UNDERGROUND LATRINES FOR MINES

BY

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INTRODUCTION.

The Bureau of Mines is conducting a series of investigations relating to health of miners and improvement of sanitary conditions at mines and mining towns. The results of some of these investigations have been published in Technical Paper 33, "Sanitation at Mining Villages in the Birmingham District, Alabama"; Technical Paper 105, "Pulmonary Disease in the Joplin District, Missouri, and its Relation to Rock Dust in the Mines"; Technical Paper 116, "Miners' Wash and Change Houses"; Bulletin 87, "Houses for Mining Towns"; Miners' Circular 20, "How a Miner Can Avoid Some Dangerous Diseases."

This paper aims to present a rational statement on the dangers of committing nuisances indiscriminately in a mine and to discuss practical methods whereby these dangers may be eliminated.

Underground latrines should be installed in mines as a protection against hookworm infection, as a guard against typhoid fever and tuberculosis, and in general to promote cleanliness, convenience, and safety.

HOOKWORM DISEASE."

The protection against hookworm disease afforded by underground latrines is an important reason why they should be placed in mines. They will not only aid in stamping out the disease if it already exists, but they will prevent the introduction of the disease in mines where it does not now exist.

Hookworm disease is caused by worms about half an inch long which attach themselves to the inner wall of the bowel and there interfere with the normal functions of the body. The worms lay eggs in large numbers, which leave the body with the bowel discharges. Under favorable conditions of temperature and moisture tiny worms called larvae, about one-fortieth of an inch long, hatch from these eggs. These tiny worms gain entrance to the body either through the mouth or by burrowing through the skin. They gradu-

* The information regarding hookworm disease contained in this paper was obtained largely from the publications of the Rockefeller Sanitary Commission.
ally make their way to the bowel, where they grow to be adult worms, lay eggs, and perpetuate the disease.

The cure of the disease in the individual is simplified because the eggs of the worms will not hatch inside the bowel. Every single hookworm in the bowel of a human being has been swallowed or has bored through the skin. A victim once rid of the worms is free of them until he becomes reinfected from the outside. Contact with soil containing hookworm eggs is the vital link in the spread of the disease. Children who run barefooted and adults in those countries where no shoes are worn are especially liable to infection.

Hookworm infection belts the earth in a zone about 66 degrees wide, extending from parallel 36° north to parallel 30° south; practically all countries lying between these two parallels are infected. Hookworm sometimes is found beyond those bounds, in sections where the mining industry prevails. The uniform conditions of the mines seemingly protect the eggs and the larvae from the action of frost, extreme dryness, and other unfavorable elements. Of the foreign countries from which the Rockefeller Sanitary Commission has received reports 54 are infected. In six of these countries—Wales, Germany, Netherlands, Belgium, France, and Spain—the infection is wholly or chiefly confined to mines. Hookworm disease in fact is sometimes known as miners’ anemia. Within our own country hookworm infection has been found in the mines of Nevada, North Carolina, Tennessee, Kentucky, West Virginia, and California. The Bureau of Mines, in conjunction with the California State Board of Health and the Industrial Accident Commission of California, is at present conducting an intensive investigation of the prevalence and means of eradicating hookworm infection from the deep gold mines of California. No complete survey of the mining regions of the United States has been made, so that the absence of a statement about the mines of other States does not mean that the hookworm is not present there. Up to the present, many of the American mines are not seriously infected; why not take positive measures to keep out the infection and prevent the ravages done in foreign mines?

The possibility of spreading hookworm disease among miners will be appreciated from the following statements:

1. Hookworm disease prevails in many of the foreign countries from which the workingmen of our mines are recruited.

2. The constant shifting of miners from one place to another makes it possible to infect, at any time, an uninfected mine, as underground dry closets or latrines have been installed in only a few mines.

3. The constancy of the warmth and moisture in many mines appears to favor the development of the hookworm and larvae.

4. The drainage in the mine may disseminate the eggs and the larvae.
5. The darkness of the mine tends to increase the danger of contact with sources of infection.

