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of the authors*

P712

REPORT

E. H. Vincent

OF THE

Sanitary Survey Commission

OF

The West Virginia State Board of Health

**An Intensive Study of the Prevalence of Intestinal Parasites Among
the Coal Miners of McDowell County**

**PROFESSOR W. H. SCHULTZ, Ph. D.,
MESSRS. C. O. GORBY, H. C. BRAY and WILBUR SHIRKEY.**

December 10, 1914

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ACKNOWLEDGMENT.

In making this report, I wish to acknowledge the coöperation of Mr. Edward O'Toole, general superintendent and Mr. Klier, chemist of the U. S. Coal & Coke Company. Mr. O'Toole gave instructions that he would do anything that would aid in the success of our work. Mr. Klier's laboratories were practically turned over to us. Too much praise can not be given a man who lends such able assistance in public work of this kind as did Mr. Klier in aiding as collector and interpreter throughout our stay at Gary.

We wish to acknowledge the intelligent coöperation of the superintendents of the Bottom Coal Co., Messrs. Sam and Joe Patterson, both of whom aided us in securing data and put at our disposal their offices as headquarters while at Vivian.

Mr. Samuel Evans, general manager at Pageton, and his brother, also rendered valuable service, and took much interest in the work of the commission, as did Mr. W. W. Wood, the superintendent, at Omstead.

We wish also to acknowledge the courteous, and at times helpful interest of Doctors A. M. Spangler of Pageton, Shanklin of Gary, Stephens and Harrison of Kimbal.

In the seventeen mines that we studied, the bank bosses of each and every one lent us every assistance possible.

W. H. SCHULTZ.

Morgantown, W. Va.

Dec. 10, 1914.

Preliminary investigations and incomplete reports of them may easily mislead, and so do considerable injustice to communities or persons. In the realm of pure science there are editors who refuse to publish preliminary reports of experiments, maintaining, and with good reason, that it is only completed investigations that yield reliable data. Thus they are helping cultivate in their readers a patience such as is not general, which is born of confidence in the value of thorough and accurate work. The American public is constantly getting the wrong viewpoint, ~~as a result of hasty conclusions obtained from getting the wrong viewpoint~~, as a result of hasty conclusions got from the press and pseudo-scientific journals. In public health matters, this is signally true. The newspaper is a strong advocate for public health, but its 'copy' is often based upon some ambitious individual's preliminary investigation, and may indeed attract attention to the activities of the investigator, but at the same time unjustly focus the attention of the public upon the health problems of a particular community.

This is practically what was done in West Virginia, when there was given to the public press by some one the result of a very cursory investigation of hook-worm in McDowell county. As a matter of fact there was considerable talk about a subject concerning which no one had any definite information. The notoriety served this purpose; the Governor, members of the Board of Health, and the director of the State Hygienic Laboratory wanted facts, and to this end made possible a scientific study of the problem of sanitation with reference to the parasite, within a limited area of the state. It is the result of this scientific study that I wish to present in the following report.

Method of Procedure. The method of procedure employed by the Commission differs from that employed by many health commissions. It has been a very common practice among public health workers to enter a community and issue a general invitation to those interested to submit to examination. By this, what may for convenience be called the voluntary, method, it is possible to secure a very high percentage of infection; but it neither represents the actual condition of a community nor of a particular class of workers, except in the cases where each and every individual of a community or class volunteers to be examined. This, of course, is seldom the case.

Our method, for convenience, may be called the census method. Upon securing the coöperation of a given mining company, it was requested that some responsible employee be sent into the mine with the collector, and a personal interview be held with each and every miner on the pay roll, or that a given number of men be interviewed, representing a given section of the mine, as seemed wisest.

The first object was to determine whether or no there was a general infection among the miners, whether this infection was in any way limited to certain classes or imported cases, and whether or no it was being

spread within the mines. In order to secure these data, special blank forms were printed and each individual interviewed so as to fill out the following card:

A—Card for Adults.

Name No.

.....

EXAMINATION CARD.

Mine
 Nationality
 How long in United States
 How long employed by
 With whom last employed
 Name of Asst. Mine Foreman
 Name of Section..... Working Place.....
 Infected with

B—Card for Children.

Name No.
 Age Nationality
 Town House No.
 Length of Residence at
 Last Residence
 Years in School? Weeks per year? Where?
 Living Conditions
 Sanitary Conditions Privy
 Infected with

C—Back of Cards A and B.

Findings of Examiner

 Physician's Notes on Treatment

 Signed

As will be seen, inquiry and record was made regarding:

- (1) Name in full (1)
- (2) Nationality, province or state reared in
- (3) If foreign, length of sojourn in U. S., in West Virginia
- (4) Length of time of present employment.
- (5) Place of previous employment
- (6) Name of foreman to whom at time directly responsible
- (7) Exact working place in mine

A small sample bottle was given to the worker, who was requested to collect a fresh sample of his feces for microscope examination. This bottle was numbered to correspond with the serial number on his data card.

At least two microscopic smears were made as follows: Upon a 38x78 mm. glass slide, two drops of water are placed; with a clean tooth pick 10 milligrams of semi-solid feces is rubbed evenly over an area of about 30x70 mm. of the slide. When it is freed from all large grains of sand, coal dust, or vegetable mass, a No. 2 cover slip 25 mm. wide and 50 mm. long is lightly pressed down upon the smear being as free as possible from air bubbles. This should give a slide with particles just close enough to detect any eggs that may lie between the particles. This is called a standard slide or smear. The entire field of this slide is searched under a lense magnifying about 80 diameters, a Spencer mechanical stage being used for moving the slide across the field to insure an examination of every portion of the smear. Along with hookworm eggs and larvae, those of the following parasites were also taken account of; ascaris, lumbricoides, anguillula, oxyuris, strongyloides, taenia solium, taenia saginata, trichocephalus and unknowns, two of which latter were found. If the individual was infected record was made out upon the reverse of the slip, and the rest left for the local physician to attend to.

The reason for including information that to the layman might appear unnecessary, will readily be obvious by two illustrations that will show how intestinal parasites may be spread.

Prior to the date 1903 hookworm was unknown in England. About this time a British subject enlisted in the army and was sent to India. A large per cent of the laboring class of India is infected with hookworm, and sanitary conditions in many places there are almost ideal for its growth and transmission to others. The soldier became infected and upon his return to England as a private citizen, he obtained work as a coal miner. Soon after the men of that mine showed signs of anemia and a general weakness. This was for some time attributed to lack of proper ventilation. Boycott and Haldane, however, found that the men were, practically all of them, infected with hookworm. The coal dust of the breakways was examined and found to contain numerous larvae in their infecting stage. Even the entries were infected by the men and mules carrying the contaminated coal dust

(1) In many cases it was found that on account of difficult, long names short ones were substituted. In one mine a boss went to the extremity of recording his men "Russian No. 1, Russian No. 2", etc.

out of the driveways leading to the face. Many of the miners had been infected by the mud from their shoes or from the mud left upon the rungs of the ladders used in certain sections of the mine as a means of exit. Thus one miner was responsible for infecting a whole mine.

