SANITATION IN DAILY LIFE

One of the most difficult sanitary lessons to learn is that tolerance of evil conditions is not proof that the conditions are not evil.

"Any kind of training is far more effective and leaves more permanent impress when exerted on the *growing* organism than when brought to bear on the adult."

— *William James*, "*Psychology*."

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BY

ELLEN H. RICHARDS

Instructor in Sanitary Chemistry in the Massachusetts Institute of Technology

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PROLOGUE

SANITARY science teaches that mode of life which promotes health and efficiency.

The individual is one of a community influencing and influenced by the common environment.

Human ecology is the study of the surroundings of human beings in the effects they produce on the lives of men. The features of the environment are natural, as climate, and artificial, produced by human activity, as noise, dust, poisonous vapors, vitiated air, dirty water, and unclean food.

The study of this environment is in two chief lines:

First, what is often called municipal housekeeping—the co-operation of the citizens in securing clean streets, the suppression of nuisances, abundant water supply, market inspection, etc.

Second, family housekeeping. The healthful home demands a management of the house which shall promote vigorous life and prevent the physical deterioration so evident under modern conditions.

The close interrelation of these two parts of sanitation should be borne in mind. Even if a man has been so blessed as to be born into favorable conditions,

he must nevertheless face the problem of retaining health and strength under the strain of modern progress and civilization. Formerly a man's occupation in the fields and woods kept him in health, but now he must ordinarily give what strength he has to his occupation, and rely upon other sources from which to secure a healthy body.[1] It is possible to understand the effect that is produced by unfavorable environment, if we compare the difference in physical stature between the Scotch agricultural worker and the inhabitant of certain manufacturing towns in England. There is an average of five inches in height and thirty-one pounds in weight in favor of the Scotchman. H. G. Wells, in speaking of the responsibility for man's physical efficiency, compares the city dweller in crowded streets and tenements with the man living in the freer, more open country, and makes the difference from three and one-half to five inches in stature and from twenty to thirty pounds in weight in favor of the country dweller.[2] The former belongs to the physically unfit for the struggle of life.

A casual observer visiting the poorer parts of one of our large cities must necessarily be impressed with the stunted appearance of the children on the streets.

Since physical strength and power have always been desired by man; and since, in these modern days, women wish to be not far behind their brothers in endurance, the facts just given should furnish food for serious thought as to the means of acquiring a body physically

[1] D. A. Sargent, "Health, Strength, and Power."

[2] "Mankind in the Making."

fit, capable of securing the greatest capacity for work and for play—for life.

Is this physical fitness and consequent mental power so good a thing, so desirable, that the pupils in our schools and colleges are ready to give their attention to habits of right living when the methods of acquiring these habits are presented to them? Is it worth their while? Let the habits be once acquired, then the attention may be turned in other directions. It has been said, "Sow a habit and reap a character." This is true of the physical and mental as of the moral. Habits become fixed. It is necessary, then, that they be good habits. Right habits of living are the foundations of health of body and mind.

To secure and maintain a safe environment there must be inculcated *habits* of using the material things in daily life in such a way as to promote and not to diminish health. Avoid spitting in the streets, avoid throwing refuse on the sidewalk, avoid dust and bad air in the house and sleeping room, etc.

It is, however, of the greatest importance that every one should acquire such habits of *belief* in the importance of this material environment as shall lead him to insist upon sanitary regulations, and to see that they are carried out.

What touches my neighbor, touches me. For my sake, and for his, the city inspector and the city garbage cart visit us, and I keep my premises in such a condition as I expect him to strive for.

The first law of sanitation requires quick removal and destruction of all wastes—of things done with.

The second law enjoins such use of the air, water, and food necessary to life that the person may be in a state of health and efficiency.

This right use depends so largely upon habit that a great portion of sanitary teaching must be given to inculcating right and safe ways in daily life.

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CHAPTER I

SANITATION. CLEANNESS

"Science stands . . . holding out resources, devices, and remedies we are too stupid to use."—*H. G. Wells.*

TO be clean is to be free from foreign or undesirable matter. Dirt is not always dangerous, but it is always undesirable. The smouch on one's nose, the greasy finger marks on one's book are foreign matter. The old definition of dirt is "matter in the wrong place." We do not avoid the man who has been delivering charcoal because he is dangerous, but because contact with him makes work, or does not improve our appearance. If we meet a man with smallpox or a child with scarlet fever we shun him because he is dangerous. His skin is dirty in a different sense; it carries little organisms which will grow on our skins if once established there, so that we shall be sick and perhaps die.

We forbid the man with tuberculosis, or the child with diphtheria, to spit in the street, or to touch us, or our pencils, or books, or our food, because the little plants which have made him diseased will grow in our own throats and lungs if once established there. We wish to keep them out, just as we wish the charcoal man to keep away from us, but for a different reason. The person with a contagion like smallpox or scarlet fever, or an infectious disease like diphtheria or typhoid fever,

is a dangerous person because he carries living microbes which we do not wish to get into our clean bodies.

There are many kinds of tiny organisms doing their wholesome work of turning waste matter into useful substances, true sanitarians obeying the first law of sanitation to get rid of all useless matter. Working in all refuse heaps, all wet gutters, all dirty corners, and on all damp, dirty clothes are these tiny organisms which we do not wish to have on our faces, or in our throats or noses. When these are dry they blow about the streets; fill houses, cars, shops; settle on books, desks, and banisters. They are wiped up by warm, moist hands, which carry them to food, mouth, eyes, noses. Soon some disease may set in because, among these microbes, a few disease germs were carried.

One of the best instances of danger in dirt is that of the tetanus bacillus or the germ that causes lockjaw. It is very common in garden dirt, and that many persons carry it on the unclean skin is proved by the frequency with which it develops in cases where the clothing over the injury has not been torn.

In fact, one never can tell when dust is what is often called "clean dirt" and when it is dangerous; therefore, avoid all dust. Keep the mouth shut when in any dusty place. Alas! all places are dusty if one could only realize it! The white beam of the search light at night, the stream of particles seen in a dark room when a beam of sunlight is let in, show us now and then what is there all the time.

Sanitation is keeping clean, not merely cleaning up and disinfecting, which seems to be the common idea.

A place which smells of chemicals is popularly supposed to be sanitary. The really healthful spot is one without odors and without any matter out of place. Personal cleanliness takes on a new meaning and all the daily operations of the house and school and city are elevated into the region of scientific work, done according to well-known laws. Sweeping and cleaning and laundry work are all processes of sanitation and not mere drudgery imposed by tradition, as some people seem to think. The experience of the race has taught a practice, the reason for which science is only now explaining.

Where there is a question of clean hands, clean finger nails, clean clothes, or clean shoes, one should never say that anything is too much trouble.

Illustrative Experiments

1. Darken the room as for a stereopticon lecture and allow a beam of sunlight, or electric light, to enter through a small orifice in as nearly horizontal direction as possible, so as to be visible across at least half the room. The more dust in the air, the brighter will be the beam.

Any movement of the audience, stamping on the floor or brushing of clothes, will perceptibly increase the brightness of the beam.

2. To prove that this dust is not all sand or soot, procure from the bacteriologist several prepared Petri dishes. Place one on the desk, or table, or chair, under this beam of visible dust. Take off the cover for 3 minutes or more, replace the cover and set away at room

temperature for 36 to 48 hours. At the end of this time numerous colonies will have spread themselves in the stiff jelly. Numberless variations of this experiment will occur to the teacher.

It is advisable to give each student at some time, if not to all at once, two prepared dishes to take home, one to be exposed when the room chosen has been quiet, or thoroughly cleaned, at least 2 hours before, and one after disturbance has "raised" the dust.

3. To show the efficient way to get rid of dust, choose a suitable room, have it swept, and set the class the experiment of dusting it with (1) a feather duster, and (2) a dry cloth, as janitors and housemaids usually do the work. Expose prepared dishes at the end of 10 minutes, half an hour, 1 hour, 2 hours. (3) The same room swept in the same manner dusted with a *dampened* duster, not a wet one. Repeat the tests. Keep careful records, when possible photographic records.

[To show how dust is carried on hands, a finger print made on a Petri dish, or a swab taken from the nose, if a physician or bacteriologist is at hand to explain, will give a culture which will be remembered always.]

It is not necessary to determine the names of the plants growing in these colonies. The purpose of the experiments is simply to prove that the dry, ordinarily invisible dust which we breathe does contain living organisms and possible sources of harm.

The number and variety of the experiments to be made in the growth of dust organisms will depend upon the individual conditions and the interest of the pupils.

The aim should be not to alarm nor merely to amuse, but to convince the pupils:

That cleanliness is a scientifically established need.

That cleanliness is a difficult but not impossible condition.

That it is easier to keep clean than to get clean.

That hands are carriers and should be carefully guarded.

It is not intended that these experiments shall be more than illustrative. It will be a mistake to go into the bacteriologist's department and attempt to make "cultures." It will be dangerous to deal with disease germs in a general lesson.

The experiments should be kept within the bounds of illustration of the principle and of confirmation of the facts stated. Ocular demonstration is a great fixative of ideas.

THE DAMPENED DUSTER

Wring out a towel, or any piece of thick cloth, from clean water; if warm, so much the better. Spread this out smoothly; on it place the cloths to be used as dusters, four to six thicknesses. Roll the whole compactly and allow to remain half an hour. When taken out the dusters should not seem wet; if they are, shake out and hang up a few minutes. A dampened duster is one that seems dry to the uninitiated.

PETRI DISHES

It is a saving of time to secure from a bacteriologist the prepared jelly to use in the sterilized Petri dishes,

but the material may be prepared in the chemical laboratory or, with sufficient care, at home.

The Petri dishes are simply flat glass dishes of convenient size, with covers of thin glass, so that the colonies of germs which grow in the transparent medium may be seen and counted. They may be bought at a supply store for bacteriological apparatus, and after using may be cleansed. They are sterilized for further use by baking, as follows: Place them, with covers on, in a pan in a cool oven. Slowly raise the temperature to about 300° F., a temperature for baking bread or for yellowing a piece of paper in half a minute; open the door, draw the pan to the front, allow the temperature to cool as slowly as it was raised, to avoid the cracking of the glass. When the pan is cool enough to take up with the bare fingers, remove to a table and allow to cool to room temperature; then place a rubber band over the cover and dish and set away for use. As the least exposure in any place is liable to collect dust, the cover is kept on the dish.

To prepare a stiff, but not too stiff, transparent medium in which germs will grow has been the study of many laboratories for many years and improvements are constantly made.

In general, it may be said that the organisms are planted in nutritive media which favor their rapid growth, which are transparent, and are solid enough to keep the different individuals apart when first sown, but which permit the new growth to form clusters or colonies that may be counted.

Beef broth is the common basis, made from lean beef,

free from fat and gristle, finely minced, soaked, and finally heated in water, filtered through folds of muslin, cheese cloth, or cotton flannel into test tubes plugged with cotton wool and sterilized. The heat penetrates readily the short distance required in the test tube.

The broth is stiffened after filtration and before sterilization by the addition of gelatine, 100 grams to the liter, or by agar, a seaweed generally obtained in dried strips from the Japanese market, 10 to 15 grams per liter. For anaërobic organisms 1 or 2 per cent. of grape sugar is added to make glucose broth.

The Standard Methods of the American Public Health Association will be found in Prescott & Winslow's "Elements of Water Bacteriology." In brief, prepared lean beef is soaked over night in the refrigerator, 500 grams (one pound) to 1 liter of water, strained through cotton flannel, the other ingredients added, the whole sterilized by heating over boiling water or steam for 30 minutes. Filter again through absorbent cotton and cotton flannel until perfectly clear, then prepare the test tubes previously cleaned and sterilized, putting 5 c.c. into each tube and plugging with sterilized absorbent cotton. Since there has been unavoidable exposure to dusty air and by handling, these tubes are set upright in a rack and sterilized 30 minutes in steam on three successive days. They are then ready to store in the ice chest until wanted.