6. The nature of mining causes the miner to be in constant contact with the soil.

**TYPHOID FEVER.**

It is now known that typhoid fever is caused by germs. Germs are tiny living things so small that they can not be seen with the naked eye. Hookworms are plainly visible; germs are not. The smallness of typhoid-fever germs can be realized from the fact that 36,000 of them placed side by side make a line only 1 inch long. If we did not know their ways it would be practically impossible to protect ourselves from such invisible foes. It is now known that typhoid germs leave the body with the bowel discharges. This is true not only of sick people, but also of those who are "coming down" with sickness or of those who are convalescent. More serious still, recent investigations have shown that persons who are seemingly well discharge disease germs. Such persons are known as "carriers." The only safe protection is to shun contact, direct or indirect, with all human excrement, because that is the source through which the disease typhoid is communicated. Each case of typhoid fever cries out that this fundamental law of cleanliness has been violated.

**TUBERCULOSIS.**

Although consumption, which is tuberculosis of the lungs, is spread by careless spitting, we should remember that other parts of the body can be affected, such as the bowels or the kidneys, from which the germs leave the body, not with the spittle, but with the excreta. Therefore, there is some possibility of spreading tuberculosis as well as typhoid fever or hookworm disease by indiscriminate defecating in a mine.

Typhoid-fever and tuberculosis germs get into the human system through the mouth. They can not burrow through the skin like the hookworm; consequently there is probably not as much danger of contracting typhoid or consumption in mines as there is of contracting hookworm disease.

**DESIRABILITY OF CLEANLINESS.**

How revolting it would be to see stools of feces scattered about the yards and shops of a manufacturing plant. A factory does not have to be modern to contain privies of some kind. A mine, after all, is a workshop, and not necessarily a pleasant workshop, either. Why should it be objectionably and unnecessarily defiled? Defilement is unnecessary, because underground latrines have been used with success in many metal mines.
The larger use of latrines in metal mines as compared with coal mines is due in part to the fact that the metal mines are warmer and not so well ventilated as the coal mines, so that their atmosphere becomes unbearable if the decomposing excrement is not removed. Moreover, the workings of a metal mine are generally more compact than those of a coal mine, the coal workings being spread over large areas, whereas the metal workings extend to great depths, one below the other.

**LATRINES SHOULD BE CONVENIENT.**

The latrines should be conveniently located so that the mine workers will not be obliged to walk far from their working places. Where day wages are paid it would appear profitable for the company to reduce this waste of time. On the other hand, if the mining is done on a tonnage basis, the workingman’s time should not be wasted.

**USE OF ABANDONED ROOMS DANGEROUS.**

Several mining companies have attempted to check the evils arising from men committing nuisances indiscriminately by requiring them to use abandoned rooms. There are marked objections to this practice as regards safety. Men going into uninspected, unfamiliar places are exposed to danger from falls of roof or the ignition of pockets of gas. As an example of the danger may be cited the testimony given at a coroner’s inquest following an explosion in southern Illinois. The explosion was possibly occasioned by the ignition of a body of gas in an abandoned room, the gas being ignited by a man who went into the room to defecate. The man suspected and seven others were killed, and nine others were severely burned.

The practice of allowing men to defecate in abandoned rooms does not eliminate the danger of infection. It gives rise to a false sense of security. Although the gross material may be placed away from the main traffic course for the time being, there is no assurance that the drainage will not convey the infection back to the active parts of the mine. Both hookworm ova and typhoid-fever germs may remain infective for a considerable period after they have left the human system.

**“PREVENTION IS BETTER THAN CURE AND FAR CHEAPER.”**

To many mining men it might appear that although some of the dangers enumerated are possible, there are more imminent dangers in connection with mining that demand attention first. Such a criticism is apt to be made of all suggestions that relate to mines in general rather than to a specific mine. In any mine the worst conditions should be improved first. It is well to look at conditions
comprehensively. All the various hazards and the relative costs of eliminating them should be carefully considered. In measuring a hazard, however, mere consideration of how frequently an accident has happened from it is not sufficient; it is more important to analyze the elements that, if combined, would cause the accident and to weigh the probability of such a combination taking place. The extent of fire-protective measures in a particular town is not based on how often the town has burned down. Safeguards against mine explosions should not be based on the number of times the particular mine has blown up.

