

Recommendations for the  
Practice of Sanitation  
on Forest Areas  
by  
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RECOMMENDATIONS FOR THE  
PRACTICE OF SANITATION  
ON FOREST AREAS

INTRODUCTION

The Problem

A great problem facing foresters today is the protection of the health of the thousands of persons who seek recreation and enjoyment over vast areas of timberland far removed from the conveniences of modern sanitation. His problem is not limited to a few camp grounds or along traveled roads, but extends to every acre where man may tread.

Importance of Problem

This problem is increasing from year to year due to higher standards of living, shorter working hours, and more leisure time, which result in an increase in the numbers of our forest visitors. The problem is of importance not only for the protection of the forest user but also for the protection of water supplies serving surrounding communities.

## Review of Previous Studies

To my knowledge, no previous study has definitely linked forestry with sanitation. Much has been done on aspects of rural sanitation, and it is true that rural sanitation is, in both theory and practice, applicable to forest areas.

## Method of Procedure and Source of Data

I have attempted to set forth facts which will give a basic understanding of the theory of sanitation in its form best adapted to forest areas. I do not claim to be a sanitary engineer or the like, and what is contained on the following pages is purely a statement of recommendations for the practice of sanitation on forest areas from a forester's viewpoint.

My sources of data were the College library and the various state health departments and conservation departments as could furnish material of this nature.

## Review of Study

Great men have devoted their lives in study that we might live in an environment most beneficial to our well-being. Years, almost centuries, have elapsed since study first began on the exact nature and cause of disease, and it has been only comparatively recent that these early studies have been collaborated and set down in the annals

of history as scientific fact. In recognition of what has come before us and in order to fully appreciate the cause of sanitation, it is my duty to give mention of these great men and their work.

Basically, sanitation in our viewpoint today deals with the prevention of the spread of contagious diseases by contact infection. It is then desirable to have an understanding of disease, its cause, source, and means of travel from one person to the next, so that we may be best able to adopt the necessary measures for the blocking of these routes of disease transfer.

In blocking these routes of travel, our first consideration is with our water supplies. We must adopt methods by which we can distinguish a good water from a polluted water, and to take steps to correct or avoid any condition which may prove dangerous to public health.

That the purity of our water supplies may be assured and maintained, and to prevent the spread of disease organisms by means other than water, our second consideration is with sewage disposal. Sewerage may pollute the streams supplying our drinking water, or carry the disease germs to man through infection of food, etc. We must, then, adopt methods to dispose of sewage in a manner that is safe, convenient, and adequate.

The forester must not only be concerned with providing the necessary sanitary conveniences on his areas for



public use, but he must also be concerned with those who may take it onto themselves to bring some of these necessary conveniences with them when they visit his areas. I am referring to house trailers and the problems they present. While their use is as yet small here in the Northwest, they do present a great potential problem. It is for this reason I deem it necessary to give a brief review of this problem and offer what suggestions I can for its solution.

The forester's main concern, from a public health standpoint, is the prevention of spread of contagious diseases by contact infection, but he is also interested in the comfort of his users by protecting them from unnecessary nuisances such as odors, dust, flies, and rodents. I do not feel that it is necessary to give these matters consideration because their control is gained largely through the construction of adequate facilities, such as toilets and garbage pits, which are considered in this study.

The forester must also concern himself with secondary sources of disease, or those transmitted through an intermediate host. However, the matter of their control is, in most cases, taken out of the forester's hands, as the problem is usually of extent over wide areas which are incorporated under systems of control. For this reason, and because the field of sanitation is more greatly concerned with man himself as the primary source

of disease, I have given this secondary source little consideration in this study.

## CHAPTER I. THE RISE OF THE PUBLIC HEALTH MOVEMENT AND COMMUNITY SANITATION

In order to appreciate the place of community sanitation in the public health movement, it is desirable to trace the development of the latter. The development of the modern public health movement may be conveniently divided into three periods; the first as the Period of the Sanitary Engineer; the second as the Period of the Bacteriologist; and the third as the Period of the Physiologist.

### The Period of the Sanitary Engineer

This period began in about 1850 with the work of Chadwick and Simon in England where, as a result of the intolerable sanitary conditions that followed the urbanization of the population in the wake of the industrial revolution, the modern public health movement was seen to have its origin with chief emphasis on environmental sanitation. Sir Edwin Chadwick, as secretary of the Poor Law Commission, presented a study of the sanitary condition of the laboring class of Great Britain, and saw as a result of his study the appointment of a Royal Commission on the Health of Towns in 1843. The work of this Commission resulted in the initiation of a movement aiming to promote better water supplies and more satisfactory methods of

sewage disposal. To Sir John Simon was given the appointment in 1848 as the Medical Officer of Health for London, and the actual organization, conduct, and development of a public health program was placed in his trust. During a generation in administrative health work, he was largely responsible for the adoption of laws and ordinances pertaining to public health, promotion of environmental sanitation, and to the introduction and development of modern health education. It was during this same period that the effects of the work of Chadwick and Simon were becoming felt in the United States. The work of Lemuel Shattuck in his Report of the Massachusetts Sanitary Commission in 1850, served as a basis and goal for organized public health work in this country for many years. It is interesting to note that many of the recommendations suggested in Shattuck's report only now are being initiated into our public health programs. But one should realize that it often requires many years of effort and education before the adoption of significant recommendations for social welfare and public health improvement. With its chief emphasis on environmental sanitation, this period flourished particularly during the next forty years, and during this time water supplies were purified, sewers were built, attention was given to methods of sewage treatment, to housing, to reduction of nuisances due to odors and smoke, to refuse collection and disposal, to food inspection, and to the combating of filth



generally.

