Same: work head from side to side, keeping face forward and straight.

(21) Arms extended outward, palms forward: bend body strongly to left, left arm rigid, right arm incurving till thumb taps top of head. Recover and repeat on other side.

(22) One arm extended straight outward, a few inches from a wall: lean sideways till fingers bring up against wall. Recover and move away an inch or so: repeat, again moving further off, and continue repetitions till limit of distance is reached. Turn and repeat series on other side.

(23) Arms extended outward, palms forward: twist body sideways, first one way, then the other, maintaining relation of arms to shoulder (motion in azimuth). This may be done also with a rod, such as a broomstick, held across the shoulders to insure correct position of the arms.

(24) Same, but when one arm straight forward, swing body over and forward, flexing forward knee only, till finger-tips touch floor between the feet. Recover, sway in other direction and swing down with other arm.

(25) Arms to side: keeping one leg stiff, flex slightly the other knee and let sink the body somewhat from the hip-joint of the straight leg. Recover and repeat on other side.

Quick, exercising arms:

Standing: (26) Arms to side, palms in: bend one arm sharply at elbow, bring thumb to shoulder, then shoot the arm quickly upward. Reverse motions, then repeat with other arm. (This exercise may also be done holding a light dumb-bell.)

(27) Arms extended outward, palms up: bend from elbow sharply inward till finger-tips tap shoulders. Recover. (This exercise may also be done holding a light dumb-bell.)

(28) Arms extended outward, palms up: revolve both arms, held stiff, through a small vertical circle, from the shoulder as a pivot.

(29) Same: revolve through a large circle.

Quick, exercising legs:

Standing: (30) Body steadied by right hand against a wall, draw up right leg, then kick strongly downward and slightly outward a number of times. Turning, repeat with other leg.

(31) Arms downward and backward, palms in: rise on balls of feet, swing arms downward and forward, at same time sinking down fully, till thighs meet calves, keeping body upright. Recover, reversing motions.

(32) Same, but when down, hop from balls of both feet at once a number of times. (Severe at first and difficult; practise a few times only at the beginning.)

(33) Arms at side: lift one leg, bending at hip and knee, as high as can be done without bending back. Recover and repeat with other leg.

(34) Arms at side, palms in, one foot before the other, length of a short step: rising on balls of feet, spring upward from both feet at once and reverse quickly the relative position of the feet, while in the air, swinging the arms naturally, as in walking.

Lying supine: (35) Hands clasped behind head: swing both legs upward as far as possible, holding knees stiff. Recover.

(36) Same: work imaginary treadle in the air with the feet.

Quick, exercising arms and legs:

Standing: (37) Arms at side, palms in: rise on toes, at same time swinging arms forward and upward till palms clap in front: then sink back on heels, swinging arms strongly outward and backward. Repeat from this position.

(38) Elbows at side, hands up, palms in: rise on toes, shooting arms straight forward: then sink back on heels, swinging arms strongly downward and backward. Recover.

(39) Left arm at side, palm forward; right arm, elbow at side, hand up, palm forward: side-step sharply on right foot, bending knee, and lunge to right with right arm, swinging left hand up till thumb taps shoulder. Recover and repeat on other side. (Imitation of the lunge in fencing: the exercise may be done also holding a wand or foil in the lunging hand.)

(40) Same: continue the lunge over and downward till finger-tips touch the toes of the advanced foot.

Note.—This list by no means exhausts the possibilities of movements, and the gymnast can himself devise others.

CHAPTER XII

EXERCISING THE MIND

The power of Thought,—the magic of the Mind!
—BYRON

They are never alone that are accompanied with noble thoughts
—SIR PHILIP SIDNEY

Health and cheerfulness mutually beget each other
—ADDISON

IT is the train-shed of the Pennsylvania Railroad station in Jersey City, in the olden time, before the invention of the enclosed pen and the ticket-puncher. Passengers are admitted freely, to find their train for themselves by directions addressed to eye and ear both. At the far end of the platform, conspicuously displayed beside a long train of heavy cars, appears a huge signboard in black and white, beside which stands an equally huge porter, in black only, clanging vigorously a huge bell. "THIS TRAIN FOR BALTIMORE AND WASHINGTON" staringly proclaims the sign, and "THIS TRAIN FOR BALTIMORE AND WASHINGTON" thunderously announces Stentor Africanus in three-second explosions. A little old woman, with distraction lined upon her simple face, draws near. Ding-dong, ding-dong, ding-dong, "THIS TRAIN FOR BALTIMORE AND—" Stentor stops, for his sleeve is plucked nervously. "Well, mum?" "If you please, which train do I take for Baltimore?" *

What is the matter here? Is the subject blind and deaf? Not at all: eye and ear both have done their duty; have received their respective impressions, and have duly telegraphed them to headquarters. At headquarters has been the fault; the brain has not taken cognizance of the messages laid at its door. In simple language, the poor old woman has seen and heard, but has not *perceived*. She is one of those whose lives are spent in a dull routine—in her case, of broom and suds and bake-oven, where new experiences are rare, and, therefore, the call for original observation infrequent. Following the law, then, that an unpractised function lapses, in cases such as this the faculty of critical observation is in abeyance, so that when comes a new experience, the mind is helpless, and must needs be "personally conducted" through the issue.