And so with hookworm infection—its absence may be due to certain conditions in the mine iminical to its spread or to mere chance. In this connection Hotchkiss\(^c\) says that it would appear that in mines having a temperature higher than 72° F., sufficient moisture to make them damp, and less than 2 per cent salt or 0.1 or 0.2 per cent acid (or alkali) in the mine waters are favorable for the development of the hookworm disease, not only in warm countries, where the disease is known to be in evidence, but also in colder districts, where it is not found outside the mines. Thus, as regards the introduction of underground latrines, the considerations mentioned above should be remembered, and the inexpensiveness of the necessary sanitary measures should be balanced against the seriousness of a mine once infected.

As proof of the need and practicability of underground accommodations, the following extract\(^b\) from special rules for the mines in Cornwall, included in the code for 1905, is given:

5. The owner, agent, or manager shall cause a sufficient number of suitable sanitary conveniences to be provided above and below ground in suitable and convenient places for the use of the persons employed, and to be constantly kept in a cleanly and sanitary condition, and no person shall relieve his bowels elsewhere than in these conveniences. No person shall soil or render unfit for use in any way any convenience or sanitary utensil or appliance provided for use of the persons employed. Pump cisterns, sumps, and water accumulations in the mine shall not be directly or indirectly used for the purpose of rule 5 as a sanitary convenience.

Similar rules are in force or have been recommended for mines in Australia, France, Germany, Belgium, the Transvaal, and other countries. Such rules exist in only a few States in this country.

A pertinent extract from the second report of the English Royal Commission on Mines follows:\(^c\)

To prevent fecal pollution of the ground, we think that it should be made obligatory on the owners of all coal mines to provide underground, at suitable

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\(^b\) Hotchkiss, S. C., op. cit., p. 13.

\(^c\) Hotchkiss, S. C., loc. cit.
positions along the main roads and at the pit bottom and also at the surface, a sufficient number of properly designated sanitary receptacles for the unavoidable needs of the men; to arrange for the regular emptying and cleaning of these receptacles, and for a supply of disinfectant, dry coal dust, or other suitable material to prevent smell. We also think it should be made obligatory on the men not to relieve their bowels elsewhere underground than into these receptacles, or at some dry authorized part of the mine proper for that purpose, and it should also be obligatory to bury the feces in coal dust or other dry material.

Even if no such disease existed as ankylostomiasis, we think that these regulations would be desirable both in common decency and as a precaution against the spread of such disease as typhoid fever. We wish to point out that the practice of unnecessarily relieving the bowels underground is a source of danger and nuisance to all who are employed, and ought everywhere to be discouraged.

VARIOUS TYPES OF PRIVY ACCOMMODATIONS.

A variety of ways for providing privy accommodations is described herein. None of them is very expensive, and all of them have been given the test of actual use.

ACCOMMODATIONS ON THE SURFACE NEAR MINE ENTRANCE.

If water-flush closets or sanitary latrines were built on the surface convenient to the mine entrance, but not too near the intake shaft or airway, and if these were properly cleaned and disinfected, they would no doubt greatly reduce the number of nuisances committed in the mine. When the body is in a normal healthy condition the movement of bowels can be controlled to an appreciable extent, and the miners, instead of waiting until they were in the mines, would use these surface closets. The condition in the past at many mines has been that the surface privies, if built at all, have been absolutely neglected, and as a consequence soon became so defiled that they were objectionably to visit, and discreet miners feared contracting vermin and disease from them. This same condition formerly prevailed at most public or semipublic closets, whether at mines, factories, or railroad stations. Improved sanitary fixtures and better appreciation of them by the public has caused the disappearance of such unclean places.

Figure 1 shows an inexpensive water-flush closet which should be located on the surface near the entrance of the mine. It is built in sections and any number of seats can be ordered. It flushes automatically at any desired interval.

UNDERGROUND WATER-FLUSH CLOSETS GENERALLY IMPRACTICABLE.