The following recipe is excellent for home use or for rural schools:

"For the soil take the following recipe: Chop finely one-quarter pound of lean, juicy beef. Mix this with

1 cup of warm water. Heat in double boiler, stirring often until water in water pan has boiled 15 minutes. Remove inner dish, place directly over the fire, and allow broth to boil 10 or 15 minutes. Clean by straining through two or more thicknesses of cotton flannel wet in cold water. Squeeze the meat carefully to get out all its juices but not much fat. The meat is acid, therefore add from one-eighth to one-quarter teaspoonful of bicarbonate of soda. Replace the water lost through evaporation.

"Moisten 3 heaping tablespoonfuls of finely divided gelatine in a very little cold water and add to the boiling hot broth. When the gelatine is dissolved, strain through hot flannel.

"Put 3 or 4 tablespoonfuls of the broth into each of several small bottles. Plug the mouth of each with a close wad of cotton wool, or tie over each a thick mat of the same. For three successive days place the bottles upright on a piece of folded cloth in a pan of cold water and boil them 15 minutes." [1]

[1] Elliott, "Household Bacteriology," Vol. II. Library American School of Home Economics.

CHAPTER II

THE CLEAN CITY

"We suffer from disease through ignorance. We escape through knowledge."— *Benjamin Ward Richardson.*

THE eagle in his mountain aerie has as clean a home as the world affords. There are only cosmic dust, ashes of volcanoes, pollen from trees, with now and then a spore of some moss or lichen in the air he breathes. The explorer in the arctic regions never "takes cold," for there are no germs to cause the catarrh.

The country dweller on a large farm need not breathe bad air if he would live out of doors and sleep with wide open windows.

But the city dweller is at the mercy of the careless habits of thousands of his fellow-beings, and of the ceaseless grinding of streets into powder, and of dust from all things subject to wear, from clothing to iron rails. An examination of the air of the New York subway showed the solid dirt sifted from it to contain sixty per cent. of iron dust.

As long as we must go to and fro to work, to school, to shop, we are subjected to the city ideal of cleanliness. We should be helpless if it was not possible for each one of us to have a voice and influence in community life.

Public opinion could stop the sweeping of house, shop, and schoolhouse dust into the street, could de-

mand suitable receptacles for it, and could insist upon crematories for all wastes.

The point of this lesson is: each should do his share in making a clean city; each should dispose of his own wastes in a manner safe not only for himself, but for his neighbor. Then only has he a right to insist that his neighbor do the same.

It is safe to say that two-thirds of the work of cleaning up is needless work, and so in itself waste, and that the danger is increased tenfold by the delay in getting rid of the decomposing materials.

Observe the reprehensible habit of tossing banana skins, lunch papers, envelopes, into the street or onto a vacant lot. Observe the rubbish along one block of a city street or one-quarter mile of a village street, or in the yard of a farmhouse. It is human hands that cast away used things to the peril of their neighbors' lives.

A social conscience must be developed to cause each one to refrain from menacing his neighbor

By "the clean city" is meant all the environment common to the community and beyond individual control. Climate is beyond community control except in so far as very limited modification of dry weather may be made by abundant use of water. We must bear heat and cold, snow and fog, in the place in which we find ourselves. But intelligent man need not suffer if he will learn what the different conditions require. If man will use the knowledge he may gain, he can protect himself under nearly all circumstances.

An excellent illustration of the value of sanitation is given by the control of malaria and yellow fever. Not

many years ago a malarial or yellow fever country was avoided as a necessarily dangerous region. Now our men are living in health and comfort in several such countries, Cuba, the Philippines, and Panama. A certain kind of mosquito was found to be a carrier of disease, and in order to make these countries inhabitable the authorities needed only to combine to stop the breeding of the pests, by draining marshes, covering pools with kerosene, and by screening houses to keep out the strays.

It is conclusively proved that a united effort to exterminate the mosquito, to prevent the breeding of flies by leaving no manure piles and no heaps of dirt, to get rid of fleas, etc., may improve the health of the community in a marked degree.

Just as soon as the taxpayer realizes the saving in money by the lengthening of life and lessening the expense involved in sickness, he will be willing to have money used by public authorities for these purposes. To repeat: the range of temperature, humidity, and sunshine is independent of man. Not so, however, is the presence of stagnant pools of water to breed mosquitoes, or of piles of rubbish to scatter dust and breed flies and harbor rats.

For all common pathways of the community—roads, streets, alleys, and sidewalks; for all public buildings—city halls and schoolhouses; for all places frequented by large numbers—parks, markets, bathhouses, boat piers, railroad stations, street cars and steam cars, the community must be responsible. The condition of these public places of concourse and conveyance reflects the sanitary standards of the community. A stranger may

tell at a glance how far in the scale of cleanliness a given town has risen. The village store and post office, for instance, are good evidence. It is the accumulated waste of the many that makes the offensive mass and convicts them of breaking the first law of sanitation—quick removal of all that is done with.

A few words on each of these things used in common by all the people of a locality will suggest others which may be followed up. Parks, markets, public gathering places, sidewalks, public pathways, have important sanitary effect in two ways. Dried sputum, excrement, decayed food or refuse may be lifted by the wind and scattered over a radius of several miles; not only onto other streets, but onto the roofs of houses to be washed into cisterns; into markets to fall on fruit and meats; into the windows of houses to be breathed by the inmates.

When such material is wet with rain, or dampened by the watering cart, it may be taken up as mud on the shoes of the passer and tracked into clean stores, schoolhouses, etc.; or it may be collected on clothes and stockings, and so carried into sleeping chambers to be shaken out of the window into the air breathed by persons who have not been out of the clean yard.

For these and other reasons, it is a duty of the whole community to protect itself by insisting on clean pathways; and a duty of the school and home to insist that shoes shall be cleaned and clothes brushed outside their doors.

In parks and squares, receptacles for all waste should be provided, and the frequenters should *use them.*

This leads to the disposal of the great accumulation of waste in a community.

The wastes to be disposed of may be roughly grouped into three classes: ashes and rubbish; garbage; sewage.

The ashes and rubbish, broken bottles, paper, tins, etc., are not in themselves dangerous, but they collect germ-laden dust and blow about; or they hold water to breed mosquitoes and are unsightly. They may be used on a dump for filling, if they do not there blow about and collect water. Such piles are usually picked over and all valuable portions saved. If this is done at once, and if such rubbish has been kept clean and separate from garbage and house sweepings, this may not be harmful; but such a dump is usually a menace to the whole neighborhood, and a breeding place for mosquitoes. It is on the whole a doubtful saving.

Garbage is the perishable waste of kitchen and market, bits of raw and cooked foods, bones, vegetables, withered flowers. The contents of the kitchen middens of the archæological early man were of this character. When the heap overtopped it he moved his hut. Modern man keeps his house in the same spot, and sends the refuse off in a cart to the farmer to feed pigs, or dumps it in the sea.

Because it is perishable, it is food for bacilli and a home of bad smells. Perhaps its worst offense is in breeding flies. Like all other wastes, it should be disposed of before decomposition sets in. Garbage should never be dumped in the open or used as filling. For isolated houses with plenty of land it should be buried in loosened soil. For city garbage various schemes of utilizing the grease and nitrogen have been proposed, and some tried, but from a sanitary point of view it is

better frankly to consider it as waste to be disposed of at a cost.

Sweepings, whether of houses or streets, should be burned on account of the danger from disease germs; dried sputa being, at present, a universal ingredient.

Sewage—the liquefied waste of water-closet, bathtub, wash basin, sink and laundry tub—is dirty water with only about one per cent. of dirt, but it is a dangerous dirt in so many cases that all sewage is suspicious.

Water carriage complies with the law of quick removal from houses and city precincts, but its after disposal is a troublesome problem. In the not far distant future all such water will be purified before being discharged into the sea or into streams. The municipal plant at Columbus, Ohio, is one of the well-known models.

For the isolated house or institution, sand filtration and cultivation is the wisest method to be adopted, not necessarily for profit, but for safe conversion into plant life. Broad irrigation is a common term. The principles so well worked out in arid regions hold here. A small catch basin called a septic tank allows the solids to liquefy and be washed out and soaked up by the porous soil, where the nitrifying plants at once convert the nitrogenous matter into nitrates, forming food for green plants.

The necessity for cremation has already been referred to. The waste material—paper wrappings, paper bags soiled with meat juice or decayed fruit, scraps of all kinds—attracts flies and, when moistened, breeds germs, molds, and bacteria, some of them harmful to

man, and all meaning decay and filth. The sweepings of houses and offices, dry lint from clothes, wood chips from pencils, threads, dust, and mud whirled in from the street by the breeze, or brought in on shoes, are too often swept into the street or left by the door.

Scraps of lunch, bones given to dogs, stones and skins of fruit, all find their way to the corners by house and sidewalk. The useful microbes do their best to get all such waste into the form of food for plants, so that it will be no longer waste; but meanwhile it is not pleasant to see or smell decay. All such wastes should be burned at once and thus be transformed into plant food in the ashes and the gases which are given off.

The kitchen wastes are more difficult to dispose of because food stuffs have more water, which smothers the fire, causes smoke and a bad odor.

Well-constructed crematories, whether of the simple sort in the vacant lot or the city plant, have something of the nature of a shelf on which the wet stuff may dry before being thrown into the fire. Most households and villages have enough paper and dry waste to burn the rest without any other fuel. The one need is a good draft, tall chimneys or forced draft, to give air enough for complete combustion. It is only incomplete combustion that gives odors.

A few years ago this method of getting rid of waste would have been considered wasteful. The paper, then made of cotton and linen rags, could be used over, the garbage could be fed to pigs and hens. It was then thought that the nitrogen was lost if food scraps were burned and the gases sent into the air. It has been

found, however, that clover and pea plants, especially, have little bacteria-bearing nodules on their roots which can make the nitrogen of the air into nitrates, or a form for plant food. Plants take the needed carbon from the air, so there is no excuse for allowing refuse to rot rather than to burn it. The ashes prove the best of fertilizer.

On the farm, the kitchen waste may be safely fed to pigs and hens, because it may be given to them fresh and sweet; but the contents of the garbage pail of the village house are not fit food if left for two or three days to ferment and decay between deposit and use.

It may be taken as an axiom that one of the most valuable aids in modern sanitation is the well-constructed crematory, and as we realize more and more the value of pure air we shall burn wastes more quickly.

We look for the time when most market refuse will be left at the large centers, and when the individual housewife will not need to deal with corn husks, cabbage leaves, chicken legs, etc. But as long as she has these to dispose of, so long she must keep her garbage pail washed out and dried whenever emptied. That means a second pail, and where shall the washings go? That means a can small enough to be washed with soda in the sink. It means, too, that it must be emptied every day. When we are willing to pay for the city cart daily, or when we will take the trouble to care for the garbage daily, the air will be sweeter and there will be fewer germs of disease floating about.

Prevention is always better than cure. While it is possible to wash meat, lettuce, and berries, it is much better to keep these and other articles as clean as possi-

ble. The driving of a load of uncovered meat through the streets or along country roads should not be tolerated by the buyer. Besides the dust there are flies, and we have learned that they are not only disagreeable, but they may be dangerous.

The picking of berries and small fruits by careless country children is a danger, for not all country people are in good health; moreover, they too often excuse grimy hands and greasy clothes with the plea of trouble in getting a sufficient supply of water.

Civic pride in clean markets should be encouraged and each purchaser should patronize only the cleanest. If plenty of hot water and towels and clean frocks cost more to the butcher, then we must be willing to pay more to him. Thus we may pay less to the doctor and nurse, and gain more good out of life by being well.

The screen will keep off flies, but it will not prevent the settling of fine dust. There is in a suburb of a Western city a really clean market. Why are there not more?

The American favorite ice cream may become a source of danger in hot weather if it is prepared in an unclean place, or is kept over and refrozen after being melted. It is a safe rule never to buy ice cream from a push cart or street stand.

Cream cakes and whipped cream confections are not good food in hot weather.

Just as common needs have developed community oversight of roads and sidewalks, so universal need of light and water has produced the public utility of gas, electricity, and water supplies. It is necessary only to

refer to these here, since they are under expert supervision in all well-conducted towns. The sanitary dangers are mostly connected with improper house fixtures, which will be considered in the chapter on the house.