Compare now the following experience of Parkman's, as told by that historian in "The Oregon Trail":

"The Indian had brought with him his pipe, so, before lying down to sleep, we sat for some

* A true incident in the experience of the writer.

time smoking together. Previously, however, our wide-mouthed friend had taken the precaution of carefully examining the neighborhood. He reported that eight men, counting them on his fingers, had been encamped there not long before, Bisonette, Paul Dorion, Antoine Le Rouge, Richardson, and four others, whose names he could not tell. All this proved strictly correct. By what instinct he had arrived at such accurate conclusions, I am utterly at a loss to divine."

These two experiences show a faculty that by disuse can dwindle until it almost wholly disappears, or, on the other hand, by cultivation can be developed to yield results that seem little short of miraculous. The faculty is **perception**—the taking cognizance by the brain of impressions received from the sense-organs. The exercise of the faculty, when it *is* exercised, follows so immediately and automatically upon the receipt of the sense-impression, that the seeing or hearing and the perceiving seem as but one act. But that the two are separate is shown plainly by the fact that the mind, when deeply engaged, takes no heed of what eye or ear may communicate. When intently busy, we neither see the new-come visitor nor hear his greeting, and the absent-minded professor will even essay to cross a railroad track directly in the face of an onrushing, roaring train. That the perceiving faculty lies wholly within the brain—is purely mental—is demonstrated also by the significant fact, stated to be shown by experimental testing, that in the savage, whose sight and hearing seem so marvellously acute, the sense-organs are really not a whit better than those of the civilized man, the acumen being in the perceiving, not in the actual seeing or hearing.

Minds differ in natural quickness and keenness of perception. There are the bright boy and the dull, the quick-witted girl and the stupid. But also, as shown in the case of the Indian, the faculty is wonderfully susceptible of cultivation. Let, then, those in whom it is poorly developed, whether from deficient natural endowment or from lack of early training, take heart and take advice. Let them decline longer to be personally conducted through life, and rely on their own observation to find the train for Baltimore, and the shady side of the car! So by exercise of perception, perception will come.

Childhood is preeminently the time for training the mind, since at that period mind, like body, is plastic and easily moulded into proper form. Mental training is first and last the purpose of early schooling, and the training of perception and close observation afforded by the critical study of language and of numbers is an invaluable function of the hated school-drill in Latin, Greek, and the mathematics. The future man may have small call, in his business, for the ablative case, the rough breathing, or the minus sign, but he will find use every day and all the day for the habit of precision gained by observing that *musâ* is quite another thing from *musa;* that ἥ is not ἤ, and that $a^2 - 2ab + b^2$ may be as tremendously different from $a^2 + 2ab + b^2$ as is nothing from anything at all!

The importance of a habit of critical observation can hardly be overestimated. Perception underlies all operations of the mind, as arithmetic underlies all mathematics; and the faculty, when well developed, gives its possessor a wonderful power and pleasure, both. To such a one, inanimate things tell their story as well as the tongued, speaking a sign-language as plain as print and twice as truthful. So the good observer goes through life easily and accurately, with few mistakes and small need to ask questions.

"Excuse me, sir, but would you mind letting go of your machine a moment?"

A tricyclist, dismounted, is trundling his three-legged steed through a thick patch of road. Two women of the well-dressed class, eying from the sidewalk the unusual machine, have, after a momentary hesitation, advanced into the road, and the younger has spoken. "Would you mind letting go of your machine a moment?" The request is unusual—as unusual as the machine—and puzzling as to purpose; but a lady has requested and so—hands off! The liberated steed turns his head slightly towards his fond master, then quietly comes to a halt. "There, mother, I told you it could, and you see it can!" Then to Knickerbocker, curious: "This lady said your machine couldn't stand up unless you held it, but I said it could because it has three wheels. I am obliged to you."*

Three points of contact, a broad base and a tapering, symmetrical superstructure—facts equally well observed by two minds; then one of the minds argues *can*, but the other strangely insists *can't*, stand up alone!

Here is an example of the second step in mental exercise—**reasoning.** The sense-organs send impressions to the brain, the mind takes cognizance of them and then proceeds to **draw conclusions,** more or less right or wrong, as the example shows.