### The Period of the Bacteriologist

The invention of the compound microscope near the end of the sixteenth century by Jansen led to a series of studies which ultimately resulted in the formulating of the basic principles of the modern theory of disease and the beginnings of the Period of the Bacteriologist in about 1880. It was Lieuwenhoek in Holland who, with his more perfectly-constructed lenses, first beheld bacteria in 1675. He noted their presence in water as well as in various substances of animal origin, and recognized differences in their appearance and size as well as in their mode of motion. His observations and others subsequently supplemented by other studies gave rise to much heated discussion concerning the relations of the bacteria, or animalcules as they were spoken of then, to animal diseases. Still a greater attention was given at this time to the bacteria and the possibility of their spontaneous generation. This theory, however, was disproven in 1765 by Spallanzani and by Schultze in 1836, who showed by their studies that no bacterial development occurs in liquids which have been subject to boiling temperatures or filtration. Kohn's discovery in 1875 of spore-forming bacteria and the necessity of higher temperatures than boiling to kill them, accounted for the occasional failures to secure sterilization by boiling, and gave

final proof to the falsity of the idea of the spontaneous generation of bacteria. Pasteur's epoch-making investigations on fermentation shed a broader light on the activities and the physiology of bacteria. His work may be regarded as the starting point for more fruitful research and as the foundation of extensive knowledge on the physiology of bacteria and their distinction not by their appearance alone, but by the chemical transformations of which they are capable. Henceforth, they were to be regarded as chemical agents of great significance, builders and destroyers of vegetable and animal substances, in organic and inorganic materials, in the presence or absence of air. Pasteur's work, which led to discoveries of specific causative agencies of fermentations, won for him the honor of being the founder of bacteriology and prepared the ground for the recognition of bacteria as agents of infection. He stimulated the introduction of antiseptic surgery, and later through his efforts to immunize sheep against anthrax and to protect humans against rabies following dog bites, paved the way for the development of a new field of immunity.

Following methods used by Pasteur, Robert Koch, in 1881, introduced a new method of cultivating bacteria by solid cultures, whereas up to this time all cultures of yeast or bacteria had hitherto been liquid cultures which were tedious, uncertain, unsatisfactory, and in the hands of any but experts were sure to lead to wrong conclusions.

The solid cultures overcame the worst defects of the method of liquid cultures, namely the promiscuous mingling of different kinds of bacteria and the time and labor consequently required to obtain "pure" cultures. The adoption by Koch of the use of aniline dyes made possible a differentiation of the cell structure of the organisms, while his inoculation of mixtures containing known forms of bacteria into experimental animals and follow-up study of effects, offered a new means of identification of specific disease germs. Thus upon the foundations laid by Pasteur, the honor of establishing bacteriology as a science of high honor among the biological sciences belongs to Robert Koch as a result of his studies of the definite causative agents of diseases of animals.

These discoveries led to the introduction of public health laboratories, to disinfection and fumigation, to isolation and quarantine. Chemistry became a strong ally of bacteriology, and enabled the latter to recognize the chemical transformations effected by the microorganisms. Medical bacteriology saw a wonderful development in the study of toxins, the poisonous substances resulting from bacterial activities, and anti-toxins, capable of neutralizing these poisons. This in turn has been the starting point for far-reaching investigations concerning the invasion of the animal system by bacteria, and the protective machinery of the human body.

In 1888, the first municipal public health laboratory



was organized in Providence, and the New York City Health Department Laboratory, which has rendered distinguished service in the fields of bacteriology, immunology, and public health, was organized in 1892. From this time on, the public health laboratory became one of the most useful tools, and there is hardly a state or city health department which does not operate its own laboratory. Functions of the public health laboratories have been greatly extended in recent times to include the diagnosis of various diseases, supervision over water, milk, and other food supplies, the standardization of disinfectants, the preparation of bacterial vaccines, and the conduct of research work in bacteriology and immunology.

#### The Period of the Physiologist

With the understanding we have today of the various causative agents of disease, it is only natural that the attention of the public health leaders should be directed to the need of building up and maintaining bodily resistance to ward off communicable and organic diseases. This is dependent upon the application of the rules of personal hygiene or principles of physiology to one's daily life, and upon the emphasis of health education and the proper conduct of life. This period was ushered in with the twentieth century, and the last few years have seen the development of health education as a special school activity, the organization of clinics, the development of

campaigns urging annual physical examinations, and of popular health education. Justification for the view that public health is now in the Period of the Physiologist is the emphasis which is being placed today on the proper conduct of life from earliest infancy to ripe old age.