In no one thing do we find more perfect justification for stringent sanitary measures than in the case of a city milk supply. The death rate of infants is about twenty per cent. In a city of 500,000 inhabitants several hundred children have been liable to die in a summer, almost wholly from bad feeding, and mostly from dirty milk. "War is nothing, when it comes to increasing the death rate, compared to filthy milk." Vigorous measures by state and town must be used, for the single householder is powerless.

In suburban rural communities, however, each user of milk should know how the cows and cow stable from which his milk is sent are cared for.

Clean milk, if cooled at once and kept cool from 50° to 60° F., should keep sweet thirty-six hours at least. There should be no sediment in the bottom of the vessel in which it stands, and it should have no peculiar taste or odor.

It goes without saying that no preservative should be added. To produce clean and safe milk, the stable, the cows, the pail, the milker (as to his hands especially), all must be scrupulously clean—bacteriologically clean, not just clean. In the house, milk should be protected from dust. Those who have no cool dark place in which to keep milk are at a great disadvantage. Milk is such good food for bacteria that they thrive at a prodigious rate when the temperature permits their growth. New-

man[1] gives an experiment on a sample of milk which at 32° F. (0° C.) contained 3,000 bacteria per c.c. The portions kept below 55° F. (13° C.) showed very little increase in twenty-four hours, but the portion at 60° gave 180,000; at 68°, 450,000; at 86°, 1,400,000,000; at 94° (35° C.), 25,000,000,000.

It may be that, just as great pipe lines have been laid to carry clean water for 50 to 200 miles and oil for greater distances, so pipe lines will be laid to give that equally necessary fluid, clean milk, to a large city; but at present it must be brought in cans 200 to 300 miles and handled two or three times before the consumer finds it on his breakfast table.

Milk differs from oil and water in that it is a perfect mixture in which to cultivate many kinds of plants, and all seeds and spores as well as plants must be kept out. For discussion of milk see Newman, "Bacteriology and the Public Health," and local bulletins and reports.[2]

It has been said that the milk problem is to get done what we know how to do, and it is an excellent illustration of the need of co-operation between the individual and the community. For instance, the milk cans returned to the milkman from retail stores, bakeshops, and from many private dwellings are in an absolutely filthy condition not only from neglect, but because of use for improper purposes.

Each housewife should see to it that receptacles for

[1] "Bacteriology and the Public Health," p. 188.

[2] U. S. Bureau of Animal Industry, Bulletins Nos. 20, 46, and 81, and Farmers' Bulletins, Nos. 63 and 74, on milk, the care of milk, and the milk supply of large cities.

milk should never be used for other purposes, and that they are washed as soon as emptied.

The requirements for safe milk are a healthy cow, absolute cleanliness, low temperature, 50°, and quickness of use, twenty-four to thirty-six hours at most.

Illustrative Experiments

Mosquito extermination, street cleaning, and garbage collection may be described by the teacher. The class may expose Petri dishes on the window sill, on the sidewalk, in the electric or steam car. Note results in different streets and wards. Examine the methods used in street cleaning; write directions for better work.

Prepare directions for personal aid in this matter to be posted on the school bulletin.

Ask permission from the Board of Health to clear vacant lots and wet places nearby by approved methods.

To illustrate garbage cremation

Experiment 1. On the hot plate to be found in most laboratories, or on a sheet iron square or round laid on the ring of a lamp stand, place a quarter slice of bread and heat it gently. At first, moisture escapes, as is proved by holding a large dry beaker over the bread for a second or two. The cloudiness is seen to be water. Soon the bread turns brown and then black, or chars, and begins to emit smoke. At this stage, if a flame is brought close to the bread, the gas so rapidly forming (hydrocarbons) will take fire and burn with a more or less smoky flame, leaving a glossy black mass of charcoal

or pure carbon, which requires a higher heat and fine division for complete combustion.

Bread contains only about 45 per cent. water and so burns rather readily. A slice of potato treated in the same way needs to dry longer in order to evaporate its 75 per cent. water. A slice of apple, or tomato, or a melon rind with 90 per cent. of water must be dried longer still, but when dry the result is the same. It is this need of drying which makes cremation of garbage costly, unless some source of waste heat is available, or some other waste is at hand to mix with it.

Experiment 2. Place on the hot iron a thin slice of suet or of butter or a teaspoonful of cream. A little water will escape, but the mass will soon give off inflammable gases and burn brilliantly, leaving almost no residue. There will be some sooty smoke because the air cannot get to it quickly enough to burn it all. If some of this fat can go in with the other garbage, the whole will burn admirably. But fat is too valuable to dispose of in this way; it has too many uses, so it is abstracted from the refuse.

Experiment 3. Place a thin shaving of beef or chicken or ham on the hot plate and treat as before. The same results will follow, with the addition of very disagreeable odors. The smell of burning flesh is sickening.

All residue containing nitrogen, such as bones, hair, woolen, etc., gives off most unpleasant odors with the gases formed, so that a specially constructed furnace to consume these gases is needed. With this there is no difficulty. The burning gases and charcoal should be used to dry the other garbage and even to furnish power.

TO ILLUSTRATE CHANGES IN MILK

Procure a sample of really fresh, clean, cooled milk not more than 6 hours from milking. Compare this with samples bought at various places.

Measure out 5 c.c. of each into a small beaker, dilute with 50 c.c. of water, add 3 drops of the indicator solution, phenolphthalein, and from a burette add drop by drop, with stirring, sodium hydroxide one-tenth normal solution (4 grams NaOH in 1 liter) until the mixture is faintly pink. Each tenth of a cubic centimeter of the sodium hydroxide used is counted as a degree of acidity.

This acid is chiefly lactic acid formed from milk sugar by the action of B lacticus. The fresh milk should show less than 10°; when the test shows 23° the original sample will coagulate on boiling. Some samples may show as high as 100° and yet no harmful results follow their use. Apparently the harmful fermentations which take place are those which affect the nitrogenous constituents, yield ammonia, and so tend to neutralize the lactic acid. For this reason no decision can be reached as to safety of milk by chemical tests.

Absolutely normal milk gives the amphoteric reaction, that is, it turns delicate red litmus paper blue, and blue litmus red because neutral and acid phosphates are present.

The Petri dishes may be used to show in general the presence of germs, and a description may be given of the methods by centrifuge for pus cells, dirt, etc., but it is not advisable to take time for the class to go through the processes.

Qualitative tests for dirt may be made by filtering through closely packed absorbent cotton.

Leach recommends the following simple test for the presence of formaldehyde:

To 10 c.c. of the milk in a white porcelain dish add 8 c.c. of hydrochloric acid (1.2 sp. gr.) and 2 c.c. of a 10 per cent. ferric chloride solution; heat gently nearly to a boiling point, stirring all the while to break up the curd. More or less formaldehyde gives deeper or lighter violet color. One part in 250,000 parts of milk may be detected.

CHAPTER III

THE CLEAN HOUSE

The sanitation of the house, a space inclosed by four walls and more or less cut up into smaller spaces, consists in keeping the air fairly clean, the water supply safe, and the food good.

THE air of inclosed spaces soon becomes overcrowded by the products of respiration, among which we note carbon dioxide and moisture. The carbon dioxide arises from the processes of decomposition of the food in the body whereby warmth and energy are furnished. Carbon dioxide is a waste product which is no longer useful and should be at once removed, like any other waste.

Modern sanitarians are inclined to believe that of all the causes of disease vitiation of the air is by far the most important. A man emits as much CO_2 through respiration daily as would be produced by about one-half pound of charcoal.

The air can never be quite clean and fresh, because it is confined somewhat and often is contaminated by the products of combustion from lamps and gas, from cook stoves and furnaces, and by deleterious gas from unclean soil on which it stands, from dirty back yards, from leaking gas fixtures, and from furnace gas. Gases and fluids leaking from joints in sewer pipes add to the contaminating odors from cooking and dust from carpets and

furniture, until it is no wonder that so many persons suffer from "colds" and from that general debility which allows the attack of many diseases.

Tuberculosis is especially a closed-space disease. Considering the bad quality of the air that so many persons accustom themselves to breathe, it is a matter for wonder that no more persons are sick.

In the cities, owing to the cost of buildings and land, the cubic air space for each person is growing smaller and smaller, until the law has stepped in and required 330 cubic feet of space for each person in a tenement, in a schoolhouse, in a factory.

The law leaves the demand for air to the good sense of the ordinary house dweller, who is learning only slowly that his brilliant gaslight of an evening, his tight steam-heated apartment, his one-window bedroom, are slowly sapping his strength.

The effort now made to educate the whole people in the use of fresh air as an important factor in curing and, still better, in preventing tuberculosis will have good results in the direction of general health as well as in any specific case.

The three essentials for healthful life are food, water, and air, and the most important of these is air. In this most medical men and hygienists are agreed. While we eat perhaps three times a day and take water every few hours, we breathe, upon the average, twenty times a minute, or 28,800 times every twenty-four hours. So constant a function must be an important one. We are told that if air could be withheld from us for six minutes, we should die. Moreover, where abundant oxygen is

present in the air, the quality of the food is of much less consequence than when the air is vitiated.

There are numerous historical records of deaths from insufficient air. We remember learning that of the 146 persons confined in the Black Hole of Calcutta, 123 died in one night.

The author has said elsewhere that "nothing will take the place of fresh air. It is one of the necessities of right living. The child should be taught to recognize stale air and to demand fresh air as he now demands a drink of water. Study rooms at home and in school must have better facilities than nine-tenths now have, in order to lessen the 'partial death rate.'" "The child should learn to heed this call [for oxygen] as much as any other. It is imperative that fresh air, not used-up, breathed-over-and-over-again air, should flow through the lungs."

It is the birthright of every child to be allowed fresh, clean air to breathe and be taught how to fill his lungs with it by deep breathing. If he once recognizes the odor and effect of unclean air and becomes accustomed to good air, he has acquired a valuable asset for life. He is in little danger from tuberculosis, and in less danger from colds and throat diseases.

Because the body does adapt itself to surrounding conditions is no reason for making those conditions as hard as possible. The pale and pinched appearance of the children of the crowded city is caused more by the lack of clean air than by any other one thing.

To secure sufficient air without dust and without drafts is the great problem of the city dweller, and he

must use all his common sense and ingenuity to secure this.

Examine briefly the constituents of the air. The composition of the air shows, on an average, 20.93 per cent. oxygen, 79.04 per cent. nitrogen, .03 per cent. CO_2, with traces of ammonia, ozone, argon, krypton, neon, metargon. These parts do not form a chemical compound, but are mechanically mixed.

Air at the height of 15,000 feet has been found to have the same composition as at the sea level. Atmospheric pressure, however, influences cell life, so that a change to a higher altitude usually has a stimulating effect.

Ozone is a form of oxygen containing three atoms of oxygen to the molecule instead of two. It is produced by electrical disturbances, and is found in some abundance, caused by the atmospheric electricity, at the seashore and on mountains. The name, coming from the Greek "I smell," is interesting, having been given because of the peculiar odor that was observed during a thunder storm, and later in the presence of an active electrical machine. It may be that it is this ozone in the air that makes in large part the life-giving quality of sea and mountain air.

A variety of causes may contribute to change the quality of the air indoors, vitiating it so that it is unfit to be breathed. There may be too much CO_2, and consequently too little oxygen; there may be too little moisture, or there may be too much moisture; there may be substances, such as dust, suspended in the air; there may be noxious gases or impurities from respiration.

The presence of any one of these in excess is a predisposing factor to disease and should be guarded against with all care. The remedy is to keep the inside air as nearly the same as that of outdoors as possible. This means a free circulation of air, with no dead spaces to hold foul air. In summer this is not difficult, but with the first chill of the fall we begin to shut our windows, and we put off the artificial heat as long as possible. This is a grave mistake of many people. The dampness of the soil and walls of houses in spring and fall should be counteracted by fires, even if the windows are left open. This is not the waste it seems, for it means making the transition from one season to the other without the severe colds which so pull one down.

Habit has a great deal to do with the desire for fresh air and the endurance of moving currents.

If one feels cold it is better to take a brisk walk or to run up and down stairs or to go through simple arm and leg exercises than to hug the stove or sit over the register.