Another illustration will reveal how men working in one industry may transmit parasites to men of another industry. After the great hookworm epidemic at St. Gothard's tunnel in 1879, many of the workers in this tunnel migrated northward, some of them reaching Hungaria, Westphalia and Germany. In those days, there were brick yards and clay pits managed in a very crude manner, the clay being mixed by semi-naked laborers with their bare feet and hands. The workers, as is often even now the case, were not compelled to use safe, sanitary out houses. The result was that infected human excreta were deposited on the higher ground of the clay pits and eventually washed into the pit itself by subsequent rains. The eggs of the parasite hatched out, and the workers who mixed the muddy clay were infected through their hands and bare legs. Later these infected workers left the clay pits at the close of warm weather and became workers in the mines of Hungaria and Westphalia. The coal dust of these mines was likewise infected through the careless disposal of the men's excreta in breakways and along entries. The result was that thousands of miners contracted the disease.

We cite an example that comes closer home which obviously holds grave possibilities. Upon examining the home surroundings of one of the miners infected with hookworm, it was found that the out house was an open one; the fecal matter dropped down a sandy clay bank along a small stream. At the bottom of the bank was a deposit of moist coal dust. The children played along this stream, wading in the mud and coal dust with their bare feet. Upon examining these children it was found that every one of them was infected with hookworm. The burden of proof rests upon the possibility that these children were infected from the open out house along the creek.

It is evident, therefore, that a number of problems at once confronted the commission, and it was necessary to collect data of the kind mentioned in the foregoing in order to throw light upon these important points:

1. The extent of infection with intestinal parasites and the kind of infection.
2. The origin of primary infection.
3. The possibility of further spread of the infections.
4. The most practical remedies to remove the infection and to prevent a recurrence of it.

Gary.

There were several reasons for choosing Gary, a well ordered camp, for the base of investigation. This is the first work of the kind that has ever been done upon an extensive scale in West Virginia. Hence it seemed wise to secure data here to serve as a basis for comparison,

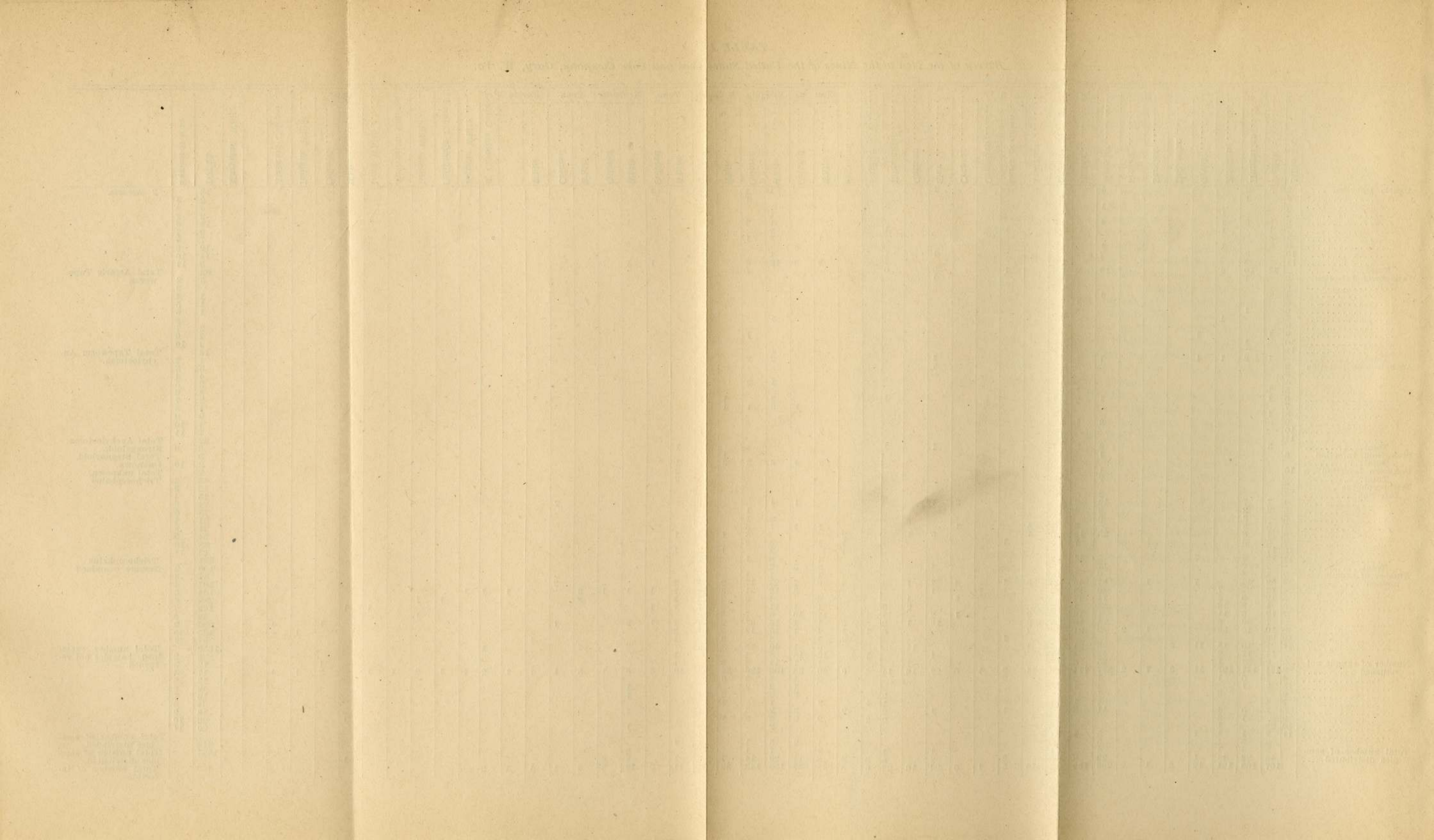


TABLE II.

Survey of the Men at the Page Coal & Coke Company, Pageton, W. Va.