In only rare instances is it practicable to place water-flush closets throughout a mine. At some mines where the closets would be available to a large number of men and where they could be con-
lected in a sanitary manner to the mine-drainage system their introduction might be practicable. They would have to be inspected regularly, as water-flush closets, even when used carefully, often get out of repair. If the mine water emptied into a stream that was used as a drinking-water supply, the sewage from the underground closets could not be mixed with the mine water.
UNDERGROUND PRIVY CARS.

Underground privy cars such as have been installed by a number of large metal-mining companies in this country furnish a practical and economical remedy. An underground privy car should be so constructed as to be durable. Such a car has to be transported into and out of the mine, often coupled to a regular coal or ore trip, and is subjected to the severe wear and tear of the ordinary mine car. A fragile privy car would soon go to smash.

Underground privy cars made of \( \frac{3}{8} \) -inch steel plate (see fig. 2)* have been used in some of the metal mines of Montana with satisfactory results.

![Diagram of underground steel-plate privy car.]

These cars were about 4 feet long by 2 feet wide by 2 1/2 feet deep. They stood severe usage and were not too heavy to be conveniently handled. The spindle passing through the body of the car is objectionable and unnecessary.

Plate I, reproduced from drawings supplied by the United Verde Copper Co., shows the details of an underground steel-plate privy car in use in an Arizona copper mine.

Many mining companies have not the facilities in their shops to build a car with a steel body. If a privy car is to be built of wood, first-class 2-inch stock should be used. It should be adequately reinforced with iron strips and lined with sheet metal.

DETAILS OF UNDERGROUND STEEL-PLATE PRIVY CAR USED IN AN ARIZONA COPPER MINE.
The car should be so designed that it can be easily cleaned when brought to the surface. After durability this is the next important consideration. At an iron mine in the Crystal Falls district, Michi-

gan, privy cars have been designed with the idea that sawdust, coal dust, or sand should be sprinkled in by each user for the purpose of absorbing the liquids and acting somewhat as a deodorizer. Figure 3 shows elevations of the closet body designed for use with such cars.
When such a plan is followed the body of the car does not have to be absolutely water-tight. The objection to this plan is the difficulty of emptying the car. It is a highly unpleasant task to shovel the contents of the can into a furnace if the excrement is to be finally disposed of by burning; it is likewise disagreeable to agitate the contents with a hose if the material is to be flushed into a sewer.

An underground privy car can be cleaned conveniently if the contents are maintained in a liquid instead of a solid state. With this system the car must be made absolutely water-tight. Before it is lowered into the mine, some dilute deodorizing liquid disinfectant should be poured into it. When this method is used the sprinkling of dirt or sawdust into the car must be discontinued.

There should be as few sharp corners and projections inside the car as possible, as the filth will adhere to these and make the cleaning of the car difficult and disagreeable. In some cars the spindle that operates the outlet valve passes through the body of the car. This arrangement is objectionable and unnecessary. Plate II, A, shows the valve spindle passing through the body of the car, and Plate II, B, shows a later type of construction with the outlet-valve spindle outside. The later type was built with only one hole in the top, whereas the earlier type had two. Practical experience no doubt proved that the one-hole car is the more desirable.

There should be a sufficient number of these cars in the mine so that the men will not have to spend too much time in going to one of them. The nature of the mine will have much to do with determining the number of cars necessary. The wage system and the number and frequency of resting periods also influence the number and locations of the cars. Wherever possible the cars should be stationed in the return airways, although if they are placed in the intake airways no odor should be spread if the cars are kept clean and emptied frequently. An electric light should be placed at these stations and toilet paper should be supplied.

If the cars are kept clean and are reasonably convenient, the miners should be compelled to use them. They will be appreciated by most of the men, and drastic punishment should be meted out to the few who are found committing nuisances. In the metal mines of the West where latrines are installed they are said to be universally used. Where the mine workers are unionized there should be an agreement between the operators and the miners to insert a clause in the contract fixing a penalty for the misuse or the nonuse of the underground latrines.