Even the kitchen can be kept decently cool if the ventilators are arranged properly. There is no such thing as being obliged to stifle. We do not care enough to remedy matters, that is all.

The newspapers make much of the powers of General Humidity, but it is no laughing matter. The relative moisture in the air is one of the serious disadvantages of certain climates. The reasons are not all well understood, and belong under physiology rather than sanitation. What does belong here is the recognition of possible sanitary precautions even though they might come

under personal hygiene, such as the avoidance of rich food, which requires the evaporation of much water from the body surface to carry away the unneeded heat, the wearing of light and porous clothing, etc. But beyond that, in climates where such days are only occasional and for that reason are not prepared for, the installation of drying apparatus is desirable and not impossible. Precautions as to food and undue exertion on hot days with high humidity should be general, in order that the blood pressure should be reduced and escape from sunstroke made possible.

In cold winter weather when halls are heated by steam the air may become too dry for comfort. Hot water heating and good ventilation will obviate this difficulty.

At all temperatures moisture exists in the air in an invisible state. A rise of temperature increases the capacity of the air for moisture to a certain limit when the air is said to be saturated. This capacity of air for moisture increases more rapidly than the temperature. Air at 32° can contain 160th part of its own weight; at 59°, the 80th part; at 86°, the 40th part, the law being that for every increase of 27° its capacity is doubled. The dew-point, or the temperature at which the moisture begins to condense, may be determined by placing a thermometer in a polished metal cup and dropping in small pieces of ice until moisture appears on the outside. The temperature read must be that of the cup and not of unmelted ice. The experiment takes time, therefore the device of the so-called wet bulb with constant evaporation is most convenient.[1]

[1] Signal Service Notes, No. III, "To Foretell Frost." By James Allen. Washington office of the chief signal officer of the Army.

One or more of the several registering humidity testers should be in the schoolroom and records kept. But whatever apparatus is kept, the pupils should set up for themselves the simple one of two common but correct thermometers whose zero point is the same. About the bulb of one tie a skein of embroidery silk, silk gauze, or some long fibered cotton wick such as is used in alcohol lamps. The essential point is that it shall by its capillarity soak up water from the bottle suspended below, quickly and constantly, to replace that lost by the evaporation about the bulb, cooling it in proportion to the rapidity of evaporation.

The water used should be soft and the silk or cotton fiber be kept clean and not allowed to become caked with dust, or greased from handling with the fingers.

The two thermometers are hung side by side three or four inches apart, and of course out of reach of the sun.

This simple device is most convenient for any one who has a garden, since it gives a means of foretelling frost. The wet bulb registers the dew-point or the saturation temperature to which the thermometer is to fall unless clouds or wind intervene. Thus if at nine o'clock on an October evening the air thermometer reads 60° and the wet bulb reads 48°, a difference of 12°, the temperature may fall to 31°. If the air is 45° and the wet bulb seven degrees lower, or 38°, the final temperature may be as low as 25° with killing frost, whereas if there is only a difference of two degrees it will fall to 40° and the plants be safe.

DEW-POINT

Difference between Reading of Wet and Dry Bulb

Air temperature.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Air temperature.
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
+30	+30	+27	+24	+21	+17	+13	+ 7	— 1	—11	—30	. .	. .	. .	. .	+30
+35	+35	+32	+29	+26	+24	+20	+16	+11	+ 5	— 3	—17	. .	. .	. .	+35
+40	+40	+37	+35	+32	+29	+26	+22	+18	+12	+10	+ 3	— 6	—22	. .	+40
+45	+45	+43	+40	+38	+35	+32	+29	+25	+21	+17	+11	+ 4	— 7	—27	+45
+50	+50	+48	+46	+43	+41	+38	+36	+33	+29	+26	+22	+17	+11	+ 3	+50
+55	+55	+53	+51	+49	+47	+45	+42	+39	+36	+33	+30	+26	+22	+17	+55
+60	+60	+58	+56	+54	+52	+50	+48	+46	+43	+41	+38	+35	+31	+28	+60

The temperature which we feel is that of the wet bulb, that is, the evaporation temperature, for our skins are evaporating water just as the wrapping of the wet bulb is doing. A little practice in watching the thermometers and consulting relative humidity tables will convince of the truth of this.

A room occupied by many people becomes saturated with moisture from the breath and bodies of the inmates and the stifling sensation is very oppressive. A current of air to carry away this moisture is essential to comfort. Just what is the physiological effect of the retention of this moisture upon the body, the scientific world has not decided, but it is agreed that it is bad. Its effect in weakening the system is shown in the fact that so many persons contract colds and pneumonia on passing from a crowded room to the dry air outside in the cold weather.

RELATIVE HUMIDITY

Difference between Wet and Dry Bulb Thermometers

+10° to +100°

Wet bulb thermometer.	1	2	3	4	5	6	7	8	9	10	11	12	13
°	°	°	°	°	°	°	°	°	°	°	°	°	°
10	79	61	44	28	13	. .	. .	. .	. .	. .	. .	. .	. .
15	83	67	52	39	27	15	5	. .	. .	. .	. .	. .	. .
20	85	72	60	48	38	28	19	11	. .	. .	. .	. .	. .
25	88	77	67	59	48	41	32	26	18	10	. .	. .	. .
30	89	79	69	61	52	45	37	30	26	18	11	6	. .
35	90	80	71	63	56	48	42	35	30	24	19	14	10
40	91	83	75	67	60	54	48	42	37	32	27	23	19
45	92	85	77	71	64	59	53	48	43	38	34	30	26
50	93	86	79	73	68	62	57	53	48	44	40	36	33
55	93	87	81	76	70	66	61	57	52	48	45	41	38
60	94	88	83	78	73	68	64	60	56	52	49	45	42
65	94	90	84	79	75	71	67	63	59	56	52	49	46
70	95	90	85	81	76	72	69	65	61	58	55	52	49
75	95	90	86	82	78	74	70	67	64	61	58	55	52
80	95	91	87	83	79	75	72	69	66	63	60	57	54
85	96	91	88	84	80	76	73	70	67	64	62	59	56
90	96	92	88	85	81	78	75	72	69	66	63	61	58
95	96	92	89	85	82	79	76	73	70	68	65	62	60
100	96	93	89	86	83	80	77	74	71	69	66	64	62

The reading of the wet bulb thermometer is found on the left-hand column, and the difference between the wet and the dry bulb in the horizontal line at the top. The number at the intersection of these columns is the relative humidity under the conditions at the time.

The table is shortened to avoid confusion, but the full tables may be consulted and may well be copied on a

card and hung up beside the humidity apparatus. (See Ward's "Meteorology.")

Public sanitation is forced to take account of the quality of air in cars, halls, schools, and places of amusement where many people are crowded together, and where the wishes of one individual may conflict with the inclination of others.

The same methods may be used in the single house. The air in this should be even more closely looked after, for one stays many hours in a house.

Dust in the air causes irritation of the air passages if nothing more, and such furnishings of the house and such care of them and of the floors should be secured as will allow clean air to breathe.

The condition of growing plants is one of the very best tests of room or house sanitation. If their leaves become very dusty, then the room is not cleaned properly; if they drop their leaves, then there is probably a gas leak or furnace gas escapes. If they do not grow, they are not rightly watered, that is, if they have been properly potted. Pots for the dry air of the house should not be of the porous kind used in the damp greenhouse. If the common brown earth pot is oiled on the outside and then shellaced, it will be much better for the plant and much neater and cleaner to handle. The roots that go to the edge will not dry up and the earth will not be cooled by evaporation. Roots as well as leaves must breathe, therefore porous drainage is supplied at the bottom. Where plants will not grow people ought not to live, is a safe maxim.

For the country house, clean soil and clean water are

the most difficult to secure. Because the living earth or soil-plants so abundant in the surface—two to four inches of ordinary "garden soil"—sweetens and disposes so efficiently of waste matter buried there, it is abused by overdosing or continuous use and thus becomes foul and a menace to the house dwellers. Moreover, such foul soil pollutes the water in the vicinity, so that, more often than not, the well at a country house, however cool and clear the water, is unsafe to use. This is especially the case when there is a supply of water in the house and a cesspool to receive the waste, or when the drain is allowed to make a wet pool within fifty feet of the well. To have things handy is not always safe.

The principle on which earth purification takes place is by supplying it with air continuously or intermittently. Little plants decompose the waste matters under all natural conditions. Those, however, that convert them into harmless, useful nitrate, carbon dioxide, etc., must have oxygen from the air. Therefore the soil must be porous, not soaked. A pail of dirty water may be thrown with impunity on the same spot each morning for twenty years if the soil takes it up within five or ten minutes, but if the soil is clayey, so that the water stands half a day, and perhaps is wet even the next morning, then purification does not take place. A small plot of sandy soil will take care of the drainage of a house, if it is used in alternate sections, and if trees such as apples or willows are grown on the edge. Some crops may be grown, such as corn, whose fruit is far enough above the surface to escape the drainage water. Since most germs, however, are killed by drying in the sunlight, there is little

danger from an irrigation garden. The underground water is in constant motion toward lower land, but the level of the so-called water table is not usually that of the surface. Herein is the cause of so many mistakes in the placing of wells and cesspools and barns in the country. The slope of surface and water level do not coincide.

Clean water from shallow wells is a rarity. Soil is porous and rocks are full of crevices, so that what is thrown onto the surface finds its way some distance down to the water level. Human beings waste salt and nitrogenous substances that are soluble and which, finding their way into the water, are carried with it wherever it goes. If they are found in any considerable amount, it means that the water is not above reproach, but it may be so well filtered that there is no real danger.

It is about as dangerous for the ordinary person without experience to attempt to interpret the results of a water analysis as for an ordinary person to interpret the indications of a serious illness. The diagnosis of invidious disease and the diagnosis of the history and conditions of an unsafe water belong to the expert having not only knowledge but experience. To the layman appearance and taste govern his judgment. Neither is a criterion of safe water. The soft, slightly yellow water supplied by many cities is shunned by visitors merely from sentiment. The meadow tea, as Thoreau aptly called it, is quite harmless.

Not all clean water is colorless. Not all clear, sparkling water is clean. Not all pond water is dangerous. Not all well or spring water is safe.

Water carries whatever gets into it unless it is fil-

tered out, and some things go through all but the finest filter.

If kitchen slops are thrown on the ground, the water filters through the soil, leaving the cabbage leaves behind, but carrying the salt from the corned beef or the ice cream freezer. This can be traced into the stream or the well if it is in the line of flow, probably that is all that can be traced. But chamber slops are all liquid and sink down into the ground; the chlorine goes through as in the kitchen slops, but the ammoniacal salts become food for grass, roots of trees, and finally, as oxidized nitrates (by soil bacteria), the nitrogen passes on into river or well. They can be readily detected and serve to indicate the source of the drainage.

The danger is that the cesspool overflow or seepage will not be well filtered and that some bacteria may go through and some disease germs also. Too great care cannot be taken to have clean water above suspicion; better boil it if there is doubt.

The schoolhouse well should be the best in town, but alas! it is often the worst. (Only very general tests will be found at the end of the chapter, for most of the water examinations require the diagnosis of an expert.)

After clean air and clean water come clean fingers. At first it might seem as if this were hygiene, a personal matter like care of feet or teeth, but it is much more. It means clean doors and desks and banisters, dainty habits in the use of fingers, never touching nose or mouth. It means soap and water and towels, a nail brush and manicure scissors. It means careful washing of hands after touching the hair, which collects dust

rapidly. It means cleaning of shoes in a basement place provided, and a brushing of clothes.

Sanitary cleanliness means washable or cleanable clothes. Clothes would keep clean much longer if fingers were not wiped on them, and if they were carefully hung up and brushed. Lint from unbrushed woolen clothing collects dust and then, when damp, smells.

Illustrative Experiments

To make a chamber for air experiments

Find a box at the grocer's about 16 x 18 x 6 inches. Get from the glazier's 2 panes of common glass; fit the glass front and back, the front pane to slide up and down fairly readily. It need not be air-tight, no room ever is. Then make holes in the two sides with a 1½-inch auger and use corks to stop the holes. If there is a manual training shop at hand the room may be made with oblong spaces like windows and sliding shutters. The idea is to secure a closed space of not more than a cubic foot content in which, without too much time, a class may see the candles go out, and watch the smoke indicating the currents.