### Improved Sanitation a Requisite of Communal Life

It must be clear that each era in the public health movement is not a distinct and separate entity, and that there is still a great need for continued services which the sanitarian and bacteriologist are qualified to offer. Public health administration in the United States is as yet in the developmental stage, and consideration of the fact that many practices heretofore undertaken in an experimental way have firmly established themselves and proven their worth, it is due time that we begin to consolidate the ground that has been gained and extend the worthwhile methods to the whole people. Even today, parts of our United States are desperately in need of more satisfactory facilities of water supply and sewage disposal, and even more disgraceful is the fact that today fully sixty per cent of our population are not served by sanitary toilet facilities. And even today in many sections of our country where environmental sanitation has made marked progress in the lowering of the death rate from communicable diseases, catastrophes such as floods which pollute water supplies and in turn bring about

great epidemics of cholera, typhoid, etc., occur every year almost completely wiping out the protective covering we do have, and sanitary conditions at once compare with those existing in the Dark Ages.

Federal, state, municipal, and private agencies have been organized and are doing valuable work for the protection, maintenance, and promotion of the well-being of the individual and his relation to his fellow men. The work of the National and State Departments of Public Health, and of the American Red Cross, are most widely known to the average individual for their work in insuring his very existence and well-being, but even their work would be of little value were it not for other agencies coordinating their services and extending them beyond administrative supervision possible of these few outstanding public service organizations. The task is a great one, but not one of the impossible.

Environmental sanitation is of first importance within the community because of the close association of every individual and every home within the community; here may be found the source of potential dangers to neighboring communities, the states, and even the nation, due to our rapid and extensive transportation systems and to the extensive interdependences of our social units. Obviously, certain essential functions of municipal or communal life must be socialized and brought together under a definite pattern, in order that the welfare of



the people may be served effectively and their health adequately protected. The requirements do not vary, only the scale of development may change from one community to another, depending only on sufficiency.

Many of our forested areas supporting certain amounts of recreational use are in remote regions which, although under the jurisdiction of Federal and state public health agencies, are beyond the scope of their administrative possibilities. It is then apparent that the administrators of these areas must abide by the rules and regulations as required by the above agencies for the protection of public health. As such, a large percentage of our population obtains its drinking water from forested areas, pollution of streams should be prevented by every possible means. This is indeed a problem over the extensive areas of our national and state forests where use is so widely scattered by amounts and types. However, strict adherence to proper sanitation practices in developing these areas for public use, and provisions for the prosecution for violations of sanitation regulations by users, must be the primary consideration before any such use can be initiated on any area.

## CHAPTER II. FACTORS OF CONSIDERATION IN THE TRANSFER OF DISEASE

### Nature of Causative Organisms

The organisms which cause diseases are termed pathogens. It is fortunate that this type of bacteria number less than one hundred. They exist in three main forms; the spherical, the cylindrical, and the spiral forms. Of two types, there are the aerobic bacteria which live in the presence of air, and the anaerobic bacteria which live in the absence of air.

There are several ways in which the invading micro-organisms might conceivably produce disease in the animal body; for example, (1) by their search for food in the body and destruction of bodily tissue, (2) elaboration of poisons produced by the bacteria or resulting from their dead bodies, (3) mere physical obstruction, clogging the arteries, veins, and capillaries, and interfering mechanically with the ordinary operation of the body, and (4) by raising bodily temperature. The principal method of damage lies in the generation of poisonous substances, or toxins, resulting from the operation of living ferments within or upon the organism. Every pathogenic organism has a mechanism by which it brings potential or real injury to the body it invades. Where the injury occurs, it is due to the elaboration of toxic products capable of producing the symptoms of disease.

## Classification of Diseases According to Discharge

The first grouping of diseases according to the type of discharge is the Respiratory Group. Discharges are from the nose and throat, and spread by personal contact over a short distance and within a short time, while the material is still fresh, as the germs can not stand drying. Diseases resulting from this type of discharge are of an acute nature characteristic of temperate climates, and often develop into epidemics. They cause eighty-five to ninety per cent of sickness and death at the present time, and include such diseases as influenza, pneumonia, and diphtheria.

The next grouping is the Alvine Group, and the control of this group of infections is one of the most notable achievements in preventative medicine. They include the intestinal infections as typhoid fever, cholera, dysentery, and hookworm. This type of diseases has been controlled largely through sanitary measures on milk, water, and food supplies. The number of these diseases prevalent in any community is a good index of its sanitary state. It is this group that we, as sanitarians, are most interested in controlling.

The Blood Transfer Group are spread through an intermediate host. All the blood-sucking insects must be regarded as dangerous, for even though they may not be an intermediate host of a disease, the open wound may



allow entrance of other infections. This group includes such diseases as Rocky Mountain spotted fever, typhus, and malaria.

The last grouping includes the Suppurative Group. This includes diseases spread by discharges from open infections. It includes diseases such as anthrax, scarlet fever, and smallpox.

### Modes of Transference

The viruses of the communicable diseases may take various routes of transference. These modes of transference may be conveniently grouped under three general heads: direct, indirect, or through an intermediate host. In the great majority of cases, the virus is transferred more or less directly by what is termed as contact infection, and in many cases the virus is transferred indirectly through food, water, milk, soil, air, etc. A large and growing group the transfer is through an intermediate host. The transfer is usually quite direct from one person to the next, and as a rule the agents of infection do not travel far. It may be said that the danger diminishes inversely as the cube of the distance; however, viruses may be spread through broadcast in water and milk and may also travel great distances by the host by cases and carriers.