**PORTABLE PRIVY CANS.**

Instead of having the container an integral part of the car, a small, water-tight vessel, transported into and out of the mine on the regular mine trip or skip, may often be used to advantage. Some
A. UNDERGROUND PRIVY CAR WITH VERTICAL VALVE SPINDLE PASSING THROUGH BODY OF CAR, SHOWN IN FOREGROUND, AND DRINKING-WATER CAR, SHOWN AT LEFT. IN THE BACKGROUND IS AN ORDINARY MINE CAR.

B. UNDERGROUND PRIVY CAR WITH OUTLET-VALVE SPINDLE OUTSIDE OF CAR. THE TOP OF THE CAR BODY IS NOT SHOWN.
of the copper mines in Arizona and many of the deep gold mines of California are using this method. The success of the system hinges upon the attention given to small details. The system requires a durable can specifically designed for the purpose. Old powder cans or other improvised make-shifts should not be used.

Privy cans must not only be provided but their use must be rigidly enforced; hence the cans must be maintained in a usable condition. Some of the superintendents complain that privies have been abused and defiled by some of the miners, the trouble being caused by the men standing instead of sitting on the seats. Two reasons prompt the men to squat on the seats—fear of catching vermin or contagious disease, also the avoidance of contact with a wet seat. These objections are rational and it is believed that a properly designed privy can will do much toward eliminating them.

The cans should be taken to the surface and emptied at least three times a week. At some of the mines they are emptied every day. The method of disposing of the contents depends largely upon local conditions. The material may be buried in a pit, it may be destroyed by fire, or it may be passed through a septic tank and liquefied. In case it must be passed through a septic tank, strong disinfectants can not be added to the cans as this might destroy the bacteria upon which the septic tank depends for its liquefying properties.

It is believed that if the cans are filled one-fourth with water, and some deodorant added at the time they are placed in the mine, conditions will be better than if a powdered disinfectant is added and the contents maintained in a more or less solid condition. Under any circumstances, the work of cleaning these cans is a disagreeable task; but if the contents are maintained in a liquid state by the initial addition of water, the deposits will not stick to the sides and corners of the can, but will readily pour out, and the churning, foul odors, and ineffective cleaning incident to emptying solid deposits will be avoided. If water is to be placed in the cans, an absolutely tight cover and one that is readily removable, must be provided for the cans so that the material will not splash out while the cans are being conveyed back and forth on the trip or in the skip.

Figure 4 shows the design of a privy can in which careful attention has been paid to details. Figure 5 shows the design of a simple and durable frame or commode into which the can fits. Note the sanitary seat, which is open back and front.

DESTRUCTIBLE PRIVY BOXES.

With a view of eliminating the disagreeable work of cleaning the portable privy cans, a cheap destructible box has been used by several copper mining companies. The boxes are about 10 inches wide by 18
inches long and 20 inches deep. They can be made in large quantities in the carpenter shop from second-grade 1-inch stock at a low cost. They are distributed throughout the mine at convenient places and a box of sawdust, coal dust, or dirt, together with a scoop, is placed beside each so that each stool can be covered. The dust absorbs the moisture and reduces the odors. When the box is filled, a cover is nailed on in the mine and it is then thrown onto a trip, carried to the boiler plant, and burned without further disturbance.

**Figure 4.—Portable privy can for use in mines.**

**PORTABLE LATRINES FOR OPEN-CUT MINES.**

It is desirable to have sanitary latrines at open-cut mines. These can be constructed inexpensively. A hole in the ground with a portable house built over it is all that is necessary at most mines of the class mentioned. Where there is danger from flying material on account of the blasting operations, the portable house would have to be built so as to minimize this danger. It is important to keep on hand a box of lime or dirt so that the excreta can be covered to
prevent the dissemination of germs by flies. The sprinkling of lime or dirt after each use is a more effective measure for keeping away flies than attempting to make the place fly proof by the use of screens, self-closing doors, and the like. A urinal trough lined with zinc or galvanized iron is essential to prevent the seat from becoming defiled.
If the soil is so fissured or so porous that neighboring wells may become polluted, or if the drainage conditions are such that the vaults fill with water after rains, a water-tight container should be used under the seats instead of a dug hole. (See figs. 6 and 7.) The container should be emptied as frequently as is necessary and the contents disposed of in a sanitary manner.

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