To test air currents with a candle flame

A current of 1 foot a second velocity does not perceptibly deflect the flame.

One and one-half to 2 feet deflects the flame 30°.

Four feet a second deflects it 45°.

Six feet a second deflects it 60°.

To change the air five times an hour in a small

room, or in a space where people sit close to the sides, is a difficult matter to accomplish without causing currents.

TO TEST FOR LEAKING SEWER PIPES

Are the sewer pipes tight as shown by the peppermint test? Pour two ounces of oil of peppermint into the soil pipe at its mouth above the roof, if it is accessible, or into the basin or water-closet nearest the roof, first closing the vent pipes which appear above the roof. Pour in immediately after a pailful of hot water. The person doing this should remain shut in until another person who has not handled the bottle, nor been in communication with the one who has, has passed through all the lower rooms sniffing for a trace of peppermint odor. If this is noticed it should be followed to the leaking spot in the pipe.

TESTING AIR FOR CARBON DIOXIDE

The most suitable solution for general pupils to use is lime water. A saturated stock solution may be kept in a bottle protected from carbon dioxide. One or two much weaker solutions, one one-hundredth or one two-hundredth as strong as the saturated solution, may be kept in similarly protected bottles, but one five-hundredth or one one-thousandth as strong as the saturated solution should be used the day they are made.

The indicator (phenolphthalein) is made by dissolving .070 gram of the powder in 50 c.c. of strong alcohol and making up to 100 c.c.

To prepare the saturated lime water, procure a stony lump of quicklime (if it is crumbly, it is air-slaked and useless) as clean and white as possible. Place it in a

porcelain dish and set on a brick or on something which will not scorch or crack with the heat. It is instructive to weigh the lump and add the calculated amount of water.

Ten grams CaO 40+16=56 requires 18 grams H_2O to make CaH_2O_2 40+2+32=74 grams.

If weights are not made, add at least an equal bulk of water to the quicklime. It should begin to heat and swell up and soon fall to a dry powder, if the lime was quick and the proportions correct. The excess of water evaporates.

Drop the powder into the stock bottle, add water to four-fifths fill the bottle. A lump weighing 25 grams will serve for a 2-liter bottle.

Stopper lightly and shake at intervals for several hours, allow to settle clear, then fit the stopper and delivery tubes. The appearance of a scum or film of solid on any part of the solution shows leakage of air.

To prepare a one one-hundredth saturated solution, measure 1 or 2 or more liters of water into whichever size of bottle is chosen, add 2 c.c. of the indicator (phenolphthalein) solution for each liter, add cautiously the lime water, finally, drop by drop, with rotary shaking, until the solution shows a faint color against a white background, remaining for 5 minutes, then add from the burette just 10 c.c. of the saturated lime water, stopper quickly, mix well, and place on the shelf with the delivery tubes, etc., as with the solution having the powder at the bottom. This being clear, no time for settling is required. The other strengths are made in the same way, using the smaller amounts; only the one one-thousandth is best

made from the one one-hundredth. The two hundredth solution will serve for the common tests: Wolpert, Fitz shaker, Cohen and Appleyard, and for the ounce bottle test. The one one-thousandth is used for what may be called the bubble method, because a stronger solution would require too much time.

In all these dilute lime water tests the results are only approximate and comparative because of the great difficulty of excluding air at all points in the process.

A quick and ready method for estimating the carbon dioxide in the air of inclosed spaces is a great desideratum. The properties of the gas and its relation to other substances have not, hitherto, admitted of a mechanical measure, as a thermometer is a measure of the degree of heat.

The Wolpert plan of a bead of liquid flowing down a thread serves for a day or two. But the thread soon becomes incrusted and ceases to conduct the liquid, and the reservoir requires renewing frequently.

The principle of the Wolpert tester and the Fitz shaker is that to 10 c.c. of the dilute lime water in the graduated glass tube is added successively measured volumes of air, which are shaken up with the lime water and by it deprived of the CO_2 until the solution is neutralized and it becomes colorless and cloudy with the insoluble calcium carbonate.

If out-of-door air takes 300 c.c. to decolorize the 10 c.c. lime water, and if the air in schoolroom A takes 200 c.c., that in schoolroom B 100 c.c., and in a bedroom only 50 c.c., we have a relative measure of the badness of the air. It is necessary to test the lime solution in outside air to be sure of the method and results.

Of a one two-hundredth solution 10 c.c. will require 300 to 350 c.c. of outdoor air to decolorize; a sufficiently ventilated room, 150 to 200 c.c.; a badly ventilated room, 100 to 150 c.c.; an intolerable and quickly to be remedied room, 50 to 90 c.c.

A set of graded bottles, 2, 4, 6, 8, 10 ounce as bought of the druggist, may be filled with water, carried to the place to be tested and the water emptied out. The air will rush in to take its place and thus be confined. The 2-ounce bottle corresponds to the 50 to 90 c.c., the 4-ounce to the 100 to 150 c.c., the 6-ounce to the 150 to 200 c.c., the 8-ounce to 200 to 300 c.c., the 10-ounce to 300 to 400 c.c., when the above solution is introduced and shaken.

The same solution may be used for the time method. The principle of this is that the higher the proportion of CO_2 in the air the quicker it will unite with the lime water.[1] Select some white glass 500 c.c. bottles, round or square or oblong, not corrugated or stamped, glass-stoppered; wash them thoroughly, soaking at first with a little acid in the water to neutralize any alkali left from the stoppers. Collect air samples by emptying the water from the inverted bottle held at the point the air is to be tested (catch the water in a suitable clean vessel and use to refill the bottle if more convenient).

When the desired number of samples has been collected, bring to the laboratory, add 10 c.c. of the one two-hundredth solution, close the bottle and shake, noting the time to the second when the lime water was added and the color has nearly disappeared. Out-of-door air will

[1] See any text-book for law of partial pressures.

require 3 or 3½ minutes, the ventilated room 2 minutes, the badly ventilated room 1 minute, the intolerable room ½ minute or less.

For the bubble method the one one-thousandth solution is used and a test tube fitted with stopper and glass tubing, so that the air is drawn through slowly and its bubbles robbed of the CO_2 as it passes. As the time method shows, this can be passed only slowly and in small bubbles and is then only comparative, but for a lecture experiment or for illustration of progressive pollution it is very effective. Fresh air takes 10 minutes, fairly good air 5 minutes, bad air decolorizes in 2 or 3 minutes. If no suction is available it may be produced from a pair of bottles called aspirators, so connected that the water from one runs into the other at a lower level, and when full the positions are reversed.

HUMIDITY TESTS

To show the stifling sensation of saturated air and that the sensible temperature, or that which we *feel,* is that of the wet bulb, use a small room or closet, which may be made moist by hanging wet blankets or moist and hot by steam; set a pupil to record the sensations and the reading of the instruments.[1]

EXPERIMENTS WITH WATER

It is usually possible to find a bottle holding 2 to 4 quarts with the bottom broken off evenly, or to have one cut; support it in some convenient manner; fit the neck with a stopper carrying a glass tube furnished with rub-

[1] If the school can have a Draper registering thermometer it will give both pleasure and instruction.

ber ending and punch cork. Fill it four-fifths full with the sample of soil to be tested, put a fine wire gauze at the bottom and some coarser gravel so as to furnish good drainage, then the sifted earth. It adds to the interest to weigh the dried earth used and then to measure the water added at the top and note the amount the earth from different sources will take up. Some clayey soil for contrast should be obtained.

(*a*) Prepare test solutions as follows: Weigh 0.165 gram salt (pure, dry NaCl). Make up to a liter. 1 c.c. = 0.001 gram Cl.

(*b*) Weigh 0.072 gram KnO_3. Make up to a liter. Measure out 100 c.c. of this and make up to a liter. 1 c.c. = 0.000001 nitrogen.

(*c*) Weigh 0.315 gram NH_4Cl. Make up to a liter. Measure out 100 c.c. of this and make up to a liter. 1 c.c. = 0.00001 nitrogen.

It is desirable to prepare fresh for experiments,

(*d*) A solution containing 1 c.c. skimmed milk in a liter.

(*e*) A solution containing 1 c.c. urine in a liter.

Varying quantities of these solutions and mixtures of them may be made by the class, each for his own filter, and tests of the filtrate made. There may be shown the following facts: That the salt goes through unchanged whatever the mixture used, and therefore that the test for chlorine is a universal one, and its presence above the normal for the region is a certain indication of past pollution. That passed through clean sand or earth, nitrates go through unchanged; but in the presence of considerable organic matter, milk solutions, for in-

stance, they are reduced to nitrites. Ammonia and urine solutions may be converted into nitrates by slow passage through unsterilized loam or garden soil, but they are not changed by clean washed sand. Nitrates therefore show a previous contamination, ammonia and nitrites show present contamination.

Filtration after Coagulation

Mixtures of *d* and *e* in considerable dilution with a little clayey soil may be used to illustrate the purification by mechanical filtration, now so common for the muddy river waters of the South and West. To 1 liter of the trial water add 1 to 10 c.c. of an alum solution, 5 grams to the liter; mix well. If on standing half an hour coagulation does not take place, add 10 c.c. of a saturated lime water, mix well and allow to stand. Experiment by adding first one and then the other until it is probable that 24 hours' standing will give a clear solution which may be decanted. A much less quantity of the reagent will give a mixture which, run through one of the prepared filters, will give a clear solution.

The hard waters of the South and West will coagulate without the addition of anything beside the alum solution. The soft colored waters do not contain enough lime or sodium salts to decompose the aluminum sulphate, and some must be added.

Examination of Well Water

Secure from the chemical laboratory a small bottle of Nessler solution to test for ammonia; neutral potassium chromate to use as indicator for chlorine titration;

a very small, well-protected bottle of phenol disulphonic acid to test for nitrates.

Give a demonstration to the class of the preliminary examination of a well water.

Examine the sample taken in a clean, clear glass bottle with a glass or new cork stopper, not brought in a fruit jar with rubber ring or a jug with old stopper.

Note if the water is clear or if there are organisms, as cyclops or daphnia, specks of rust or stringy cobweb, like gray threads. Heat about 100 c.c. in a beaker capable of holding three times as much. Cover with a watch glass while heating until the moisture begins to condense on the glass cover. Remove and at the end of 5 minutes take a quick sniff. There should be no unpleasant odor.

Measure into clean beakers 100 c.c. each of distilled water, a well known to be good, the town, city, or school supply, and of the sample to be tested. Add 5 drops of the potassium chromate indicator to each, then from a burette run in, drop by drop, silver nitrate, stirring gently after each addition until a reddish color appears. The chloride of silver is white and is formed before any chromate.

Distilled water will show red after a drop or two; the good supply may take several drops, but a bad well often requires several cubic centimeters. Good water 100 miles from the seacoast rarely has over one part per million of chlorine. Nearer the sea there may be ten parts, so that the normal chlorine must be known to the expert analyst.

To test for nitrates, which always accompany chlorine

in bad wells, evaporate 2 c.c. of each of the water samples tested for chlorine just to dryness on a warm bath or plate.

Three-inch porcelain dishes are best. Add 5 drops of the prepared phenol disulphonic acid, moisten the dish wherever the water has dried, and neutralize the acid by a very dilute alkaline solution of potassium hydrate. If there are nitrates a yellow color will appear more or less deep.

It is a very polluted well which shows free ammonia, but ordinary distilled water almost always contains ammonia concentrated in its distillation, hence there must be a caution in making this test. Well-filtered ground water does not show ammonia.

None of these things are in themselves harmful, but they indicate certain underground happenings which are to be avoided.

Before going into any extensive discussion of these matters the teacher should read some of the text-books on water.

CHAPTER IV

HABITS OF CLEANLINESS

"Correct habits, not rules, are the proper preventions for all sorts of defects." — *Saxon saying.*

"A most essential part of modern education is the early formation of such habits with regard to environment as shall conduce to the best living."

HEALTH, like religion, is to be such an integral part of the individual as to be a daily performance, and not a matter of times and seasons.