Contact infection applies to a grouping of circumstances by which infection is spread more or less directly

from person to person. The time is usually short and consists of fresh infective material contacted over a short distance with cases or carriers. This mode is of greatest importance in the transfer of the respiratory diseases in which the discharges leave the mouth or nose. Also, this route plays a large role in the transfer of diseases in which the virus leave the body in the fecal and urinary discharges, as in typhoid, cholera, and dysentery. Contact infection also plays an important part in the transfer of infections having open sores on the surface of the body such as syphilis and gonorrhea.

Indirect infection includes a large group of diseases transferred indirectly from person to person through water, food, soil, and fomites. A large majority of the diseases contacted this way are taken into the system through the mouth and discharged from the body through the feces. The best examples of this class are typhoid fever, cholera, and dysentery.

Transfer through an Intermediate Host deals with the transmission of diseases through the bites of insects which harbor a life-cycle phase of a disease organism. In the zoological sense, the intermediate host is that animal which harbors the asexual phase of the life cycle of the disease, which is always the insect, and the definitive host is the animal which harbors the sexual phase. Thus, in malaria the mosquito is the intermediate host and man is the definitive host. The reason that a

certain disease may have an intermediate host of, as a rule, only one species or at most a single genus,<sup>3</sup> because it is believed that this particular virus is pathogenic to other hosts. Diseases transferred in this manner are, for example, malaria, dengue, and yellow fever.

### Sources of Infection

The two great sources of communicable diseases are man himself and the lower animals. Aside from a number of diseases, man contracts from the lower animals such as rabies from the dog, glanders from the horse, trichinosis from hogs, plague from rats, and tuberculosis in part from cattle, most of the communicable diseases which occur in epidemic form are peculiar to man. It is therefore plain that man is the greatest source and reservoir of human infections, and that man is man's greatest foe in this regard.

The very fact that man is the chief source and reservoir of most of his own infections adds greatly to the problems of public health work and makes the control of disease often dependent upon education and cooperation, and even upon social and economic changes.

### Summary of How Disease is Spread

The primary source of disease in a community is man, and the secondary source is the lower animals. The cause is some pathogenic organism, either bacteria, filtrable



virus, fungi, or protozoa. The sources of infection are between man and the lower animals or, in the greatest majority of cases, between man and man. The modes of transference are by either direct contact, indirect contact, or by an intermediate host.

### Blocking Spread of Disease

To control communicable diseases is to control the environment, and to control the movements and practices of man. The great achievements in public health work to date have been to bring the environment under control. Official activities of the public health administrations in relation to man's movements and practices are greatly limited by police power; hence the importance of education and cooperation. The understanding and sincere cooperation of each individual citizen is essential for success. But fortunately, perfection is not necessary for control of infection. This is true because that partial control of any one of the causes which in multiplicity conjugate to promote epidemics, may break the link in the chain and prevent the disease. Routes of travel are blocked by sanitary engineering, rigid inspection of food, quarantine and isolation, research, and public education.

## Place of Sanitation in Prevention of Disease

In public health administration, sanitation of the environment always comes first. The importance of sanitation is obvious because of the many important diseases transmitted from man to man through the environment. After a community has a good water supply and an efficient sewerage system, it can then turn its attention to hygiene.

Sanitation of the environment must be a matter of primary importance of any public health work, and it is our duty, as foresters, to realize our obligations in the protection of the health of our forest users.

### CHAPTER III. SANITARY ASPECTS AND DEVELOPMENT OF WATER SUPPLIES

#### Classification of Water

From a sanitary standpoint, water is either good or bad, spoken commonly as either pure or impure. However, at the present stage of our knowledge, it is not possible to draw so sharp a line of distinction. It is seldom possible to detect infection directly from water, although the possibility of infection may be inferred from the degree of contamination. Then for all practical purposes, water may be classified as good, polluted, or contaminated.

A good water is one that is free at all times from human contamination and safe for human consumption, as

determined by laboratory analysis and sanitary survey. A polluted water is one that has suffered impairment to physical properties as odor, taste, color, etc., through the addition of substances. A contaminated water is one which is potentially dangerous by reason of the addition of human or animal wastes or poisonous chemical compounds.

### Requirements for Good Water

While the essential requirement of a good water is that it must be free of pathogenic bacteria, there are other demands which must be met if the water is to be considered satisfactory. These properties include relative freedom from color, turbidity, tastes and odors, and hardness. Also, the water should have a relatively low temperature.

Color in water is due to the solution or suspension of substances with which it may come in contact, as vegetative material and sometimes iron. A highly-colored water is not necessarily a dangerous water, but high colors are often associated with pollution and are objectionable from a psychological standpoint. Waters which are of a doubtful sanitary quality are usually highly colored, and the popular demand therefore, based on experience, is for a water comparatively free from color.

Turbid waters are highly objectionable and are frequently dangerous as well. This condition is brought



about by the suspension of various particles of matter with which the water comes in contact. Turbidity is not dependent upon the nature of the materials in suspension, but upon the fineness of the particles. Streams which drain forested regions are usually comparatively free of turbidity, and the same may be said of lakes.