Conclusions may be obvious or the reverse. When strikingly plain, the reasoning follows so quickly and certainly upon the observing that the two operations seem but as one. We turn a corner upon the street and see a small delicate handkerchief lying on the sidewalk. Instantly we look ahead for the woman owner. Here, though hardly appreciated, has been a process of reasoning: the thing would not be where it is unless dropped, and would not be small and dainty unless its owner were of the fair sex.

* A true incident in the experience of the writer.

At the other extreme are cases where the proper conclusion is so obscured as to puzzle even long and hard thinking. Hence come indecisions and perplexities, or opposite opinions, with disputes and even feuds.

The faculty of reasoning is the highest attribute of that highest of creations known to us, the human intellect. It constitutes the distinctive trait of the mind of man, enabling its proud possessor to do what is impossible for the brute, namely, to modify his environment, and bring all belongings of earth—animal, vegetable, and mineral—under his sway, to be utilized for his purpose.

The development and exercise of this wonderful gift constitute not only a privilege, but a duty, for every sane human being. Here, as in the case of the perceptive faculty, not all are endowed alike. There is the clear-headed man, who reasons always carefully, coolly, and shrewdly, and there is the "rattle-brain" who "goes off at half-cock"—who talks first and thinks afterwards, often to his sorrow.

Because of the close alliance of the two faculties, severally, of observing and reasoning, the two commonly go together in endowment. The bright boy that naturally observes closely, also reasons straight; while the dull boy that never "sees" also never thinks. By the same token, as the power of observing can wonderfully be developed by training and exercise, so also can that of reasoning, and indeed training in perception inevitably trains in reasoning, by the very act. Also the two faculties develop themselves to a great extent under the stimulus of necessity, when the mind is thrown on its own resources. This fact should be applied in the rearing of children. It is a wise parent who, in its companionship with its child, leads the youngster to do his own thinking. Instead of giving perfunctory answers to the incessant questions, or, worse, administering a snubbing without answer at all, the parent should bring the little seeker after knowledge to see with his own eyes, hear with his own ears, and reason with his own wits. Development of the mind through itself and by itself constitutes a special advantage of the large school or college. The campus of boarding-school or university affords a miniature world-arena where each gladiator stands or falls according to the prowess of the sword of his own forging.

The reasoning faculty, properly developed in youth, should regularly be exercised throughout life. And as in the case of exercise of body, so in the exercise of mind, the practice brings its own reward of pleasure. To the wise, a problem in geometry or algebra offers greater interest than the latest novel, and chess delights far more than chatter.

A group of children play at the deserted breakfast-table. The squat tea-pot is a hen, and the cups her chickens. Lo, a snake! and a spoon, bottom-up, bearing on the bowl two crumbs of bread for eyes, sways stealthily forward, steered by a dumpy finger on the handle, pressed to the table. What goes on in those intent little heads? Simple as seems the outcome, in those busy brains is doing a wonderful thing, the taking by the mind of conceptions from present impressions and from past memories, combining them, and out of the fusion deriving new conceptions of its own making. This feat is the exercise of **imagination,** a faculty of mind perhaps the most marvellous of all.

Imagination underlies all original thinking, and, joined with critical observation and reasoning, gives **invention**—the magician that with one wave of his wand transforms a lump of ore into a steam-engine, and with another makes of a roll of paper a tragedy of Hamlet.

Far more than in the case of observation and reasoning do minds differ in natural endowment of imagination, and far less is the faculty susceptible of cultivation. It is the faculty of mind that preeminently is a gift. Yet in no one is it wholly lacking, and if not all of us can be Shakespeares or Beethovens, Newtons or Darwins, each can at least burn his lamp for such light as it may be capable of giving, and not hide it under a bushel. One who forever takes in, and never gives out, deserves contempt rather than credit for his learning. The "great reader", the "scholar", the "bookworm", who absorbs but never contributes, of what use is he to the world? Except for the memory of brilliant conversations vouchsafed as legacy to a chosen few, the accumulated lore of years perishes off the earth when the light by which it was gathered is quenched.

For those whose daily routine does not call for intellectual work, an excellent habit for mental development is the keeping of a journal, in which to jot down original thoughts on the presentments of the day. The requirement thus to record thoughts will breed thoughts, and the setting-down will crystallize them. By such practice, not only will the machinery of mind be kept from rusting,* but ennui will be a thing unknown, and who ever can tell in what oyster may not be found a pearl of genuine worth?

And for any one, playing with the intellect makes a delightful game of solitaire for spare minutes, unique in that it can be played at any time and place. And it is astonishing how much can be accomplished in the odd times of day. Idyls may be born of a home-stretch on the street; operettas, of trips on trains; and books, of tours awheel. Thus a substantial pleasure is got out of minutes that otherwise would go to waste.