When this is the case, the person has a set of habits become as much a part of him—as involuntarily performed—as breathing. Such habits can be readily impressed on the body while it is plastic and growing, that is, while it is young. But they are acquired only with difficulty and by much thought in after years. Hence there is the greatest economy of time and energy in accustoming young people to habits of daily living which will give them the best chance in after life—the chance to be healthy, happy, and efficient human beings.

Grown people find it such an effort to change a habit that curious devices are resorted to to cheat them into doing what they agree is right and desirable, but which it takes an effort to remember to do.

An excellent example of bondage to habit is brought out in the proposition that was at one time made to change the clocks of an island town in summer so that

instead of breakfasting three or four hours after the birds and squirrels, the people may be up at five or six o'clock and enjoy the best of the summer days.

This illustrates the purely mental effect of going by the clock and not by what is wise and desirable. An intelligent community has not strength of mind or energy enough to take the great sanitary advantage of the life-giving early hours without being inveigled into doing right by the clocks.

Without becoming frightened by a discussion of germs we may well ask where do microbes come from? We find them in dirt and refuse and wherever there is food for them. They act as decomposing agents to make over waste matter into food for plants as soon as possible. Men and animals eat the plants, and other microbes complete the cycle.

Refuse thrown out on the cornfield or buried in soil soon becomes absorbed, but the same refuse hidden in the back yard under a pile of boards where nothing green can grow may become dangerous and will be offensive. The organisms which work in the dark and often make bad smells are called anaërobic, without air. Rout them out into the sunlight and air and they soon die. In the city there is nothing to do but to get rid of them, down the sewer as quickly as possible, if they are liquids or fine solids; and to burn all coarse solids.

But how does it happen that there is so much dirt to get rid of? Why must we be on the lookout all the time?

Largely because we are careless and thoughtless and leave refuse about to be looked after by the microbes, which are doing their best to help us.

That is, we have not acquired good habits of cleanliness—never to leave wastes about, but to get rid of them for good and all as soon as possible.

These habits will become second nature very soon if we will take pains for a little time. If we will think for a short time, then our habits will take care of themselves and we can think of other things.

We have certain inherent capacities as to bodily strength, length of life, etc., but it lies largely with ourselves to adopt a mode of life which may make an actual difference in height, weight and physical strength and intellectual capacity. An eminent physician says that "*most* people die prematurely through *needless exposure* to infection, improper food, excessive drinking, impure air, diet of various kinds, unhealthy occupations, improper clothing," etc.

These essential habits are largely connected with breathing, eating, and drinking (air, water, and food), together with sleep, exercise, and cleanliness.

Every man who hopes to make a success of his life work—whatever that may prove to be—must get into the habit of forming good habits, of taking infinite pains habitually to fashion his character in the right way.

If heredity has hampered one's life, it is so much the more desirable that the one who has little force to expend should acquire habits of doing the right thing, and so husbanding both physical strength and mental power.

"Even inanimate things acquire habits—a lock works better after being used some time; it costs less trouble to fold a paper when it has been folded already. This saving of trouble is due to the essential nature of habit.

which brings it about that to reproduce the effect once gained a less amount of the cause is required. The sounds of a violin improve by use in the hands of an able artist because the fibers of the wood at last contract habits of vibration conformed to harmonious relations. This is what gives such inestimable value to musical instruments[1] that have belonged to great masters."

If inanimate things can acquire desirable habits of value to the world, shall human beings not take pains to make themselves of as much value as possible at as little cost of nervous energy as may be? For it is certainly true that "habit diminishes the conscious attention with which acts are performed."

Thus one may involuntarily and without effort do the right thing at the right time, *leaving the mind free to decide upon matters requiring higher thought.* If practice did not make perfect, nor habit economize the expense of nervous and muscular energy, man with his multifarious impulses to action would be in a sorry plight.

Children and youth learn so easily and adults with such difficulty that the plan of education should include the daily habits which make for long life and immunity from disease. "The more of the details of our daily life we can hand over to the effortless custody of automatism, the more our higher powers of mind will be set free for their own proper work." "Could the young but realize how soon they will become mere walking bundles of habits, they would give more heed to their conduct while in a plastic state."[2]

[1] M. Leon Dumont, Essay on Habit, *Revue Philosophie*, Vol. 1, p. 324.

[2] James's "Psychology," pp. 122–127.

Whenever the sanitary enthusiast begs his friends to take more pains to do certain right things or to avoid certain doubtful ones he is met with such remarks as, "I cannot remember," "It takes too much time," "It is too much trouble to think of that," etc.

Right sanitary actions should not require conscious thought. They should be done involuntarily without the effort of thinking.

Professor James's two important maxims are: (1) "Make our nervous system our ally instead of our enemy —make automatic and habitual, as early as possible, as many useful actions as we can."

(2) "Never suffer an exception to occur until the new habit is securely rooted in your life." It is far more costly to learn by our mistakes than by patient repetition of right ways which soon become unconscious acts.

The habits to be contracted early are both personal and social, the reasons are explained in treatises on personal hygiene and in those on community sanitation. At this point only a general survey is needed. Those concerning personal hygiene are for the most part mandatory, as bathe daily, clean the teeth after every meal and on rising and going to bed, etc.

One of the most important habits to acquire is that of keeping one's fingers and all other objects of use away from nose and mouth. Then the hands will be far less dangerous. This fingering of the face seems to be a relic of savage days.

Eyes and nose are subject to disorders of the greatest infective power, and hands transmit to a great variety of objects handled by others. That is why personal habits

of this kind come into a consideration of community sanitation.

In the light of modern knowledge one of the bad habits is wetting the finger to turn the leaves of books. This not only soils the leaf and causes it to turn yellow, but since the mouth harbors many kinds of dormant germs, it is a dangerous proceeding as well as an untidy one.

It is astonishing how few people have outgrown the child's habit of putting things in the mouth. "Out of the mouth cometh all uncleanness." This habit is not a little to blame for the spread of children's diseases and for all those which find an agreeable home in nose and throat.

The habit of biting an apple and then handing it to a little friend is most pernicious.

Do not cough into free air or into your hand. The fine spray even in speaking, when there is mucus in the throat, may and usually is sent for a number of feet away from the person. That is why grip and tonsilitis spread so rapidly in crowded shops and cars.

If the hand catches this spray it stops it, to be sure, but carries it to the friend's hand or to the book or bag one is carrying. Use a handkerchief or piece of cloth always, and have plenty of them.

Each morning the greatest pains should be taken to have face, hands, and finger nails really clean, not just clean to appearance. Washable gloves put on when the hands are clean are a protection against others' carelessness.

After handling books, chairs, banisters, coats, etc., wash the hands again and wipe them on a clean towel. A dirty towel is often the worst carrier of infection.

Daintiness in these respects is one of the most important habits to form. Cheese cloth may be used instead of towels and may be washed and dried on the school premises. Ironing is not necessary.

Another very necessary habit is care of pocket handkerchiefs. No matter how inexpensive the material, cloths of some kind should be used to protect the hands, and therefore they should be large enough and there should be enough of them to prevent re-using when one is wet or soiled.

There are more sanitary sins of commission in connection with lack of sufficient handkerchiefs than with any other one thing except, possibly, spitting on the floor.

The spread of the deadly spinal meningitis has been pretty clearly traced in several cases to mothers who were carrying sick children lending the soiled handkerchief to the next child.

The mothers will sigh over the multiplication of handkerchiefs and towels, but rightly used (they are not for wiping desks or boots) such accessories to cleanness will more than pay in good health.

The habits affecting community sanitation are largely prohibitive. Do *not* spit in the street, in the car or in the public paths, because it may infect others. Do *not* go about with dirty hands and finger nails, because not only may your own body suffer from the entrance of germs by means of scratches, but your hands touch others and others' property, and may distribute undesirable organisms.

The tendency to get rid of waste material with little trouble to one's self and without thought of the effect on

one's neighbor is seen in the sweeping of houses, halls, and shops into the streets, in the throwing of papers and luncheon boxes under seats in public parks, and in the scattering of peanut shells in cars. No surer test of the general sanitary intelligence of a community can be made than the inspection of a suburban train, both as to its ventilation and cleanliness. The public carrier and the public caretaker take pains only to the point demanded by the public patronizing them. The grocery store has responded to this demand. Have the schoolhouse and the city hall and post office in your vicinity so responded?

The best exercise for a class will be to make out a list of "don'ts" from their studies and from observation in their own localities. The country school will have one set, the suburban another, and the city school a third, with many variations.

This opens the way for a study of the next chapter. What is a community to do in order to demand right and safe habits from itself, namely, the making of rules and regulations which mean the acquirement of habitual ways of doing things of the most advantage to the community?

The habit of putting wastes in a proper place prepared for each kind is one of the most valuable sanitary habits.

This should be enforced in school. The schoolhouse and schoolyard should be the example of tidiness. It takes only a few seconds for each one to do the right thing, and taxation for paying public scavengers is lightened and safety from distributed dirt insured.

The care of clothes is a sanitary problem.

Loosely woven wool is the warmest covering but collects the most dust and is most difficult to wash. Loosely woven cotton or silk is next best but soon loses its neat look and becomes limp and twisted.

Finely woven cotton or linen holds its texture and shape best under hard usage, sheds dust and cleans easily, but conducts heat rapidly and is not suitable for cold weather.

Under the conditions under which city children live—dusty streets, dirty cars and staircases, crowds of people and sooty air—clothes should be frequently changed, stockings especially. In the city, water is abundant and there is no excuse for not keeping clean.

Illustrative Experiments

Tests for Cleanness. Dust on Things

In the Navy the inspector wipes the inside of the soup kettle with a fine cambric handkerchief. No discoloration of the immaculately clean linen should occur. Not all furniture may be kept in such order, but an approximation may be made.

Have several squares of fine bleached cheese cloth six or eight inches square. Test desks, chairs, walls, tables, window sills, door handles, banisters, etc., to see if they are free from black dirt. The moist hand will take up even more than the cloth.

For the dampened duster see page 5.

Flies are tabooed; but if the windows are spotted, a cloth moistened with a little alcohol may be used to wipe

them clean. This is done not only for neatness, but as a sanitary precaution, since flyspecks may distribute disease germs. Put used squares in a pail of water at once, and wash out when convenient.

With floors prevention is half the battle. Do not bring in dirt on shoes and clothing. Unless windows are screened, or the air is forced in through a screened chamber, dust will blow in, if the house is on a street or near a plowed field. Hang a large piece of the dampened cheese cloth across the opened window, pinning it on so that the air must pass through it and leave the dust behind. Note the time when it becomes darkened and when it begins to bag out, showing that it is clogged. Do the same before the ventilating inlet. Dampened sawdust is one of the best agents for taking up dirt from a hardwood floor. It may be burned and so all particles disposed of. Bits of dampened, not wet, newspaper are next best, and for the same reason. Dampened cloth fastened to a broom or bristle brush may be tried.

When a room has been cleaned, expose Petri dishes for 10 minutes, cover and set aside for 48 hours. If the room is free from dust half an hour after cleaning, it is fit to live in, that is, if there are not more than five or six colonies.

EXERCISES

Observe:

Do you keep your hands so clean that the water shows little change in washing?

Do you avoid touching walls and banisters, chairs and tables unnecessarily?

Do you notice dirt on your hands afterward?

Do you keep your mouth closed in cars and dusty places?

Do you refrain from putting pencils and other things into your mouth?

Do you refrain from wetting your finger to turn leaves?

Do you keep your hands dry so that they do not gather dirt?

Do you breathe deeply without needing to think?

Do you notice stuffy air?

Do you do your part toward a clean house and city, and avoid throwing papers, etc., anywhere but in the proper receptacles?

Do you avoid spitting?

Do you avoid coughing into the free air?

Don'ts:

Don't live in foul air.

Don't drink impure water.

Don't buy dirty milk.

Don't use stale milk.

Don't eat food badly cooked. Take cooking lessons somewhere.

Don't kiss dirty children.

Don't mouth dirty money.

Don't fail to wash your hands often.

Don't rub your eyes with dirty fingers.

Don't forget to put the shovel of dry earth or ashes down the privy vault in the country. Take a lesson from the cat.

Don't throw apple cores and banana skins out for the flies to breed in.

Don't leave the water in the flower vase more than twelve hours.