The natural pleasant taste of a good water is due to the solution of oxygen and carbon dioxide. Often there are tastes and even odors in water supplies which are due to the solution of certain gases in the water as hydrogen sulphide, but in most cases the undesirable tastes and odors are due to the presence of certain algae, diatoms, and infusoria. The tastes and odors produced are due to little drops of oil secreted by the microorganisms, and while they are unable to produce any communicable disease, are highly objectionable.

Hardness in water is brought about by the presence of certain mineral substances in solution. This characteristic can not be of too much concern in determining the suitability of any water supply within our forests, for the main objections to use of such water are purely economical, that it is unfit for boiler or laundry use. The only objection which may arise would be one of personal taste, and what one has been used to. It is true that soft waters are more desirable for cooking and drinking purposes, but I can see no reason for condemning any forest water because of its hardness alone.

The American people have become so fond of cool water that this one factor is what usually determines their like or dislike for any water. Water supplies within our forests are usually outstanding for their pleasant coolness. However, we must be concerned over the maximum temperature any potential supply might attain during the hottest summer months.

### Sources of Water

The primary source of all water supplies is of course atmospheric water in the form of rain, snow, hail, or sleet. A certain amount of this returns to the atmosphere by evaporation, and the rest collects upon the surface of the earth or soaks into the ground. Some of the water flows off the earth following contour into our ponds, lakes, streams and rivers, and ground water including springs and wells. Our interest of water sources in forested regions is with surface and ground waters.

Surface waters include all waters upon the earth in contact with the atmosphere. These waters vary greatly in composition, depending upon the type of soil or other materials with which they may come in contact. From a sanitary standpoint, these waters are always looked upon with some element of suspicion because of the way they are exposed to impurities. This can not be said of surface waters in all forested areas, but it is certainly true in some cases, and careful analysis must be taken

before use of any surface waters in our forests for water supplies.

Water taken from the ground by means of wells or that which flows naturally from the ground, is usually satisfactory as far as infectious impurities are concerned. The water, as it percolates from the surface through fine, sandy soil, is greatly purified. This is nature's way of filtration, in which the organic matter is oxidized and the bacteria are mostly strained out. This water finally reaches a stratum which it cannot penetrate and is then directed in a horizontal plane forming a more or less continuous body of water. This body of water is known as the ground water table and is tapped when wells are sunk, and forms springs, lakes, and marshes, where it crops out on the surface. This ground water table does not follow the contour of the land, but more the contour of the impervious stratum on which it rests. Rainfall more or less determines the surface of the ground water table, and it reaches a certain degree of uniformity during drought. Concern must therefore be given to the uniformity of flow throughout the summer months that an ample supply will be available over and above the maximum demand that can be expected. This is true of all water supplies.



### Determination of Water Purity

A water supply must not only be adequate, it must be safe. No supply shall be used until it has been tested and pronounced safe by an accredited laboratory.

The organisms of the water-borne diseases such as typhoid, cholera, and dysentery, are not in their natural environment when outside the human body, and accordingly they tend to die out quickly in relation to temperature conditions of their new environment. Their numbers decrease rapidly at high temperatures, and less so at lower temperatures. They may exist for weeks and even months in cold waters as may be found in our forest areas.

Obviously, it is dangerous to use any water for domestic purposes until its purity has been proven by laboratory analysis, even though no immediate source of pollution can be found to exist. But unfortunately, the bacteriologists have as yet given us any suitable test that will definitely prove the presence of dangerous organisms. The most the tests can show is evidence of pollution.

A certain bacteria, namely colon bacilli, is present in the intestines of men and warm-blooded animals. These bacteria are harmless to the host and are excreted in very large numbers. Should their presence be found in water, a great source of pollution has been proved as typhoid or other disease organisms may accompany them. The test for their presence is based on the fact that

they have the faculty of fermenting lactose and forming a carbon dioxide gas. Essentially, the test consists of placing a sample of the water to be tested in tubes of lactose broth and incubating them for 48 hours at a temperature of  $37.5^{\circ}$  C. A positive test for gas will indicate a dangerous water, and since colon bacilli will live longer in water than will disease bacteria, a negative test will indicate that the water is safe.

### Taking Samples

For bacteriological analysis of the water, a four-ounce sample is ample. The water must be collected in a sterilized bottle. Care should be taken to get a sample representative of the water to be analyzed. If from a well, pump out several gallons before taking sample, and if from a stream or spring, take sample away from water edges. Do not remove cap of bottle until ready to take sample, and do not touch inside of cap or bottle or place cap on ground or any object.

The following data as requested by the Department of Bacteriology, Oregon State College, should be included in a water report to accompany the sample. Give date collected, a.m. or p.m., and by whom collected. Tell whether from a spring or well, and if well, give depth and whether dug or driven. Give information as to the nature of well platform, its water tightness, and materials used in construction. Give distances of water

source from any possible agency of contamination as houses, barns, and toilets. State whether or not the land slopes toward or away from the well, as the case may be. Include any additional information and state whether or not you suspect sewage contamination.

The sample should not be too long in transit, and it is best to send sample at a time when best mail connections will be had. It is best that samples be taken of every water supply at least once a month.