* A brain actively used is less liable to disease than is one where the intellect is allowed to stagnate.

One well trained to observing, reasoning, and thinking has, perforce, an opinion of his own; and having the opinion, naturally develops the will to execute it. Mental training and exercise thus unconsciously cultivate that most important attribute of mind, the will-power.

To remember what was for dinner yesterday seems as natural as the dinner, yet is the act nearly as wonderful as one of imagination. Memory and imagination are allied, in that both faculties give to the mind the marvellous power to conjure up images of its own, which then it views nearly as vividly as if they were actual present impressions on eye or ear. In the case of imagination, the images are of the mind's own fancy; with memory, they are purely reproductions of past happenings.

It would be superfluous to descant on either the usefulness or the joy of possession of a good memory. It needs then but to cheer the hearts of those who have not the endowment, by saying that the gift is still within reach. For while, as usual with the faculties, memory is bestowed by nature to very different degrees, yet, again as usual, it is very susceptible to cultivation. By exercise, regular and systematic, just as a flat chest can be made full or a skinny arm plump, so can a poor memory be made over into a serviceably good one. An effective practice is the following: A bit of writing, verse at first, as being easier to commit, is memorized in the morning and recited in the evening. Next morning the succeeding stanza or paragraph is committed, but in the evening both portions are recited, and so on until the whole poem or essay is in memory's grasp. Another trick is, on returning home from lecture-hall or church, to write down an abstract, as accurate as can be remembered, of the discourse. As in all cases of exercise for development, the training should be undertaken seriously and determinedly, and then, if the exercises are carried out faithfully, the result will be as surprising as gratifying.

"I wonder what I did with my hat!" "I wish I could remember where I left my parasol!"

The phase of memory-failure constituting **heedlessness** is very common with persons of poor memory generally, but also occurs where the memory is good, simply as a vice of habit. And in this latter case, if truth must be told, it is all too often the fault of the mother! For heedlessness is particularly common among the well-to-do, all from lack of early training in the care of self. It is passing strange that a child who in later years is to have the responsibility not only of self but of others, is nevertheless brought up with no heed whatever of domestic duty. Nurses care for the clothing, and maids "clear up" and "put away" the things which the spoiled little one is permitted without check or hindrance to drop or toss about at will. So with later years come the disorderly college-room or boudoir, the lost key and the left umbrella.

For one in the grip of the miserable habit of forgetfulness and disorderliness (twin vices, Siamese-linked), there is nothing for it but to turn and grapple with the oppressor, with determination to overthrow. The struggle will be long and hard, but if determination be there, it will win. The following makes a serviceable trick in the wrestling: Acquire the habit that whenever hand lays anything down, even if it be the right thing in the right place, head is to bow solemnly to the thing, while tongue murmurs *sotto voce*, "Here rest!" The absurdity of the one action will fix the other upon the attention, and thus fix time and place upon the memory.

A special phase of forgetfulness is failure in chance duty to others. This fault, especially to be seen among the unmarried, is again one of early training. The child is reared, it may be, to be orderly as to self, but never is put under any obligation to do for others. So it grows up to the habit of **passive selfishness,** that is, to intentness on self, with no thought of the interests of others, and brings into married life, with its interdependencies, the irritation of the unmailed letter or the missing button, missing still. Childhood is the one and only time for the easy and certain forming of habits, physical and mental, both. Training to orderliness, to responsibility and duty both to self and to others, always should be a fixed purpose in the rearing of children. The child should early be taught to dress itself, to take charge of its own clothes and toys, and do its own putting away. Then it should be given duties to others, such as occasional charge of little brother or sister, or the doing of some simple task for parent. So will it grow up in glad obedience to " heaven's first law ", and prove a comfort instead of an exasperation to those with whom it may come into future relation.

Where duties are multifarious—too many and too important to trust to any memory, however good, the memorandum-pad is indispensable, and it is strange that this device for the saving of time, trouble, and temper is not more used in domestic life. By its means, instead of a dozen items to be remembered, there is but one, namely, the pad itself. All that is necessary is to make the pad a part of the person, and to form the habit of consulting its friendly pages regularly, on stated occasions. Then the pad itself does the rest, and home is happy.

A smile or a scowl; a pleasant word or a snappy; a boon or a snub—such alternatives tell of another aspect of mind, that of **being,** as contradistinguished from **doing,** which so far alone has been considered.

There is with every one a constitutional **temperament,** buoyant or anxious, reckless or cautious, excitable or calm, as the case may be, overlying which is an habitual mental attitude toward life and the world.