Don't forget to wash and scrub your hands after lunch.

Don't wipe your hands on your clothes.

CHAPTER V

SANITARY REGULATIONS

"Within the past few years the knowledge of the causes of disease has become so far advanced that it is a matter of practical certainty that by unstinted application of known methods of investigation, and consequent controlling action, *all epidemic disease could be abolished within a period so short as fifty years.* It is merely the employment of the means at our command.

"Where there is one man of first-rate intelligence employed in detecting the disease-producing parasites, their special conditions of life, and the way to bring them to an end, there should be a thousand. It should be as much the purpose of civilized governments to protect their citizens in this respect as it is to provide defence against human aggression. . . . The masses of the people are not yet aware of the situation. . . . It is certain that democracy will demand [that the authorities] shall put into practice the power of nature-control which has been gained by mankind and shall exert every sinew to obtain more."

—*E. Ray Lankaster, in "The Kingdom of Man."*

THE educational effect of legal enactment and enforcement none should know better than health officers. But it is also painfully evident to those in whose hands lies the enforcement of sanitary law that this education has not gone very far nor very deep, that year after year the same sort of work has to be done as if it had never been done before. The non-intelligent masses rebel against the rules they do not understand and evade all that they find it safe to ignore.

It is like sweeping back the sea with a broom, since each year brings a fresh contingent of ignorance. A respect for the power of the law is inculcated by the enforcement of the ordinance against spitting in public conveyances, but no permanent cure for the evil habit can be expected until the children and young loafers also are reached by the reasons why it is dangerous.

Until both parents and children understand the reason why rubbish in the streets and garbage in the back alleys are not to be tolerated, it will continue to be found there in spite of city ordinances and health officers.

Sanitary regulations are of little value unless they are generally known and obeyed, and to be obeyed cheerfully they must be understood.

Each town has or should have certain regulations for the protection of its citizens.

Each state has also laws in relation to the protection of the people in such cases as affect a wider community. These are often compiled in manuals which may be obtained.

Finally the Federal government has regulations which affect long distance travel, imported goods, etc.

Each school should have copies of these laws in its library and the fact of their existence should be called to the attention of each pupil, even if they are not read to the whole school.

Laws are for our protection and not for our oppression. As long as we are ignorant and selfish we shall be a menace to our neighbor in our careless and ignorant ways, and he has a right to claim government protection against us

Many of these regulations seem at first sight oppressive and unnecessarily costly, but in the long run they will be found to be as fair as they can be made.

Injurious Trades and Factory Inspection

Two great enemies of indoor workers are close air and dust, gritty or linty or poison fumes. But individual carelessness and unclean habits make dangerous the handling of such materials as lead, paint, or arsenical products.

Factory inspection includes inspection of air space, floors, toilet accommodations, and most of the general environment; but instruction of the workers as to their part in co-operating to maintain a sanitary condition is too often lacking.

In most of the dangerous trades, nelps are provided which the workers are too lazy to use. Sanitary instruction must go so deeply into the daily lives of the people that nothing will seem too much trouble, if, by that means, health and capacity for work may be secured.

Inspection

Tenement inspection shows the same lack of attention to laws of health. School inspection is only just being supplemented by the work of the school nurse, who is really a teacher. All inspection should be supplemented in this way by practical instruction in the means of carrying out the regulations. All rules, however carefully drawn, will fail to meet exceptional circumstances, and intelligence must take into account the fundamental principles.

Education

Sanitary science has advanced so much faster than popular knowledge that many communities get their education in preventive measures only after they are confronted with an epidemic.

The case of the New Orleans epidemic of yellow fever in 1904 is in point. Although the suppression of yellow fever in Cuba was the most remarkable result the world has ever seen of the application of scientific knowledge to immediate beneficent result, the officials of the Gulf States did not fully accept the mosquito theory and thus did not suppress the trouble in the beginning. It required the presence of the United States authorities and constant lectures and ward meetings to educate even the intelligent people to the true remedies.

Education in sanitary matters, knowledge of what are proper precautions and a belief that such precautions *pay* in the end must be carried on day by day—must be the aim of all wishers for human progress.

Another case in which an epidemic was the costly teacher was in the camps of the United States soldiers at the time of the Spanish War in 1898. Typhoid fever became epidemic in the camps situated in the Southern Atlantic States to such an extent that more than one-fifth of the soldiers had it, and it was brought away to an extent that undid the work of twenty years in suppressing it. Nearly twenty per cent. of the officers contracted the disease. It was conclusively proved (to our everlasting shame) that flies were the chief carriers of the disease. But this was possible only because the precaution of covering and disinfecting the excreta was not attended to.

There should not have been flies to carry the disease and the first case should have been the last.[1]

The plague of flies may be stopped when breeding places are screened, as manure heaps in the country; when streets and alleys are kept clean in the city; and when restaurant and house garbage is removed daily—in short, when nothing is left about for flies to feed upon.[2]

Let us protect all foods from flies. If the community cannot or will not prevent their propagation, then individuals must resort to fly paper, insect powder, and occasional fumigation.

Official Public Health Work

At Washington, D. C., Surgeon-General Rufus Blue is in charge of the Public Health and Marine Hospital service under the Treasury Department. The Hygienic Laboratory carries on researches and issues bulletins. Conferences of state and territorial health officers are held in Washington.

All the states have Boards of Health with offices at the state capitol. Many of them issue reports of great interest and value which may be obtained on application or through representatives.

Several of these boards issue bulletins and pamphlets for free distribution, notably Maine, New Hampshire,

[1] Walter Reed, Victor C. Vaughan, E. O. Shakespeare, "Report on the Origin and Spread of Typhoid Fever in U. S. Military Camps during the Spanish War of 1898." Government Document.

Dr. L. O. Howard, "A Contribution to the Study of the Insect Fauna of Human Excrement." Proceedings of the Washington Academy of Sciences, Vol. II.

[2] W. E. Britton Donn, State Entomologist, "The Common House Fly in Its Relation to the Public Health." *Yale Medical Journal*, January, 1906.

Vermont, Connecticut, New Jersey, New York, Ohio, Indiana, Illinois, Iowa, Wisconsin. Michigan has for many years given much attention to the dissemination of popular literature on sanitary topics. A series of teachers' bulletins, reaching a circulation of over a quarter of a million, have been issued since 1895 to enable them to comply with the law of that year requiring instruction to be given in relation to contagious diseases and other health matters. One of these gives an interesting estimate on the money value of health work.

In order to have information, well-equipped laboratories are now being installed, with a corps of investigators and routine workers. Visit that in the locality of the school, if possible.

From these offices a surprising amount of information in the way of bulletins and reports is being issued, most of it free. One has no excuse for ignorance.

The State Board of Health of New Hampshire issued a special Sanitary Bulletin for gratuitous distribution throughout the state on scarlet fever, "in order that a wider and more general knowledge of the means and measures necessary to the restriction and prevention of scarlet fever may be disseminated."

The town of Montclair, N. J., has been a model for local supervision. The 1906 report says:

"Its chief efforts have been directed, as in former years, towards preventing the spread of communicable diseases. Its efforts to prevent the spread of disease center:

"(1) In the proper control of persons suffering with communicable diseases, including their environments.

"(2) In safeguarding the milk supply of the town.

"(3) In constant watchfulness over both pupils and buildings of the public and the parochial schools.

"The oversight of the milk supply is one of the most important if not *the* most important branch of work which is intrusted to a Board of Health."

Comparatively few householders know what the law requires until they come in contact with it. The tenement dweller and the recent immigrant can know little of the best ways of keeping clean in a strange country.

Instructive nursing has found its place and instructive inspection should be introduced in every village. The school and the Woman's Club can each do a part in becoming a source of information and a repository of the best appliances. There should be one or more trained women inspectors in each town and city ward.

In 1905, Prof. J. Pease Norton, of the Department of Economics, Yale University, presented a paper to the American Association for the Advancement of Science in which he gave statistics to back up his plea for government attention to the great wastes in human life by preventable disease. He claimed that of the people then living over eight millions would die of tuberculosis, that during the next ten years more than six millions of infants under two years would die; eight millions will perish of pneumonia, six millions from heart and kidney diseases. Of these twenty-eight millions, representing a potential value of $5,000 each, or even $2,000 each, a tremendous money waste is going on which might be prevented by an expenditure of perhaps ten per cent. of the amount in money and a little time and thought by

each one. A committee of one hundred has been organized to work for public enlightenment and for a public sentiment resulting in government aid.

A modest effort had already started under the name of the Health Education League,[1] whose work is the circulation of booklets giving an epitome of the practical knowledge on certain definite points. There is little excuse today for any one to go ignorant of the various precautions to be taken to ward off disease.

In the state of Connecticut there is a woman deputy factory inspector, recommended to the factory inspector by a commission of three women appointed by the governor. This deputy is to consider whatever relates to the health and welfare of the 50,000 working women in the state. This includes inspection of sanitary fixtures, cleanliness, ventilation, etc.

Law is the foundation of state medicine—the protection of the ignorant, the helpless, and the thoughtless. Many a school-teacher allows the schoolhouse to become unsanitary because it does not seem important in comparison with the lessons; many a shop manager never thinks about it; and many a tenement owner says, "Oh, well, they need not hire it"; or, "They do not want any better." Then the law steps in and says, "But they should want better, and if they are to become good citizens and efficient workers they must have better."

So important is this education through sanitary regulation that the states of New York, Texas, Pennsylvania, and the District of Columbia have each a Department of Health, with a single commissioner and county health

officers and inspectors. Massachusetts has a system of district inspectors.

Many states have milk commissions.

All this effort to enforce the laws is a great factor in instructing the people in safe ways of carrying on their daily life, for the laws are almost always ahead of the general belief concerning the necessity for them. For instance, the city of New York has a provision in its sanitary code that all food in the streets shall be protected, but it is not enforced because the general sentiment of the people is not ready for it.

Diseases that are carried by flies, fleas, mosquitoes, water, etc., and that are carried from one person to another by contact and by handling of food or utensils, MAY BE PREVENTED.

WHY ARE THEY NOT PREVENTED?

Because the people do not believe that the rules of health are necessary and they are not willing to take the trouble to follow them.

In the Panama Canal zone they collect all garbage and rubbish *every day;* even shavings, shingles, empty barrels, the litter of house building, are removed before night and burned. No rubbish of any sort is allowed to accumulate.

Large bodies of men are employed in every town of the zone keeping every pool of stagnant water well covered with crude petroleum. The banks of the streams are constantly patrolled and every small pool or slack water bay is filled up and all the work is under most careful inspection.

All this shows what might be done in our towns if we only believed it was worth while.

In England they have come to feel that the great question of the day is THE HEALTH OF THE PEOPLE, and they have formed a National League for physical education and improvement.

The late Lord Derby said sanitary instruction is of the two more important than sanitary legislation.

Nothing can supersede the value of personal and private care to relieve the public officers of so much duty as can be carried out by individuals.

Illustrative Experiments

Exercise in Inspection

Secure the loan of a house for inspection. Observe the streets and alleys adjacent; watch for the water cart if summer, for the sanitary collector of ashes and garbage. Note if the carts are covered; if the men take care not to scatter or spill or drip; if they come as often as they should. Note how often and how well the streets are cleaned.

Pass through the gate, examine the back premises; note any broken bottle or bent metal which can hold a cup of water; note if roof gutters leave pools; note any soft refuse food for flies; note rubbish in general. Especially look after the garbage can; see if it is of light metal so that it may be cleaned on emptying. (If it is sunk in the ground and protected by a light frame and heavy cover, after the manner of the Stephenson, it keeps cool and does not become offensive.)

It is desirable that in tenement houses and small apartment houses all garbage receptacles shall be emp-

tied and cleaned each day. Some public co-operation must be obtained to force this upon careless tenants.

If all is proved to be really clean and well cared for outside, pass to the area or basement door. Note if this space is damp. Enter the basement or cellar. Go in quickly from the outside air and observe the presence of any kind of odor and its source—decay, mold, gas, stale or stuffy air. Follow into kitchen and laundry, dining room, hall and chambers, or such of these rooms as there are. Show the friend how better ventilation could be obtained by windows raised or lowered, and board or cloth screens inserted or placed outside, cross currents obtained, etc. Convince him that a little more coal to "heat all outdoors" is cheaper than loss of time and doctor's bills.