#### Methods of Sterilizing Water Supplies

Water supplies may be rendered safe and harmless by the use of disinfectants or by types of filters, or a combination of both. I would suggest that before any attempt be made on the part of anyone concerned with improving the purity of his water supply, to adopt any method for use, that he first obtain expert advice on the method and application best suited for his particular problem. Any sterilization method necessarily entails an expense, and it is a question whether or not the expense is justified for value received. Any evidence of pollution can best be corrected by protecting the source of the water supply, and continued efforts to safeguard against any further pollution. It is my sincere opinion that, save for areas in more heavily-settled districts than we are accustomed to deal with in the Pacific Northwest, the safety of our water supplies within the forests



can be assured with proper development of these supplies to eliminate any possible means of pollution. I can say this because of the remote and sparsely-settled districts we are dealing with, and the subsequent ease of locating and eliminating possible sources of pollution.

### Safeguarding the Water Supply

Pollution of the water supply is usually brought about by three different methods. First, we have constant surface drainage if the supply is not protected. Second, by direct pollution from soil and air if the surface of the supply is not covered. And third, supplies may be polluted by underground seepage.

To eliminate surface drainage, the well or spring should be protected by a curb or casing which will allow no outside surface waters to enter. In addition, the soil immediately surrounding the well or spring should be sloped in such a way that all surface water will drain away from and not toward the well or spring.

Direct pollution can be eliminated by, in the case of springs, enclosing the supply in a water-tight concrete box. A galvanized iron pipe should be placed in the concrete box to serve as an outlet for the water. Further precautions must be taken by preventing access of animals to the source of water. Direct pollution of wells occurs through open taps, use of unsanitary means of removing the water (dirty buckets, etc.), and through

use of faulty pumps which permit drainage to enter the well. To avoid this, the well platform should be watertight and made of reinforced concrete, having a minimum thickness of four inches. The platform should extend at least two feet in all directions from the well casing, and should slope well to the outside edge. Hand pumps should be of the force type with cylinders placed below or near the water level so priming will not be necessary, as often the water used to prime a pump is taken from a source of questionable purity. The pump base should be cast or threaded into the pump column, and of sufficient diameter and depth to overlap the well casing at least one inch. A suitable gasket should be placed between the pump base and the platform, and the pump base and platform must be fastened securely together. The spout should be of the closed, downward-directed type, and provision must be made to carry all waste water to a point some distance away from and below level of pump platform. Further information regarding types and construction can be found in any number of publications dealing with this subject. I especially recommend U. S. D. A. Farmers' Bulletin No. 1448 as being an excellent reference easily available.

Underground seepage from nearby sources of filth is a dangerous problem with which to deal. Such seepage may occur into a well or a spring from a nearby barnyard, toilet, or from the drainage of a septic tank. With porous soil conditions, the zone of pollution of a long

continued infection of a plat of land is likely to extend long distances from the source, especially in downhill directions. Even a well may draw pollution from lower ground when drought and heavy pumping reduce the water table enough to reverse the direction of the drainage movement. With due consideration of soil conditions and possible extent of pollution from any source, a well or a spring should not be located within 150-200 feet from a source of filth. It is advisable in every case to keep the surface of the water in the spring or well at an elevation higher than any nearby source of filth.

#### CHAPTER IV. WASTE DISPOSAL

##### 1. Sewage Disposal

###### The Problem

One of the most difficult problems concerning sanitation on our forest areas will be to secure proper disposal of fecal matter in order to prevent any transmission of pathogenic organisms and to exercise such control as necessary to promote and maintain aesthetic values.

###### Methods of Disposal

There are two main methods of sewage disposal; namely, the dry-earth method, and the water-carried method.

The dry-earth method was at one time in high repute,



and in some cases, as in our forested areas, is still useful where water is scarce or difficult to get. This method is less convenient than the water-carried, and the transfer of diseases is easier in this method.

The water-carried system has been almost universally adopted, and is the method used in communities with extensive water systems.

Our concern in forest areas is centered mostly on problems of the dry-earth disposal method.

#### Strict Observance of Regulations Necessary

A sanitary rule that must be obeyed by every worker and traveler on our forests is that no human excreta be deposited on the surface of the ground where it may remain as a source of danger to the public health. A simple precautionary measure to follow on areas where permanent facilities are not provided is to dig a trench eight to ten inches deep and cover with earth as used. This will eliminate danger of flies carrying disease from excreta to food, and will also greatly reduce chances of pollution to nearby waters by surface drainage.

#### Excreta Disposal by Dry Earth Method

In the great majority of cases, the simplest method of excreta disposal, that of the pit-privy, will be employed over our forest areas, and for this reason will be discussed first. But on some of our areas of heavy use

and where water systems must be provided, a system of toilets which flush into a septic tank and sub-surface drainage system will be employed. This latter system will be discussed later and is the most efficient system of the two.