INFECTIONS.	LOCATION.	Italian.	Hungarian.	Roumanian.	Russian.	Polish.	Hovvatt.	Madyjar.	Greek.	German.	Lydwish.	Austrian.	Slavish.	W. Va.		Va.		N. C.		Penn.		Ga.		Tenn.		S. C.	Ky.	Fla.		
														White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.					White.	Colored.
Ascaris	Mine 1 .....	..	..	..	..	..	..	..	..	..	1	..	..	..	3	1	..	1	..	..	..	..	..	..	..	..	..	5	Total Mine 1.
	Mine 2 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	Total Mine 2.
	Mine 3 .....	..	..	..	..	..	..	1	4	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	12	Total Mine 3.
	Tipple	Total Tipple.
	Coke Ovens	2	1	3	Total Coke Ovens.
Total .....	..	..	..	..	..	..	1	6	..	..	..	..	..	2	..	8	3	1	1	..	..	..	..	..	..	..	..	22	Total at Pageton.
Anchylostoma	Mine 1 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Mine 2 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Mine 3 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
	Tipple .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1
	Coke Ovens .....	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Total .....	..	..	..	..	..	..	1	..	..	..	..	..	..	2	..	1	..	..	..	..	..	..	..	..	..	..	..	4	Total at Pageton.
Tape Worm	Mine 1 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Mine 2 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Mine 3 .....	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	2
	Tipple .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Coke Ovens .....	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Total .....	..	..	..	..	..	..	2	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	3	Total at Pageton.
Trichocephalus	Mine 1	1	..	..	1	..	..	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..	6	Total at Mine 1.
	Mine 2 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	Total at Mine 2.
	Mine 3	3	1	..	7	..	..	1	12	..	..	..	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	29	Total at Mine 3.
	Tipple .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Coke Ovens .....	..	..	..	..	..	..	..	8	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	9
Total	4	1	..	8	..	..	1	20	..	..	..	..	1	2	..	7	1	..	..	..	..	..	..	..	..	..	45	Total at Pageton.	
Unknown	Mine 3 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	Total unknown.
Total infections by nationalities .....	..	4	1	..	8	..	..	2	28	..	..	..	1	6	..	17	4	3	1	..	..	..	..	..	..	..	..	75	Total infection.
No of samples examined	Mine 1	6	..	..	3	..	..	..	..	..	..	..	2	1	..	12	9	..	2	..	1	..	..	..	..	..	..	28	Total at Mine 1.
	Mine 2 .....	..	..	..	..	1	..	..	..	..	..	..	1	..	..	10	10	..	..	..	..	..	..	..	..	1	..	47	Total at Mine 2.
	Mine 3	8	6	3	19	1	..	15	29	2	2	1	2	15	2	15	5	11	3	1	1	..	..	..	..	1	..	146	Total at Mine 3.
	Tipple .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Coke Ovens	21	3	8	3	1	5	1	1	13	Total at Tipple.
Total	16	6	3	22	2	..	15	50	2	2	1	2	18	2	44	35	22	21	1	1	1	2	1	2	1	2	1	272	Total examined.	
Samples not returned	Mine 1 .....	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	..	..	..	..	..	..	..	..	..	..	..	3	..
	Mine 2	3	..	..	..	..	..	..	..	..	..	..	1	..	1	1	..	1	..	..	..	..	..	..	..	..	..	8	..
	Mine 3 .....	..	..	..	..	..	..	2	3	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	6	..
	Tipple .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Coke Ovens	12	..	..	..	..	..	..	7	..	..	..	..	..	1	4	..	..	..	..	..	..	..	..	..	..	..	9	..
Total	15	..	..	..	..	..	2	10	..	..	..	..	1	..	6	12	..	2	..	..	..	1	..	..	..	1	50	Number samples not returned.	
Samples distributed .....	..	31	6	3	22	2	..	17	60	2	2	1	2	19	2	50	47	22	23	1	1	1	3	1	2	1	1	322	Number samples distributed.

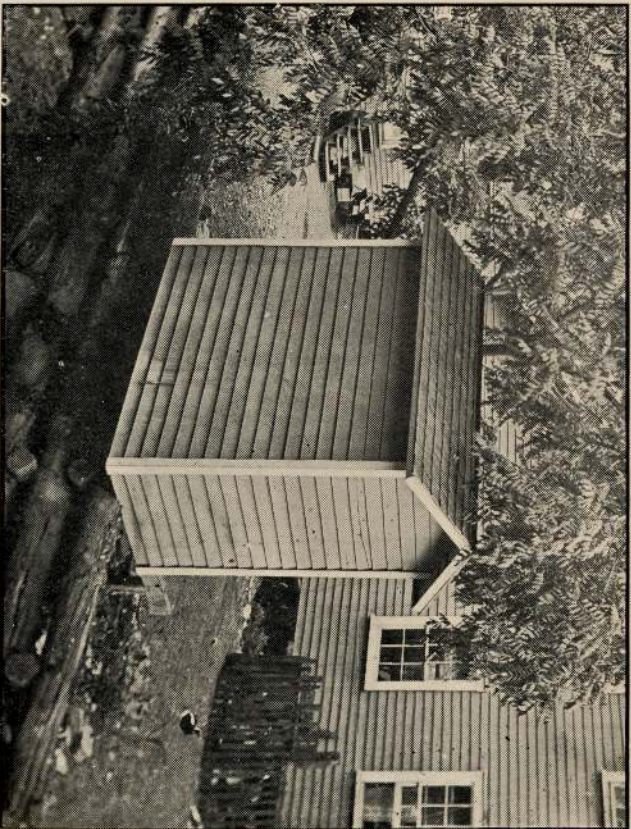


Figure 2. One of the outhouses of the row shown in Figure 1.

This is an excellent building, but a dangerous type of privy, since it is open at the back, where flies, rats and other scavengers have access to it. During the dry, hot summer months the excreta accumulates upon the edge of the creek. It is such methods of sanitation that have brought on West Virginia severe criticism by visitors passing through the State.

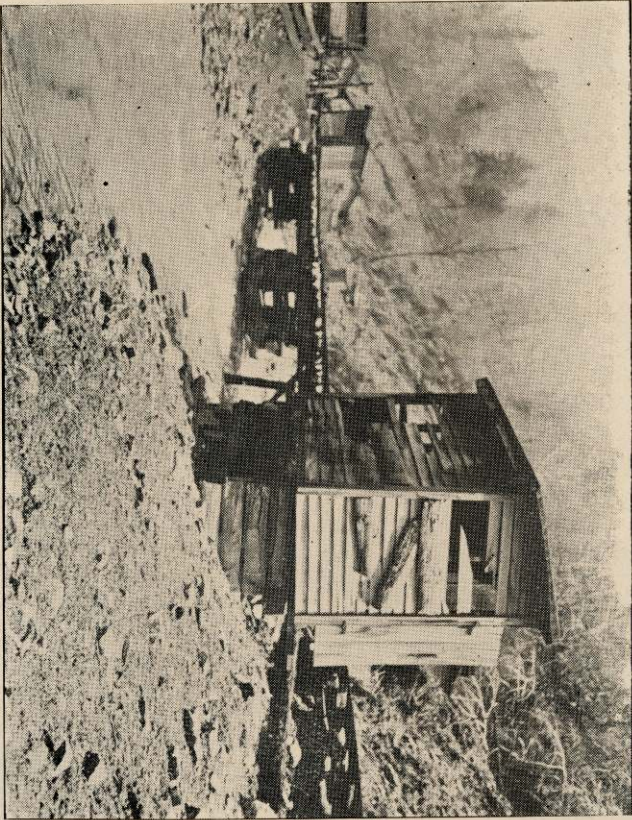


Figure 3. An old timer which speaks for itself.

and so also be able to bring its methods to the attention of somewhat less progressive companies. (1) At Gary the housing conditions are good, considerable attention is paid to sewage disposal, and in numerous ways there is evidence of welfare work. All of this, barring the influence of the importation of labor and the migrating of miners from one camp to another, the results of which could not be determined until investigation, would make for a healthful community.