Now this attitude, is it, like the color of eyes and hair, a matter of intrinsic individuality, fixed and unalterable? Let two observations make answer. Go to childhood, where expression of feeling is outspoken, and where the subject has had small chance as yet

> "... to suffer
> The slings and arrows of outrageous fortune."

Watch a group of ragged urchins at play—ragged preferred for the observation, as being of the sort whose demeanor is wholly unartificial. Some of the little fellows evidently are more excitable than others, but all are happy. Give them a smile and get back a grin; toss them a penny and hark to the merry shout that goes with the scramble! If there is one sitting apart and peevish, inquire,—and elicit quite surely a story of ill-health or of ill-treatment.

Next, make this simple experiment: Standing before a mirror, draw down the mouth and scowl. Immediately there will be felt a disposition to be ugly—to think hard thoughts and give short answers. Now smooth out the scowl, uplift the brows strongly and smile. Instantly there comes a reversal of feeling—a sense of joyousness and an inclination for mirth.

These two observations show that naturally mental attitude is cheerful—that where it is otherwise the case is one of artificial change, wrought by the accident of circumstance, and that the disposition for the moment can be determined by so simple a thing as assumption of the characteristic expression of face.

What more is wanted to prove that attitude of mind is just what we may choose to make it—that it lies wholly within ourselves to make of ourselves, for ourselves, and for others, genuine blessings through well-ordered cheerfulness, kindliness, thoughtfulness, and courtesy, or curses, through surliness, selfishness, and general brutality!*

The corollary is plain enough: cultivate cheerfulness and cheer will come; seem serene and serenity will fill the mind; offer courtesy, and kindliness will creep into the heart. There is never honest excuse for a disagreeable bearing or for bad manners.

"You'll be sorry for this when your anger cools!" "Oh, it's just her jealousy." "You

* The fact that mental attitude can be determined by will gives to the physician a remedial agent of wonderful power for use in so-called functional nervous disease. Gaining his patient's confidence, the physician can, by hypnotic suggestion or by shrewd appeal without hypnotism, lead the subject himself to modify his mentality—to assume the mental pose of health. Then, if organic change do not bar the way, health accepts the invitation, and returns forthwith to resume its proper post of control.

think her pretty? You must be in love with her!" "Ask him what we had better do; he doesn't seem afraid." "She is utterly prostrated; the shock has been too much for her."

Analysis of familiar phrases such as these shows another feature in mentality—**distraction.** Strong impressions are received from without, exciting within the mind a commotion, of character corresponding to the nature of the impression; and such commotion, according to its intensity, deranges or wholly upsets the natural play of the faculties, and reacts upon the general system, producing more or less nervous shock, and in severe cases even death.

Commotion of mind from outside influence is **passion;** and the different styles of commotion constitute *the passions.* Many of the passions are abhorrent—anger, jealousy, envy, hate; some are depressing—fear and grief; and others are enlivening or uplifting—joy, hope, love, reverence.

But no matter what its character, any passion, by its very nature *as* passion, operates as a disturber of serenity. Passion and reason, then, are mental incompatibles—natural enemies, as are the burglar and the policeman; and for the same reason. As the one dominates, so by the very measure of the domination is the other subdued. The incompatibility in question is seen strikingly in the mental derangement accompanying narcotic intoxication, as wrought by alcohol, ether, or "laughing-gas". In the early stage, before general stupefaction, there is an irritation of the emotional side of mentality, at the same time that there is, from the very start, depression of the rational. But different subjects give very different outward showings of this mental disturbance. With some, there is a violent display of passion, combative or hilarious according to the habit of mind; while with others the showing is slight or even altogether absent. And, as a rule, the lower the subject in the walks of life, the more pronounced the emotional outburst—a fact which means simply that the less the intellectual development, the stronger the sway of passion. Narcotic intoxication thus operates curiously as a practical test of habitual control over the passions. Subjects differ as greatly in natural susceptibility to passion as in endowment of imagination; and, by a natural coordination, it is the imaginative temperament that also is the passionate.

Since reason and passion are irreconcilables, reason must be master if it would not be slave. And this means that a standard item of mental exercise must be the establishing and maintaining of control over the passions. But while it is recognized universally that severe repression is the proper treatment for emotion from an abhorrent passion, indulgence is not only permitted, but approved, in the case of the passions that uplift. Yet right here many a mistake is made. Passion is passion, and emotion prejudices judgment and warps reason, no matter from what passion it may spring. As a talesman is challenged for jury duty because of hate, so does a physician wisely decline, because of love, to treat a child of his own for serious disease. Similarly any passion whatever, indulged habitually to the point of strong emotion, is weakening to the mind and exhausting to the body, by the exact measure of the emotion. Thus art is a form of emotion, and excessive indulgence in its gratification tends to the usual effect upon mentality. Musicians, painters, poets, actors, and other devotees of art are notoriously unpractical, excitable, and emotional generally. Passionate devotion to music, the most emotional of the arts, may be positively pernicious to health. The phrase "drunk on music" is all too often true to the physiological fact. No matter, then, what the passion, be it even so beautiful a one as love or reverence, repression of indulgence, within the bounds of reason, is a proper general rule of mental hygiene.