#### Specifications for Location and Superstructure of Privies

All privies must be below and at least 100 feet from any source of water supply. The earth surrounding the structure must be banked to carry surface drainage away. The structure must be firmly attached to the pit and be fly-tight and water-tight. Seats must have a fly-tight cover and it is best that they not be self-closing as is the recommendation of the Oregon State Health Department. Self-closing seats are a nuisance on areas that cannot be maintained once a month, as patrons place rocks or sticks beneath them to hold them open, and they are soon broken and useless. It is best to have a fly-tight superstructure and make the closing of the seat obligatory on the part of the user. This has been the experience of the Forest Service in Region Six. Screened vents should be placed on sides of structure at pit level, and at both ends of structure at roof-peak for ventilation. Riser should be covered with tin or tarpaper on inside to prevent discoloration. The door should be self-closing and swing in.

### Types of Pit Privies

Of the two general types of pit privies, namely the earth pit privy and the concrete vault privy, the earth pit privy should be employed most extensively. This type is less expensive to erect and less expensive to maintain. The vault type is designed for use where there is great danger of polluting nearby water supplies and is necessarily made water-tight. When the vault is full or nearly so, the contents must be removed and disposed of, which entails a big expense for maintenance. The leaching action of the earth pit privy drains and dries out the excreta, becoming relatively inoffensive and of small cost to maintain. When the pit is full, the super-structure is moved to a new pit and the old pit is covered.

The pits may be shallow or deep, but between four and one-half and five feet is the depth where best results may be obtained. If the pit is too deep, soil water may rise into them, and oxygen may be insufficient for bacterial action in reduction of organic matter. Pits are advantageous in that they are dark and tend to keep flies out. However, flies must never have access to the pit.

The privies must be moved to a new location before the pit becomes completely full, so that the pit may be covered with a twelve-inch layer of earth.



## Septic Tank Systems

Whenever running water system is feasible and soil conditions are right, the septic tank disposal is a feasible method.

The theory upon which the septic tank operates is simple. Much of the organic material carried in suspension in sewage is slightly heavier than water and under favorable conditions will naturally settle out. If the sewage is allowed to remain in a water-tight tank for a few hours, the heavier particles settle to the bottom and those lighter than water will float on the surface of the liquid. The accumulations soon begin to decompose, resulting in changing part of the solids into liquids and gases. The gasses escape into the air and the liquids pass out of the tank mixed with the liquid part of the sewage.

The tank must be of sufficient size and of such shape as to allow the sewage which flows in at one end to pass very slowly and quietly to the other end where it is drawn off with the least possible disturbance in order to prevent the escape of the sludge and scum which collects on the surface of the liquid and on the bottom of the tank. The liquid waste which flows from the tank is called the effluent. In order to obtain the above, the tank is usually built in two sections with an open pipe connection. This treatment will remove from 50 to 85 per

cent of the suspended matter of sewage, and will reduce about 40% of it by anaerobic bacterial action into liquids and gases.

The capacity of the tank should approximate twenty-four hours' flow of sewage under normal conditions. The tank depth below water level should rarely be less than four feet, and for fair-sized installations, about seven feet. The length should be from two and one-half to four times the width, depending on capacity, for more efficient sedimentation. Tables of dimensions are available in any publication on sewerage systems. I especially recommend U. S. D. A. Farmers' Bulletin No. 1227 and a publication prepared by the Oregon State Board of Health entitled "Information for the Establishment and Maintenance of Industrial Camps".

Sewage is introduced into the tank from the toilets by a regular four- or five-inch main. Leaving the septic tank, the fluid or effluent is far from the inoffensive, innocuous liquid it is often thought to be. It still contains sewage substances capable of causing nuisances and many of the disease-producing organisms it originally contained. It may be disposed of by subsurface irrigation systems or discharged into county drains, streams, or lakes. Discharge of such effluent into any of our forest streams and lakes must absolutely be forbidden if we are to insure and protect the safety of our streams which are in many cases used for municipal water supplies.

By use of a dosing chamber and siphon, the effluent is charged intermittently into a pipeline which leads to a series of tile pipelines in the distribution field. The purpose of the dosing chamber is to store the flow from the settling tank for several hours and when the water reaches a certain height, the siphon automatically discharges the entire contents of the dosing chamber into the subsurface irrigation system within a few minutes. The size of this chamber should be of such size that discharges will occur not more than three or four times with ordinary use during twenty-four hours. This method of intermittent charges allows the irrigation area time to absorb the flow.

The distribution field consists of lines of vitrified sewer pipe or open-joint tile laid about one foot underground, with open joints, so as to allow the liquid to pass out more or freely. These pipes should be laid in lines which follow the land contour, so as to have a fall of about three inches per hundred feet. It is sometimes advisable to lay the pipe in about eight inches of gravel fill, which greatly aids the distribution of the effluent into the soil. About twenty to fifty feet of line per person is generally required with the tile lines to be at least six feet apart. The function of the distribution field is to sterilize organic matter left in effluent by filtration and drying out.

Effluence must never be discharged into an area from



which there is danger of infecting nearby water supplies. It is well to locate your distribution system well away from any stream, lake, spring, or well.

## 2. Refuse Disposal

### The Problem

The problem of refuse disposal is only to a slight extent a sanitation consideration; it is more a problem of convenience, economy, and general cleanliness. If allowed to stand in open and ferment, garbage would provide breeding places for flies, attract rodent populations, cause disagreeable odors, and cause a nuisance generally. Large accumulations would also create a distinct fire hazard and greatly impair aesthetic values. It is for these indirect relations to the public health that proper steps be taken to provide efficient means for disposal.