Tables 1 and 2 will show that a wide range of nationalities is represented in good sized groups. Table 1 shows that at least twenty nationalities are represented, along with American white and colored from fifteen different states of the Union. A glance at the densest part of the table will show that the Americans come chiefly from West Virginia, Virginia, and North Carolina, and the foreigners for the most part represent Russian and Austria-Hungarian provinces and Italy.

In regard to Italians, it has been talked not a little in our press that a certain class of them is being introduced into the United States who make very undesirable citizens. This fact was evident while endeavoring to instruct certain classes in some of the rudimentary principles of decent living. Indeed, nothing but police force would seem to appeal to certain families that make proximity, even to the poorer class of colored people, intolerable. Something must be done with this class, for aside from their low moral tone, many of them are infected with various types of intestinal parasites, and their filthy manner of living is such as to endanger the other members of the community.

It will be noted that for the adults, the number of ascaris infections is rather high. The largest number of infections occurs among the men from Italy, Austria-Hungaria, and Virginia. Infections by this parasite is through the mouth; this means that excreta containing the eggs must either have contaminated the hands or the food.

A parasite that is very common in McDowell county is the whip-worm, *trichocephalus*—a parasite for which no certain remedy has been discovered. Nearly one-fourth of the men of this group are infected with this parasite. Out of 1339 men examined, 331 were infected. According to Neveu-Lemaire this parasite develops direct, as does *ascaris*; hence the infection is chiefly by mouth. The egg is very small and easily carried along with dust into the nasal and buccal cavities. There seems to be no constant relation between the number of infections and the dryness or dustiness of the mines. There is, however, some relation between the number of infections and the number of foreigners in a given mine. The Italian, Hungarian, and Polish nationalities seem to be most highly infected. There is evidence of the parasite being spread, for where the men are working in groups, upon finding one man infected, it was common to find a number of the workers in that particular section of the mine likewise infected. Their custom of defecating in the breakways, abandoned entries, and in some mines even along the main and sub-entries in constant use, is favorable to the spread of

(1)

this parasite. Many times have I seen men—all unconscious of the harm until told—scratch up the infected coal dust with their bare hands or with their boots (later to be handled), and then, without washing their hands, eat lunch. Naturally, such habits result in a constant and gradually increasing infection.

According to table 1, of the 1339 miners examined, 32 were infected with hookworm. Eleven of these were from Europe, six from West Virginia, nine from Virginia, five from North Carolina, and one from Tennessee. Thus, the number of men infected is not large, nor did the symptoms of those infected simulate those of persons heavily infected. As a rule the number of eggs found in the stools did not exceed thirty per standard slide, and from the cases treated we never secured more than fifty adult worms. Such light infections, while they may and do deprive the men of a perceptible amount of energy, do not render them economically unfit. The chief danger is that resistance to other diseases may be lowered. To the community, however, they may be, as mentioned before, a real source of danger to every other person within it, unless proper disposition is made of the fecal matter.

As proof of how dangerous such stools may become, I collected samples of them from some of these so-called mild infections, mixed them thoroughly with powdered coal, dampened with mine water, and then placed the mixture in flasks kept under proper conditions—conditions similar to those that could exist in the locality where they were found. From these cultures, great numbers of larvae were obtained which had reached the infecting stage. It requires only seven days for the larvae to develop into the infecting stage in damp coal dust during the summer months (the time, of course, may be lengthened or shortened by the lowering or raising of the temperature respectively). Thus these worm-carriers may spread the infection during the summer months. All of this naturally raises the question "Why is the infection not more general within the mines?" This point I will discuss later.

Three individuals were found to be infected with strongyloides, one with anguillula, and two with an undetermined parasite. This latter parasite had an adult and rabbitic larval stage outside of the host's body.

Strongyloides deserves special mention, since it has a larval form which resembles hookworm larvae and infects through the skin in the same manner as hookworm. To the miners of West Virginia it is of interest because it develops an infecting stage within the mines. I collected samples of feces from the infected men, mixed the cultures at once inside the mines, using coal dust and mine water as it dripped from the top, and at the end of ten days had heavy cultures of the infecting larvae that were very active. At this date (Dec. 10, 1914), I have live larvae from these cultures which have been living in water inside of sealed tubes. It is obvious that with larvae so resistant as this, the parasite should be controlled at once.

In the preliminary investigation in which samples of feces were collected in the breakways, a larger percentage of the samples collected contained larvae of strongyloides than is represented in Table 1.

This may have been due to a duplication of samples from the same individual or to the mine samples having been infected by rodents or possibly by a small fly very commonly found in the mines. Unfortunately, we were for some reason unable to secure samples from men who were responsible for the infection. They were reported to have sought work elsewhere. This means (1) they left the breakways infected, thus exposing to disease those who took their places; (2) they infected new breakways in whatever mines they secured a new job.

In all 1557 miners were interviewed (2) and given bottles. Of these 218 bottles were not returned, and of the 1339 samples collected, 463 were found to be infected with one or more parasites. Some of the miners were infected with four different kinds of worms; and it was very common to find the members of an entire family infected with two different kinds.

Having found the adult male members of the various mines at Gary infected with such a wide range of parasites, it was of interest to know the condition of the children, many of whom show a considerable degree of pallor. Streams fascinate children. Their pollution troubled them no more than it did their parents. I have seen many children playing in the mud and water of the polluted creeks; and it is no uncommon practice for the boys to dam up a portion of the stream and use the hole as a swimming pool. Upon locating a miner infected with hookworm who lived on the stream, we interviewed all the children about that particular house. (3) Part of the children were infected with hookworm, and most of the others either with ascaris or trichocephalus.

We then interviewed over one hundred children. Unfortunately, out of the 119 bottles distributed, only 75 were returned. The children that we most wanted were the ones, as a rule, whose samples could not be obtained. Hence our data are not at all satisfactory. A further study ought to be made to determine what is the chief cause of the frequent pallor observed in children living along the creeks. (See further discussion in connection with table IV.)

Summary.

1. In spite of the relatively sanitary communities at Gary, there is a relatively large number of individuals infected with intestinal parasites. This high percentage of infection is due primarily to the following factors:

- a. The importation of labor from European states where the inhabitants previous to immigration were infected.
- b. The introduction of domestic labor from counties in adjoining

(2) A glance at the column headed "Bottles returned" in Table 1 reveals the interesting fact that there is a direct relation between the percentage of bottles returned and the unwillingness of a particular group of miners to co-operate for the community's good.

(3) In the four houses there were two families that had children; the three children nearest the infected out house were all infected with hook-worm.

states where the sanitary conditions are bad and where intestinal parasites are known to be common.

c. The wandering from place to place on the part of a certain class of labor, the data cards of which show that many of the infected individuals had previously worked and lived under sanitary conditions known to be worse than those of Gary, in which former places they were probably infected.

d. While the outside sanitary conditions may be rendered safe by the use, for the most part, of concrete vaults, yet the common practice of the miners of defecating within the mine and not at home has, in a measure, defeated the purpose of the sanitary out houses, so far as the men are concerned. The breakways, and certain other galleries of the mines are constantly being infected by carriers of various parasites. The coal dust containing either the eggs or the larvae of various worms then gain entrance to the intestine by the usual methods.