At this point let the class discuss and draw up a set of regulations for their own town in the light of all they have studied, such as would seem to be conducive to better sanitary conditions and not too burdensome to carry out either in regard to time or money.

Then procure a copy of the Board of Health regulations for the town and for the state and compare them to see if anything has been omitted.

The class may prepare cards suitable to be hung up in schoolrooms, or one-page circulars to be distributed among the people, stating clearly and concisely certain things we do know and avoiding sensational phrases or reference to things we do not know.

Also the pupils should draw up rules of conduct for themselves, and once a week revise them as they find them too stringent or too lax.

This kind of constructive exercise is of great value to

any one. Certain difficulties stand out prominently which would otherwise be overlooked.

The cost of obtaining the requisite amount of fresh air in a cold climate, and of maintaining the desired standard of cleanliness in a place where labor is dear and dirt abundant, should be brought out by concrete illustration.

The teacher will find an excellent model in "A Handbook for the Housekeepers of Chicago," pages 16-28.

Require only those things to be done which are practicable.

EXERCISE IN PREVENTION OF DECAY—ANTISEPTICS

Treat small bits of meat in test tubes, in salt, alcohol, smoke, borax, formaldehyde.

EXERCISE IN DISINFECTION—STOPPAGE OF DECAY ALREADY BEGUN, SO THAT NO FURTHER HARM MAY COME

Treat beef broth which has been allowed to spoil in test tubes, or small flasks, with heat, alcohol, formaldehyde (very cautiously), corrosive sublimate, sulphonaphthol, cresol, etc., to see if decay is really stopped.

EXERCISE IN DESTRUCTION OF ORGANIC MATTER

Put a thin slice of meat, say ¼ inch thick and ½ inch wide, 1 inch long, into a thick earthen cup in the middle of a layer of pounded quicklime 1 inch deep under and over it. The cup must be deep enough to allow the swelling of the quicklime as it slakes and must be set where the heating will do no harm; cover and leave for a week, then examine. Repeat with copperas, iron sulphate.

CHAPTER VI

IMMUNITY. CONFIDENT LIFE. EUTHENICS

"If our corpuscles are weaker than the invading foes, no drugs can save us — we are doomed. Hence the importance of keeping our nerve centers well charged and our minute life cells in vigorous condition." — *Sidney H. Beard.*

The cultivation of sanitary tastes which will enable us instinctively to avoid unclean air, doubtful food, and dirty paths is as much a duty as the cultivation of a taste for beauty in form and color.

"We make them hope, and hope is health."
— *B. W. Richardson.*

IN every community some persons are constantly liable to disease, always ailing, while others go through epidemics unscathed. Common tradition attributes this immunity to some mysterious inherited property, just as little under control as the color of one's hair or the shape of one's nose.

It is true that a certain set of tendencies is inherited and that care in infancy is of extreme importance in the development of physical power; but the perfecting of the organization lies with the individual himself, chiefly as a result of the habits just considered, together with those concerned more intimately with the individual personal hygiene.

To be perfectly well is to be resistant to disease. But the strong man is careless and may drink bad water

when he is tired or chilled, and have typhoid fever; may eat bad food, and be poisoned with ptomaines; may be sweated in bad air, and come down with pneumonia. These things the person sensitive to sanitary conditions will avoid, when one who takes no notice will not.

There is personal immunity, good physical condition; and mass immunity, good sanitary environment. The first is an individual matter, the second a collective social affair to be promoted by a consensus of opinion.

Fear is one of the most frequent causes of illness. Confidence in one's surroundings, in one's own good condition, is half the battle. How can one have confidence when the senses are offended at every step, in every hall and shop and car? How can one gain strength from food served in unclean vessels on unclean tables in rooms swarming with flies?

All conditions should be made right and then no one should worry.

Whatever may be the ultimate cause of immunity—whether the care of the body-soldiers of defense, the phagocytes, or whether it be opsonins, or just plain good blood—to feel fit to rise in the morning, ready for the day's work, without headache, with energy waiting to be used—that is confident life, that is the surest condition of immunity. A happy life enjoyment in work, whatever it may be, is the best safeguard against disease.

Proper diet belongs under personal hygiene, but communistic living may well come under the head of sanitation. It needs inspection and demands the services of an educated person.

In fact, the taking of food is as much a regulated

process as breathing or drinking. Life processes cannot go on without heat; and the union of the oxygen breathed in with the air, joined to food stuffs eaten and digested, furnishes this heat as well as energy for work.

It is not, then, a matter of whim, or of like or dislike. Each one of us must eat to live, to work or play, and the less we think about what we eat the better, provided that we start with good habits, or that some one who knows the right food sets it before us.

The boy or girl who expects to travel, to move about and see the world, should learn to eat all wholesome foods. One of the best assets in the Bank of Health is a strong appetite and a non-squeamish stomach. This organ can be strengthened or weakened like any other; like an arm, or the heart, it is susceptible to mental influences. That is why food comes into sanitation. It is as important to have right ideas on food as on air, for only then will sufficient effort be made to get the right kind and to have it clean and free from objection.

Market inspection of the strictest sort should be demanded in every state or city. The buyer cannot give the time to study with reagents and microscopes the bread and meat he purchases. Inspection is part of the city expense for which the individual householder pays taxes.

But in order not to make this an intolerable burden, each one should refrain from adding to the danger. The excrement or flesh of infected animals infects others, therefore the first law of sanitation is here also applicable—disposal of waste matter so that it will not infect others. We have yet to learn that this must be thor-

oughly done. All diseased meat should be steam treated and the excrement from diseased animals sterilized. These dangers will come in country towns rather than in cities, for the countryman is obliged to look after his own premises.

Fruit is praised as most healthful food, but the half green or half decayed stuff exposed for sale, especially in the country village, a little out from cities, should be buried out of sight rather than eaten. As in all the other subjects treated, standards should be learned so that it will be easy to avoid the dangerous product. Standard quality will of course have its price, but will be better worth it. In cities much sickness comes from eating decayed fruit and dirty fruit.

Avoid taking a winter diet in summer. First, because it is needless to force the body to manufacture heat to throw off by water (evaporated perspiration); second, because much of the food becomes uncertain, if not dangerous, in quality during the hot, damp weather. All foods decay more quickly under such conditions. Left-overs may be unsafe and all minces and croquettes are to be looked upon with suspicion in the ordinary restaurant and boarding house, especially in hot weather. Even milk is subject to the same suspicion. In fact, it is today one of the most difficult viands to secure in excellent condition.

Sanitation in relation to food deals first with wholesome and clean materials—meat from animals free from disease, fruit and vegetables free from decay, milk, butter, etc., free from contained bacteria. The dangers are the transference to the human body of encysted organisms

like trichina, of the absorption of poisonous substances, toxins, ptomaines; of the lodgment of germs of disease along with dust on berries, rough peach skins, crushed open fruits; of the dirt clinging to lettuce, celery, and such vegetables as are eaten raw.

For the next class of dangers, we turn to the handling of foods with unclean hands, or the dripping of infected matter over clean clams or oysters.

It is a safe precaution to patronize only those restaurants in which the waiters are evidently trained to handle the food and vessels with care. The mouth habit is so universal that it will take years of calling attention to it before girls can be broken of the habit of wetting their fingers and smoothing their hair. Not even the waitress' cap can prevent this very unsanitary habit. Boys have a correspondingly bad habit of wiping their hands on their trousers.

In these and countless other ways disease is mysteriously spread, all due to uncleanly habits. It will pay well to take care of one's hands and learn sanitary habits when one is young, then one will do right without effort. Whatever change of ideas may come with increase of knowledge, these habits will not need to be unlearned. Without knowing the reasons, they have been proclaimed in civilized lands.

All evils and dangers cannot be eliminated, therefore we cultivate immunity, not carelessness, but that degree of good blood which can easily care for stray germs that get in. This good blood cannot be made without good air. Good food is necessary, but oxygen is *essential,* and for this reason air comes first in the study of the means for the best of health.

We have one very bad habit which comes from an erroneous notion—the habit of going to the fire or putting on more clothes if we feel chilly.

That feeling is due to slow circulation of the blood, often because it has become too thick or too loaded with waste products. The remedy is a glass of hot water or a little brisk exercise; usually both are best.

If chilly, do not eat until warmed by a brisk walk about the square, or by light gymnastics. Every one should be trained to do three-minute exercises to start the circulation, "appetite exercise," it may be called. One or two glasses of water as hot as can be taken, plain water is best, colored by tea may serve, or hot milk may be taken if some time before a meal. It is the quickened circulation that is of value, to bring enough oxygen to the food to be used.

There is one phase of immunity which it is well for the teacher to keep in mind—that of inoculation, as for smallpox, by vaccination. There seems to be a sort of self-inoculation which prevents further trouble, as in the case of ordinary mosquito or flea bites. The first few days many persons suffer greatly, but soon become immune. Whether the blood develops an antitoxin or what happens is not certainly known. We become accustomed to certain conditions, and so tolerate them, but this belongs to another department and is only mentioned here because this indifference of some people living under the same conditions as others who are sensitive is often a strong argument brought up against all sanitary measures intended to include the community.

We were not poisoned by the water, or by the flies;

why should we clean up so that these strangers can live here?

Communities have accepted a degenerate life and laid it to the climate, when it is now known to be caused by some parasite, as the famous hook worm disease in the South and in tropical regions. The people lived a bare existence because of the prey of the disease, and went on scattering it wherever they went. Luckily they were not great travelers.

Rules of Safety

Since diseases are most frequently conveyed by actual contact with persons or with fresh body wastes, sputum, excreta, etc., it is safest to treat all body wastes as possibly dangerous, to avoid contact with them, and to dispose of them as soon and as completely as possible. Town authorities should demand isolation of all infectious cases.

Since dust in the air is always irritating to the delicate mucous membrane of nose, throat, and lungs, and thus is a cause of receptive condition for attack; and since objectionable organisms are frequently carried with other particles in the form of dust, it is safest to dispense with dust.

Since dust on furniture and floors is harmless so long as undisturbed, it is safest to remove it without sending it into the air to be breathed again. A dampened cloth should wipe it up, not a feather duster or dry cloth, sure to distribute it into the air again.

Since water and milk are frequent carriers of disease, both should be under sanitary control, and the community should pay cheerfully the price of clean supplies.

Since produce is brought from long distances and exposed for considerable time, markets should be under careful inspection and buyers should inform themselves in regard to the cleanliness and care with which all food materials are stored and handled. This will apply to one's own kitchen and pantry.

Since all wastes may harbor unpleasant and possibly dangerous agents of decay, they should be completely disposed of as soon as possible; not redistributed in small quantities, but burned or buried beyond recovery by prowling curs or rats.

Since the best preventives of germ growth are sunlight or cold below 55°, secure as much of the first as possible, and keep all perishable foods below this temperature until cooked.

Remember, sanitation is prevention, not cure. Cleanliness is absence of smells, not addition of a strong and pleasant one to an unpleasant one.

A healthy body, trained by all the rules of hygiene, may pass safely through the worst conditions, while a body weakened by self-indulgences will succumb at the first exposure.

A FEW REFERENCE BOOKS

Climate and Health in Hot Countries. G. M. J. Giles.

Mosquitoes. L. O. Howard.

Household Bacteriology. S. M. Elliott.

Principles of Sanitary Science and the Public Health. W. T. Sedgwick.

Street Cleaning and Disposal of the City's Waste. G. E. Waring, Jr.

Garbage Crematories in America. W. M. Venable.

Home Sanitation. Richards and Talbot.

Sanitary and Applied Chemistry. E. H. S. Bailey.

Care of a House. T. M. Clark.

Laws: See State Digests or Bulletins.

The Human Mechanism. Hough and Sedgwick.

Personal Hygiene. Maurice LeBosquet.

Personal Hygiene. A. A. Woodhull.

Health, Strength and Power. D. A. Sargent.

The Efficient Life. Luther Gulick.

These and other books on these subjects may be obtained from Whitcomb & Barrows, Boston.

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