CHAPTER XIII

SLEEPING AND WAKING

O sleep! it is a gentle thing,
Beloved from pole to pole!
—COLERIDGE

Health that snuffs the morning air
—JAMES GRAINGER

MAN, despite his habits since Prometheus brought him flame, is, by nature, a diurnal animal, and, for the diurnal animal, day is for waking and night for sleeping. But the habitat of man ranges over the whole of the habitable globe, and within that range the duration of day and night, respectively, varies greatly according to latitude and season. Man's sleeping and waking life, therefore, cannot be ordered by the rising and the setting of the sun, but must be more or less arbitrary. Common experience seems to show that, as a general rule for adults, sixteen hours out of the twenty-four should be for waking, and the other eight for sleeping.

But, as usual, the matter does not permit of a hard and fast rule. The need for sleep varies, first, with age, the new-born infant waking only to take nourishment, while the nonagenarian wakes eighteen, nineteen, or even twenty hours out of the twenty-four; secondly, with the season, the long nights of winter conducing naturally to long sleep; thirdly, with the activity of the life, the man with the pick needing more sleep than the foreman standing idly by, the author more than his amanuensis; and, fourthly, with individual idiosyncrasy. This last-named factor in variation is a genuine one, and should be respected; and the parent, boastful of early waking, who forces a "lazy" child from bed before nature has opened the eyes, is a brute as well as a braggart. There is the story of a great commander who invariably took his nap just before going into action; and of a great physician, a man of extraordinary achievement, who would excuse himself in the midst of an engagement, drop anywhere, on lounge or easy-chair, for a ten-minute snooze, and then, waking bright, resume work with more ardor than ever. In general, brain-workers need a full quota of sleep.

The hours for sleeping should be laid within the hours of darkness. Such placing accords with instinct, with common sense, and with common experience. Sleep is not all the same. There is the first sleep, profound and dreamless; then, with turnings in bed and dreams, the slumber lightens; then succeeds a delicious half-sleep, when the mind wanders off and on from the highway of waking to the bordering groves of dreamland, and then at last, with lifting of eyelids, waking is full.

Now profound sleep requires rest for the nerves of sense, that the slumbering brain shall not be teased by the ringing of the cerebral telephone-bell to take messages of feeling, sight, or hearing from disturbed sense-organs, ever on the alert. Darkness, quiet, and absence of jar are, then, standard requirements for perfect slumber, and these conditions, *with proper ventilation of the bedroom*, can be secured only at night. Proper ventilation means more or less open windows; open windows after dawn mean light and noise, and light and noise mean disturbance of slumber.

Daytime sleep, therefore, never is, because it never can be, the same as sleep by night. Those whose occupations require the turning of night into day, and so of day into night, tell that their repose by day, even though the hours be plenty, does not give the refreshment of natural, nocturnal sleep.

And the charm of early morn! Those who know it not, know not of it and would laugh it to scorn; but they who do know it, know it to be true, and being true, to be also beautiful and good. The season matters not: by the white of January or by the waving green of June, it is the same—the touch of rosy-fingered dawn that makes of earth a fairyland before the mounting chariot of Phœbus marshals it to toil.

In the long nights of winter there is latitude in the placing of bedtime; for the night will outrun the eight hours wanted for sleep. But in the short nights of summer, unless curfew ring at nine o'clock, chanticleer will surprise the moulder of dreams before his task be done.

Sleep should be sleep and not drug-coma. If a good day's work, with proper exercise, a clear conscience, an untroubled mind, a dark, silent, and airy chamber, and a glass of milk, do not woo the drowsy god, there is something wrong, for which a physician, and not a self-prescribed whiskey-bottle or pill-box, should be consulted. Insomnia is, of course, a symptom, and not a disease. And, as a symptom, it accompanies a long list of most incongruous disorders. Of causes other than actual disease, the most common are overfatigue, physical or mental, anxiety, empty stomach, and cold feet. For overfatigue, "don't overwork", and for anxiety, "don't worry", are the respective cures, often exasperating enough in the prescription when the work or the worry is inevitable. The complaining stomach, which especially troubles the burner of the midnight oil, is easily appeased by a light snack before retiring—a glass of milk or a few biscuits with an egg. To make a regular meal, is to make a mistake. In the case of cold feet, the members should be thoroughly warmed before getting into bed, night-wear and bed-sheets should be of wool rather than of cotton or linen, and the night-robe should be long, so that it will tuck under and around the feet when knees are bent in bed. Then over the feet should be an extra fold or two of blanket.