2. In contrast to this, the data cards show that those whose earlier history reveals that they had been infected with either ascaris or with hookworm, have, since working in offices or where they have been protected from re-infection, ceased to harbor these parasites.

Payeton.

This mining camp is a very interesting one from a sanitary point of view. For the most part the houses are stretched along a shallow creek, with another group of houses nearly at right angles up a hollow. The company has provided nice, neat structures as out houses for each family. These for the most part are open in the back and either project over the edge of the walled-off creek or jut into the hillside. For all purposes of discussion, therefore, it is the surface method of fecal disposal. Owing to the steep slopes of the hollow, the yards and the hillsides are doubtless washed free from undesirable excreta during that season of the year when freshets are common. Then, too, the yards of the main portion of the village along the railroad are gradually being filled in with fresh ashes and fine coke from the ovens. The chief source of menace, therefore, is the open outhouse during the dry, summer months.

A glance at table II will show that eleven nationalities and nine different states of the union are represented. Among the Europeans, the greatest number of men come from Italy, Russia, Greece and Austria-Hungary. The Americans are mostly from Virginia and North Carolina.

In all we made 322 interviews and distributed as many sample bottles. Forty were not returned; 272 samples were examined microscopically. The result was that 75 men were found to be infected or 27 per cent. Of the total infection among the men there were 22 cases of ascaris, 4 of hookworm, 3 of tapeworm, 45 of trichocephalus, and one unknown. The discussion regarding the practice of defecating in the breakways and old passage ways applies also to the mines of this place.

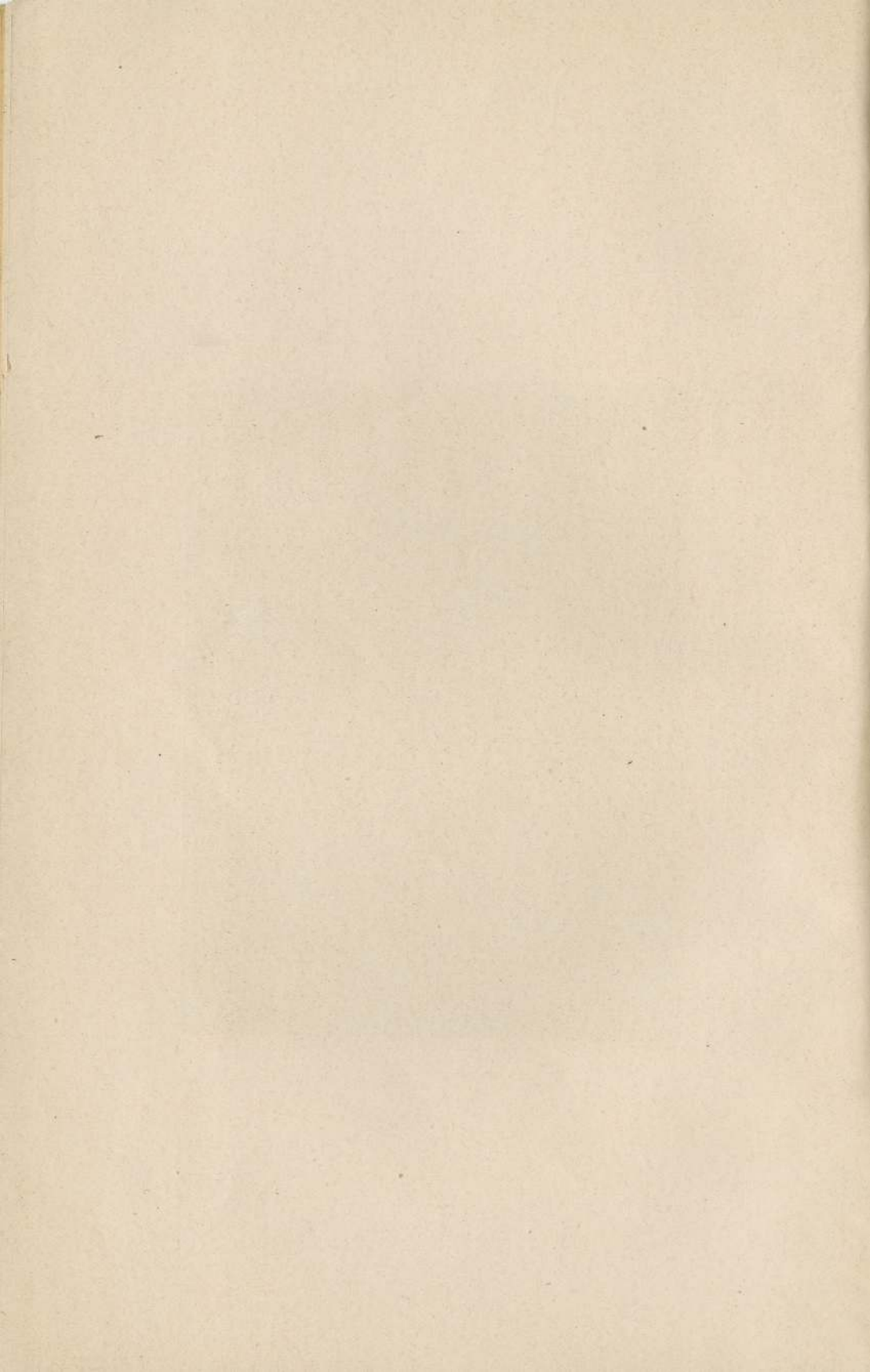
The Children of Payeton. A study of table IV, shows that



Figure 4. An outhouse used by four families.



Figure 5. This shows how the back yard must of necessity be contaminated with fecal material. The arrow indicates the lower part of an open closet which was very dirty. The children who played in this spot had sores between their toes.