### Burial of Refuse

Best adapted to the smaller and more isolated camp grounds is the method of burying all refuse. A pit is dug, over which is placed a fly-tight cover with a hinged trap door through which refuse is passed into the pit. It is necessary that the pit be placed on well-drained ground to avoid its being filled with water, and its location properly marked. When the pit is full, a new

pit shall be dug and the old one covered with earth.

### Collection and Burning of Refuse

Where large amounts of refuse collect, as on a large camping area, it becomes necessary to provide garbage cans placed in convenient locations for the collection of refuse. Every few days, depending upon use of area, these cans should be emptied and the refuse taken to an incinerator.

The incinerator should be located to the leeward of the prevailing winds through the camp ground, and in a patrolled place safe from fire danger.

There are two types of incinerators in general use, open and closed. The open incinerator is more objectionable from a fire hazard standpoint, and it also causes more odor. For best results, the closed type is recommended.

Of a general type is an incinerator built of fire-resistant brick with a fifteen- or thirty-gallon drum for a stack. The garbage is changed in through the top onto a heavy sheet iron tray just above the fire box, and remains there until dried and decomposed by the heat.

## CHAPTER V. THE PROBLEM OF THE HOUSE TRAILER

The widespread use of house trailers presents a problem of great importance to public health officials and many others because of the lack of uniform laws and regulations pertaining directly to the construction and use of house trailers. The principles involved in the control of house trailers are essentially the same as those encountered in the sanitation of camp grounds. These factors include the control of sewage and waste disposal, provision of pure water supplies, and the prevention of the transmission of disease organisms by contact infection. The opportunities for the promiscuous dumping or discharge of sewage and wastes from trailers is apparent and presents a great problem difficult to control. Sanitary features of house trailer construction such as sinks, toilets, waste tanks, and outlets have not been brought under any standardization of type or installation.

Our national problem is, then, to induce manufacturers to follow reasonably uniform specifications for the installation of approved types of sanitary conveniences in house trailers, and to draw up rules and regulations pertaining directly to trailer camps to be adopted and enforced by states, municipalities, and other agencies, under the jurisdiction of the departments of public health.



The forester is definitely linked with the problems presented with the use of house trailers, for it is on his areas where large numbers visit yearly. The problem is one of a minor nature here in the Northwest, and may continue to be so unless the trend of house trailer use takes a rapid swing upward. The majority of the visits to our forest areas are made over the more accessible routes of travel, and the accommodations are, for this reason, usually provided by agencies other than those directly administering forest lands. But the forester can not consider himself exempt from the responsibilities from this time on; studies must be conducted to ascertain expected future demands of house trailers on his areas, and which must come directly under his supervision. As a result of his studies, the forester must formulate a definite policy pertaining to house trailers on his areas. This policy, in view of greater costs of establishment, maintenance, and administration of trailer camps compared with public camp grounds on the basis of values received, must in any case be to the business advantage of the forester.

## CHAPTER VI. SANITARY SURVEY

To provide data for immediate development of any area, as well as to provide data vital for formulation of plans of future development, the following should be included in a sanitary survey.

1. Introduction

- (a) Location and accessibility.
- (b) Topography.
- (c) Geology.
- (d) Climate.
- (e) Soil.
- (f) History of area--past use, settlers, data of sanitary significance.
- (g) Present and expected use.

2. Water

- (a) Source.
- (b) Possibility of pollution from surrounding area.
- (c) Reports on water analysis.
- (d) Recommendations for development.

3. Sewage

- (a) System of disposal.
- (b) Future development.

4. Refuse Disposal

- (a) Collection and disposal.

## 5. Sanitary Nuisances

- (a) Dust.
- (b) Source of odors.
- (c) Flies.
- (d) Rodents.

## 6. Secondary Sources of Disease

- (a) Collection of known hosts of diseases as ticks, etc., and have them examined.

The above data must be collected and prepared into a report by a competent field man who is familiar with field sanitation. The survey may be most efficiently carried out in conjunction with a regular field survey party which is collecting data for recreational development.

## CHAPTER VII. CONCLUSION

In this study I have attempted to trace the rise of our modern theory of sanitation and disease prevention, to stress the importance of sanitation in the protection of the public health, and finally to offer recommendations for the practice of sanitation on forest areas.

The fact that I am not familiar with the sanitary conditions as they exist universally on our forest areas today hardly puts me in a position where I can arrive at conclusions or make any definite recommendations for their correction. The experience I have had here in the Northwest with the U. S. Forest Service leads me to



believe that our expenditures for construction and maintenance of basic sanitary conveniences are far below what they should be in relation to volume of use. This is especially noticeable in the more remote areas accessible only by trail, and where maintenance of improvements occurs, on the average, only once every three or four years. Due to heavy snows and wind damage, it often happens that the effectiveness of these improvements is reduced to near zero by their second year in use.

If what my observations have amounted to could be taken as true, then my recommendation would be to conduct surveys during spring maintenance to determine the condition of sanitary improvements on every area, and to take steps to correct and bring conditions up to standard before the summer influx of forest users.

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