Waking should be natural. Waking by force *is* force, and like all dominion by force is something rough, cruel, and justly provocative of rebellion. When eyelids do not lift of their own accord at some required hour, let dominion be exercised at the other end of the night—persuade *into* bed, not force *out* of it.

CHAPTER XIV

WORKING AND PLAYING

Man hath his daily work of body and mind
Appointed —MILTON

From labor there shall come forth rest
—LONGFELLOW

TOIL is the watchword of animate existence. From the microscopic animalcule to the giant whale, all animals must toil to gain their food and avoid their enemies. Without toil there would be neither development nor progress, and man would be unknown on earth.

And the watchword of toil itself is thoroughness. The saying is as true as it is trite, that whatever is worth doing at all is worth doing well. Alongside of the word *task*, the words *time* and *trouble* have no proper place. If, after counting the cost, a task is accepted, let it be undertaken; once undertaken, let it proceed, and time and trouble be reckoned simply as incidents of the doing, and never as considerations for the undoing.

This rule should apply to the trivial undertaking, the same as to the mighty. When once the habit is formed of prompt and thorough doing, with never a thought of retreat, the secret of success is found.

Effective work requires three things of the doer. First, a trained mind or hand. Secondly, concentration:—it is possible to do two things at once, if one be a matter of automatic routine, such as walking or riding, and, indeed, the mind often works best under the exhilaration of locomotion outdoors. But if the two tasks both require attention, then to be done well, each must be done separately. A pianist can play some familiar piece while also conversing, but the playing will be perfunctory and expressionless. To play with the soul in the music, tongue must be silent and mind undisturbed at its task.

The third requirement is a fresh brain or hand. The worker with steel halts when the tool is dull, nor will use it again till sharpened; the worker with brain or sinew must do exactly the same. Shut the book; put away the pen, and betake to cane or couch according to the hour. Then, after walk or sleep, of itself will the knot loosen, or the puzzle-pieces drop into place.

Comparatively little of man's achievement on earth is the work of genius. Genius has, indeed, seriously been dubbed a phase of insanity, even of degeneration! The substantial work of man's record has been done by good but not extraordinary minds, working simply under the three requirements just presented. Given a fair mind, thoroughly trained as a thinking machine; a well-nourished brain worked only when in good condition, and the habit and opportunity of concentration, and far better work will be turned out than by a brilliant mind, untrained either to observation or application, and working under the handicap of fatigue, distraction, or stress.

"Doctor, have a tow?"

"No, thank you."

The professional skipper sails on, lost in wonder at the city lunatic that comes to the seaside and persists in rowing when he might take a tow and be saved the labor. But the lunatic is not so crazy as he seems: his *work* is at a desk, so he takes his *play* at the oar. Were his work at the oar, doubtless he would, like the professional boatman, take his play at a table over a newspaper or a backgammon-board.

It is simply a fact of physiology that, over and above necessary repose, there is needed for tired muscle, or brain either, rest in the shape of other work that shall be a something at once utterly dissimilar to the regular work, pleasurable to the individual, and itself not overfatiguing. Such restful work is *play*.

At once it is plain that, as in the illustrative example, what is one man's work may be another's play, and *vice versa*. But the necessity for play cannot be gainsaid: for it is founded on physiological rock. A fatigued muscle regains its vigor quicker by massage than by a splint: a tired brain sooner by diversion than by star-gazing. So long as man must work, so long also must he play.

In this matter, however, the nature of the regular work makes an enormous difference. There is work that is all work, and there is work that is half play. In the one case, the work is a dull, grinding monotony—a drudgery whose confessed purpose is nothing higher than a balance at the bank; while in the other, the work is a pursuit of intrinsic interest that yields delight along with its dollars. A worker of the former kind needs his play imperatively; but one of the latter sort gets his play very largely in his work itself. So comes it about that, without proper diversion, the harassed business-man breaks down, while the professor preaches serenely along, hale and happy through the tallying years.

He whose work is play is not at serious risk if, in his enthusiasm, he gives to it even long hours; but he whose work is work should have a care. For such a one, the threshold of his home should ever be to his business as a castle-moat, with drawbridge up and portcullis down—a dividing line that may not be passed. When the office-day is over, no black bag with papers; but an hour, at least, beneath heaven's blue, and then, dinner done, *play*. And for the brain-worker, evening play should be something mentally active, something that will both interest and occupy the mind—some game, some fad, some devotion to a muse or apprenticeship to Hephaistos. Within the wide range of literature, science, art, or mechanics, surely may be found some pursuit congenial to taste. Let, then, the evening lamp shine on cabinet, desk, or microscope-table, on pen, pencil, or piano—

> "And the night shall be filled with music,
> And the cares that infest the day
> Shall fold their tents, like the Arabs,
> And as silently steal away."