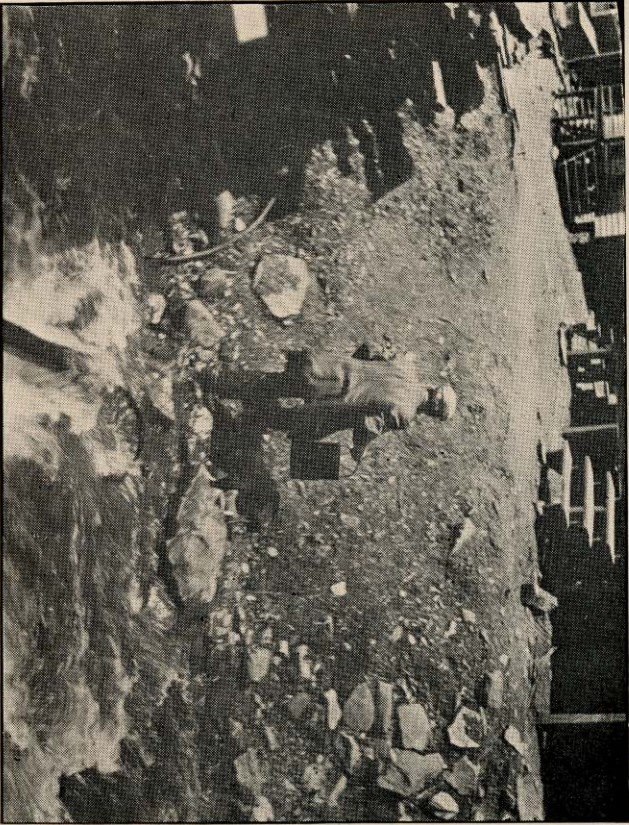
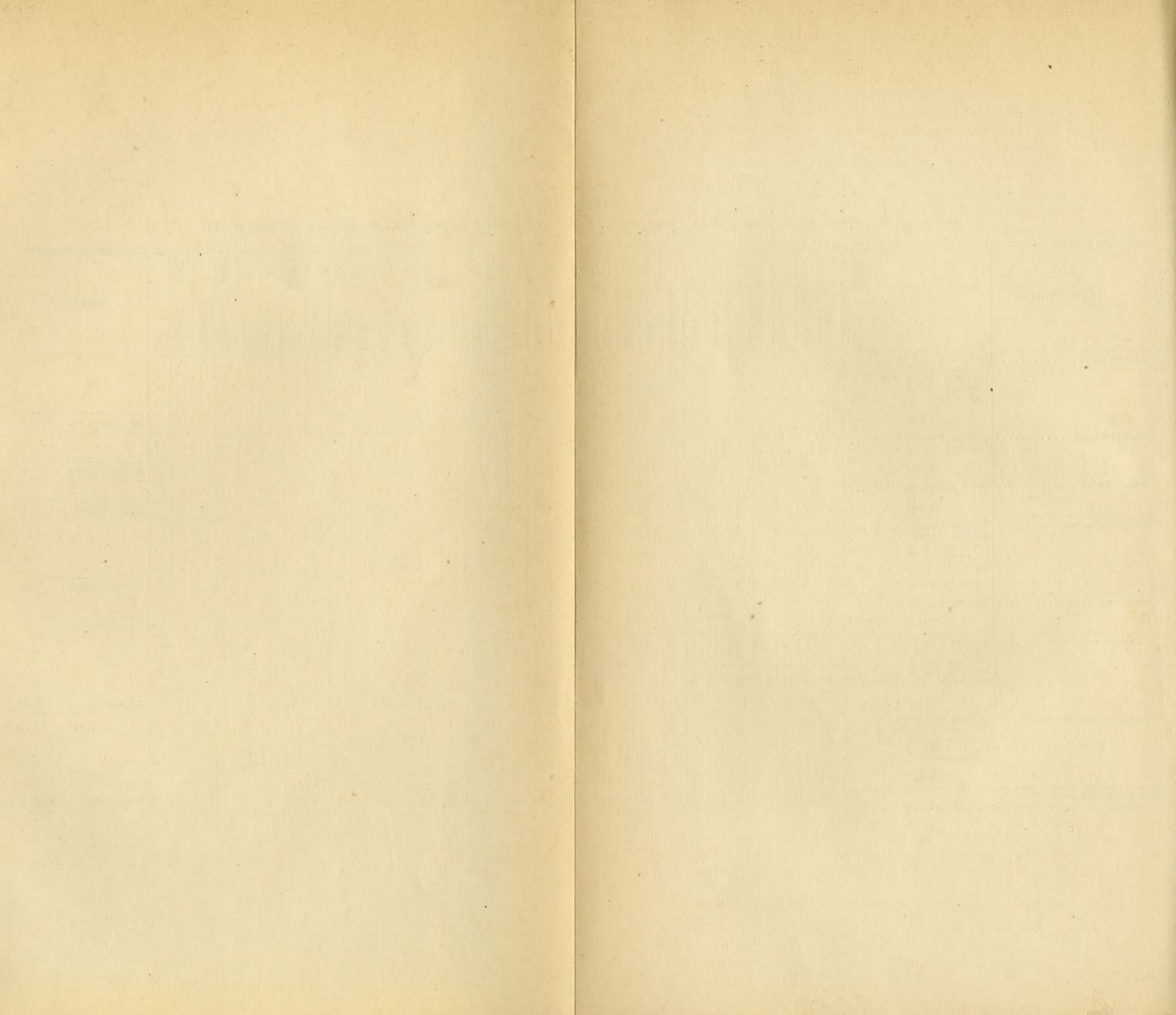


Figure 6. It is a common custom with some foreigners to get water from the creek for washing clothes, etc. This man knew that he ought not to use the water that was contaminated by many outhouses like that of Figure 3, so that when the camera was turned upon him, he was caught running.

TABLE III.

Survey of Men at the Mines of the Bottom Creek, Peerless and Tidewater Coal and Coke Companies, Vivian, W. Va.

INFECTON.	MINE.	Italian.	Hungarian.	Russian.	Magyar.	Polish.	Hoywat.	Slav.	Roumanian.	Austrian.	English.	W. Va.		Va.		Tenn.		Ky.		Ala.	N. C.		Ga.	N. Y.		Iowa.	Ill.	Pa.	Ohio.	Canadian.	S. C.	TOTALS.	
												White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	Colored.	White.	Colored.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	Colored.	Colored.		
Ascaris	Bottom Creek No. 1	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Bottom Creek No. 2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Tidewater	1	1	1	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Total	1	1	1	1	7	Ascavis	13
Ancylostoma	Bottom Creek No. 1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 2	..	..	..	..	..	..	..	..	..	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Total	2	1	Ancylostoma	4
Tape Worm.	Peerless No. 2	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Total	1	Tape Worm	1
	Trichocephalus	Bottom Creek No. 1	2	2	..	1	1	
	Bottom Creek No. 2	..	2	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Tidewater	3	2	3	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	Total	7	2	3	..	1	4	1	2	1	Trichocephalus	22
Unknown	Bottom Creek No. 1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Total	1	Unknown	1
Samples examined	Bottom Creek No. 1	3	1	2	2	4	..	2	6	3	..	3	5	9	14	..	..	..	..	2	..	3	..	1	..	..	..	2	..	..	..
	Bottom Creek No. 2	4	..	..	..	2	..	..	5	..	..	11	6	2	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 1	1	..	..	..	..	..	..	..	..	..	8	1	6	2	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	Peerless No. 2	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Tidewater	9	15	11	..	6	..	2	5	..	..	..	..	..	..	..	..	..	..	..	..	5	7	2	..	..	1	..	..	..	1	
	Total	17	18	13	2	12	..	6	16	3	..	36	33	22	51	3	2	..	2	3	5	11	2	1	..	1	2	2	1	..	1	Examined	265
Samples not returned	Bottom Creek No. 1	1	1	7	..	1	..	..	3	..	..	3	1	4	5	2	..	1	1	..	..	..	..	..	..	..	..	..	1	..	..
	Bottom Creek No. 2	5	..	2	..	2	..	..	1	..	..	6	9	2	5	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peerless No. 1	2	..	..	..	..	..	..	..	..	..	..	..	3	7	2	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	Peerless No. 2	..	..	..	..	7	..	1	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..
	Tidewater	12	7	2	1	1	1	4	15	
	Total	20	8	11	..	10	..	1	4	..	1	12	18	13	35	7	..	1	1	..	1	..	1	..	1	..	3	..	1	Unreturned	149
Total Distributed	48	51	35	86	10	2	1	3	3	6	11	3	1	1	1	1	2	5	1	1	Distributed	414



out of a total of 75 children interviewed, 47 turned in samples. Of the 47 examined, 42 infections were found or nearly 90 per cent. The infections were, 16 ascaris; 18 trichocephalus; 2 hookworm; 2 tapeworm; 1 each strongyloides and oxyuris, and 2 unknown.