CHAPTER XV

LIVING AND DYING

So may'st thou live, till like ripe fruit thou drop
Into thy mother's lap —MILTON

SLAUGHTER or old age, one or the other, is nature's provision for the ending of life. Yes, slaughter; for, shocking though the thought may be, in the inscrutable scheme for the cosmos it is ordered that one thing shall prey upon another. So the soil absorbs the snowflake, and the herb absorbs the soil; the ox rends the herb, and the tiger rends the ox; the elephant rips the tiger, and then yields his victorious tusk to the magic of that arch-victor, man.

Nor does man himself escape the doom. True that by his intelligence he shuns or defeats the rough violence of visible foes; but the very mode of life that by his intelligence he has ordered for himself, has in turn brought into being hosts of new and subtle enemies to prey upon man's estate, none the less potent for that they are unseen. The child that succumbs to the swift inroads of the armies of diphtheria, or the adult that yields his life to the slower ravages of the tuberculosis-swarms, is just as much a victim of slaughter as is the kid whose back is broken by the crush of a lion's paw.

These noiseless, viewless nemies, then, born of the house and the hall, the church, the street, and the car, that, like a coiled snake in the grass or a couched tiger in the jungle, lie in wait for unsuspecting man, how can they be defeated? Broadly answered, the reply is, when the battle is on, consult a physician, but to decline battle, consult common-sense.

There is a picture whose title is "Peace", but whose subject is a mighty battle-ship alert with all the panoply of war. So, to oppose disease, make strong the citadel, that the enemy may pass by without assault, or, assaulting, easily be hurled back from the battlements. The cult of the rosy-cheeked goddess, then, besides its gift of the joy of being, armors its disciple against the shafts of disease.

But not against all; moreover, the best coat of mail may have a faulty link, or may rust and loosen by age. So far, then, as can be done without a cowardly shirking of life's duties, the avoiding of disease should be a practical consideration in life, even in the case of the robust.

As already hinted, a certain large proportion of the ills that afflict mankind are the direct offspring of the civilized life. They are the diseases of herding and of domiciling, and their avoidance means, theoretically, simply the complete avoidance of man in his gregarious aspect! For *possibility* of danger lurks in flies and mosquitoes; in exposed raw foods obtained from the neighborhood of human habitations, such as berries, lettuce, celery, raw oysters, and even raw milk; in strange drinking-waters, drinking-cups, towels or beds; in hostelries, public places, public conveyances, public gatherings, and even public streets!

A formidable list, whose dangers can fully be shunned only by a Robinson Crusoe! Unless, then, man is again to be a nomad savage, he must expect to face *some* risk of the ills engendered by his very mode of life. He can no more hope wholly to dodge disease-germs than to dodge lightning. He can, however,—and that is the present point,—avoid *unnecessary* exposure, by an intelligent understanding of where danger lurks, on the same principle that, knowing the ways of electricity, he will not, in a thunderstorm, seek shelter under a lone, tall tree.

Increase of years brings decrease of power to resist outside influences. Fortunately, however, age brings also lessening demands upon the breadwinner. The " many to keep " now keep themselves; so that with the peeping of silver hairs may come a lessening of toil, and more than ever a shunning of unnecessary exposures. Yet despite this truism, on every hand are to be found graybeards still at it, at it, at it, the same as when twenty years younger. The grizzled politician still reeks through a midsummer night of an unadjourned convention session; the veteran wit and orator still dares the snows of January for his accustomed place as pride of the platform or pet of the banquet-hall. With the voyage of life nearing the last bend in the stream, what folly unnecessarily to risk the running of dangerous rapids! How wiser far, accepting the inevitable, to steer silently for that safer passage where smooth flow the waters in the gold of the setting sun!

To him who is as wise as fortunate, and as fortunate as wise, comes nature's alternate and serener ordering—the simple falling of the leaf in the fullness of its autumn day. And as for him who passeth thus there is no pang of body, so for those, his dear ones, who must tarry yet awhile, should there be no pang of mind. In the purity of flame, let be purified that which was mortal; and then with ashes returned to ashes the summons is fulfilled.

THE SILENT SUMMONER

It is the silent summoner
Hath come at droop of day
To touch with fateful finger one,
And beckon him away.

And he, our loved one, straightway hath
The head obedient bowed,
And even so hath passed from us
As passeth a summer cloud.

O messenger of mystery,
Whose summons soon or late
Each thing that boasteth breath or bloom
Must meet in full of fate,

Teach us to know thee as thou art,
The silent friend supreme
Who bringeth us at droop of day
The peace of perfect dream!

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