The combination of forces at work at Pageton to give a higher percentage of infection among the children is too complicated to discuss here. One very important factor, however, is the easy access that the children have to the infected creek.

Bottom Creek Coal Company.

This company extended every courtesy that one could expect; the management invited criticism and advice, and I wish to say profited by acting upon the advice. The method of discipline, however, is not so rigid as at some places, as is evidenced by the failure of many to return their bottles. Because of this, some of the specimens that I especially wanted could not be got without more pressure than it seemed wise to give.

Miners. Out of 157 interviewed and requests for samples, only 87 bottles were returned. Of these 22 infections, or 25 per cent were found as follows: Ascaris, 8; hookworm, 1; trichocephalus, 12; unknown, 1. A glance at the table shows that most of these infections were from Virginians and West Virginians, though the Roumanians and Italians also contributed their share. (See table III.)

Children of Bottom Creek. In all we interviewed 98 children. Eighty-one samples were returned. Of these 47 or about 58 per cent, were infected as follows: ascaris, 20; trichocephalus, 24; tapeworm, 2; hookworm, 1. (See table IV.)

Judging from the condition of the outhouses as found upon our first trip, it is really surprising that we did not find a greater infection. This unsanitary condition upon our second trip of inspection was remedied. The outhouses were not only thoroughly cleaned, but the more dangerous ones were removed, and the rest thoroughly repaired. The Commission was given to understand that just as soon as good, practical outhouses could be decided upon, an entirely new system would be adopted. When this is accomplished and the infected individual have been cured, it would be interesting to re-survey this community and note the results.

The Tide Water Coal Company.

Owing to our time being limited here, only a part of the miners were interviewed. One hundred and fifty-five men were given bottles; 112 were returned. The following infections were found; ascaris 5, trichocephalus 10, a total of 15 or 13 per cent. (See table III.)

Children. Table IV shows that 118 children were interviewed and given bottles. Of this number 101 returned their bottles. Fifty-two infections were found as follows: ascaris 23, trichocephalus 25, tapeworm 1, hookworm 1, or 51 per cent.

Contrary to the usual experience, a greater number of infections

were found among the people living upon the hill sides in spite of the deep vaults and good structures over them than was found in the low lands, the reason being that those on the hill side had a more unsanitary way of living than the ones in the hollow. On the hill, conditions existed that were simply intolerable. The people themselves were chiefly to blame; but the company was indirectly responsible in that discipline was not introduced which would protect the innocent and punish the offenders. They had also introduced the economical and—unless rightly planned—objectionable practice of building a house large enough to divide into four compartments, with two doors on one side and two on the opposite side. Thus one deep vault answered for four outhouses. The building was so located that four families were supposed to use it. One can imagine what would happen if a house with 10 to 20 foreigners located near by were attacked with an epidemic of diarrhoea. Who, then, could be held responsible for the cleanliness of the outhouse? Aside from the standpoint of economy, the benefits thought by some to be derived from reducing the number of small vaults may indeed be great, providing the lots are so fenced that the outhouse sits at the intersection of the fences—these running up to the middle of each. Then each door ought to be supplied with a lock, and the family be made responsible for keeping it clean. Even this arrangement can hold very grave sociological problems.

At any rate, the experiment in this community has failed, for even the new structures were in such a condition on the inside that it was unsafe to use them. The colored people blamed the condition upon the Italians; the Italians said each had to go where it was possible, there not being enough closets. If typhoid fever ever gets a start in such a camp, nothing but a miracle can prevent an epidemic. The large number of worm infections is proof of the extensive contamination of the hands and of the food with feces.

The Peerless Coal Company.

There are three main camps, one in the hollow near the railroad, inhabited mostly by white people, one on the hillside inhabited mostly by colored people, and a third opposite the Tide Water Company. This latter, a new camp, is provided with excellent houses and outhouses; everything is nice and clean, the people are apparently well cared for, and are an excellent class of workers. The older camps were very dirty. The deep, long standing vaults lining one of the alleys, because of not having been cleaned, were indescribably offensive. (4) Pigs were either running loose or else kept in pens near by. I am sure that an occasional visit of a public health officer to advise with the proper authorities would greatly help matters. People become so accustomed to such surroundings that individual complaints are ignored, and as a result everybody suffers.

Miners of the Peerless. In all, 92 men were interviewed and given bottles, 56 of these were returned and 5 or a little less than 9 per

(4) For some reason these deep vaults were cleaned the last week of our stay there, though it was by no means neatly done

cent were found to be infected as follows: ascaris, 1; hookworm, 3; tapeworm, 1. (See table III.)

For some reason, the men got the idea that they did not need to return their bottles; the result is that the highest percentage of hookworm was found here, it being 5.2 per cent.

Children of the Peerless. One hundred and seventeen children were interviewed and given bottles. Eighty-five of these were returned; thirty-seven or 43 per cent of them were infected as follows: ascaris, 14; trichocephalus, 18; tapeworm, 2; hookworm, 1. (See table IV.)

Omstead, (The Houston Coal & Coke Co.)

Here only the outside living conditions of the people were studied. Bottles were distributed to 111 children; 86 samples were collected. Of these 34 or nearly 40% were infected as follows: Ascaris, 17; trichocephalus, 11; tapeworm, 5; hookworm, 1. (See Table IV.)

The new management has plans on foot for changing the present system of fecal disposal. Certainly the old management is to blame for a system that was without doubt responsible for the last epidemic of typhoid fever. I requested the people to boil the water; one of a family replied, "What's the use? We boiled our water, and had three cases of typhoid." Without doubt the large number of typhoid cases was not alone due to the use of water from certain springs, but in a large measure to the very bad condition of the outhouses and the ease with which this infected material could be spread over the entire camp.

General Discussion.

In all of the data cited, it must be remembered that the figures represent the very lowest possible infection. There were without doubt in those communities where a large percentage of bottles were not returned, persons that were infected. I have in mind cases where special effort was made to secure samples from suspects, but at first all such efforts were in vain. Finally, after having attended one of our illustrated lectures on the subject, these obstinate persons returned samples and were found to be infected; other suspects would not even attend the lectures. They are a class from whom one could get a response only by force.

As has been emphasized, there can be no doubt of the danger of the open outhouse and of its pollution of small creeks and yards. And this grave consideration must not be lost sight of. In any community that is heavily infected with a parasite that reaches the intestine through the mouth, it must naturally follow that bacterial diseases, the germs of which show an equal resistance to drying, sunlight, etc., will go hand in hand with the parasitic disease. Indeed, one need but study a community intensively to see that, where the percentage of persons having ascaris or trichocephalus is high, the proportion of those who at one time or another have had typhoid fever, dysentery, or other intestinal infections is also high. Hence the presence of intestinal worms may not only be an index of the extent of their prevalence, but also of an absence of a guarantee against other more deadly diseases associated with fecal contamination. This is no theory, as is shown by the follow-

TABLE IV.
Survey of the Miners' Children.

Infections	Pageton Hollow	Bottom Creek Hollow	Tidewater	Peerless No. 1	Peerless No. 2	Tidewater Bottom	Kimball	Olmstead	Gary	Pageton along creek	Total Infections
Ascaris	16	20	3	3	11	3	..	17	10	8	91
Anchylostoma	..	1	..	..	1	..	..	1	3	..	8
Tape Worm	2	2	2	1	1	1	..	5	2	2	19
Trichocephalus	18	24	4	5	13	1	..	11	15	4	95
Strongyloid	1	..	..	..	..	..	..	..	..	3	4
Oxyurus	1	..	..	..	2	..	..	..	1	..	4
Unknown	2	..	..	..	..	..	..	..	..	1	5
No. Samples examined	47	81	53	57	28	20	7	86	74	67	Total examined
Samples not returned	28	17	36	27	5	..	..	25	45	11	Samples not returned
Samples distributed	17	98	89	84	33	20	7	111	119	78	Total samples distributed
	17	98	89	84	33	20	7	111	119	78	Total No. of infections

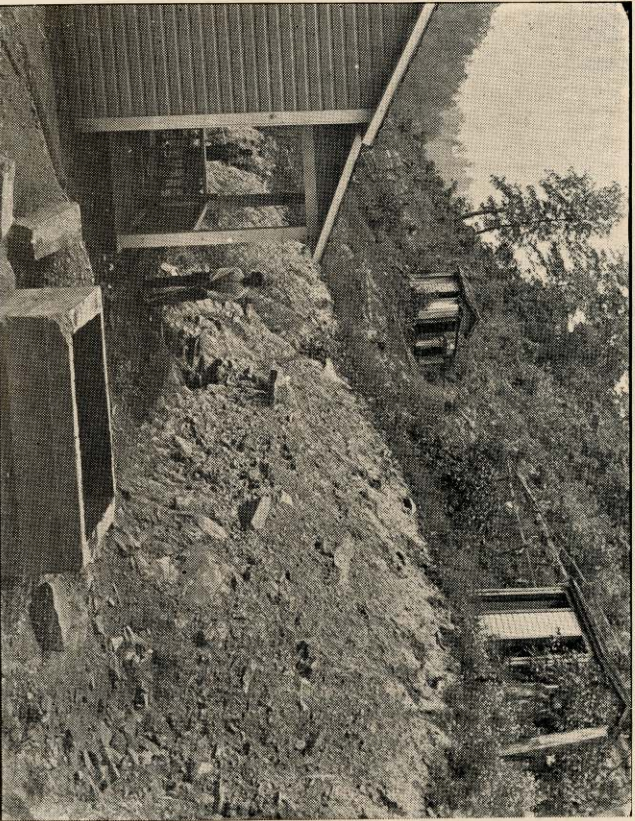
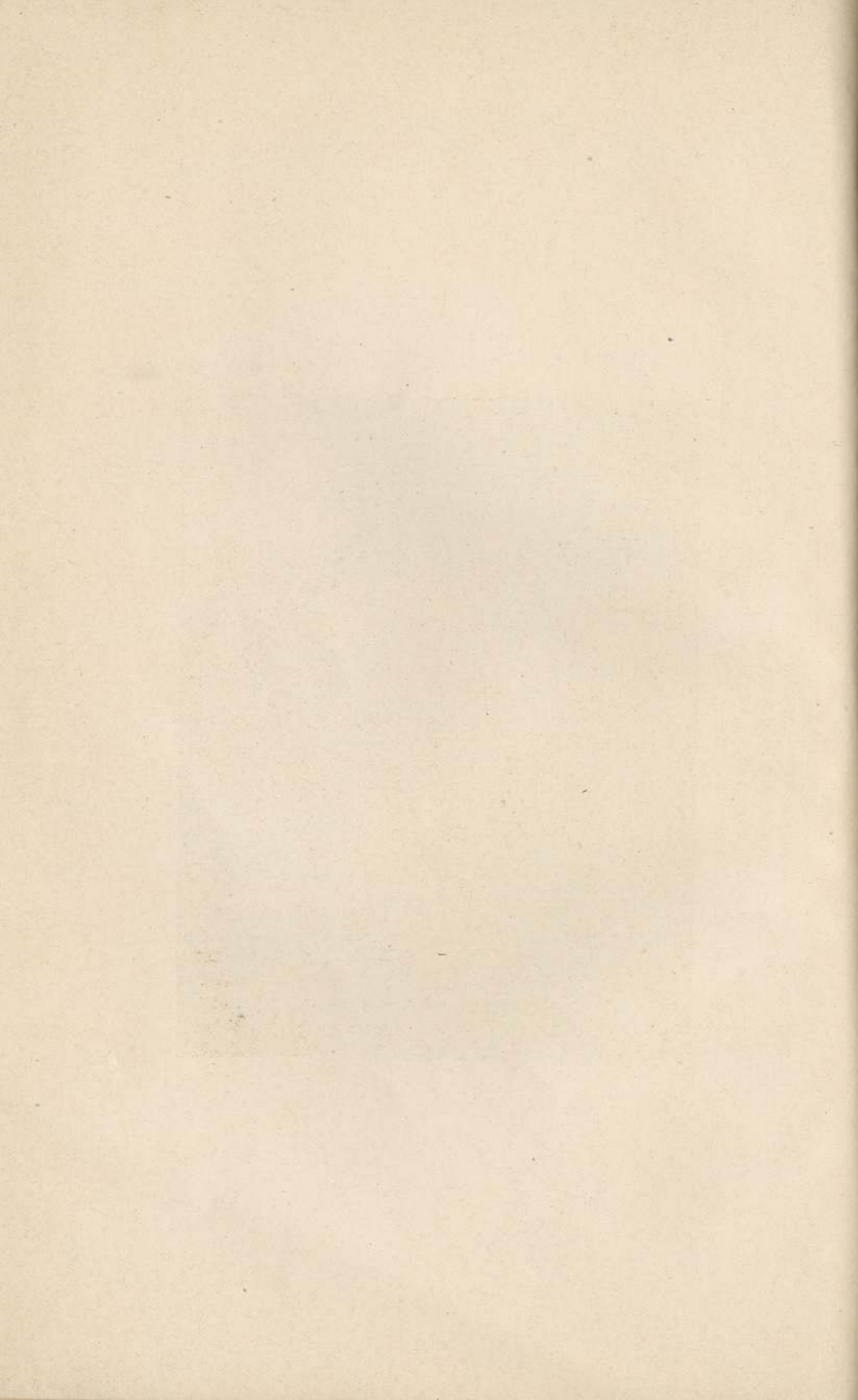


Figure 7. A good example of some up-to-date sanitary work being done at Garry, W. Va. Note the concrete vault upon which the outhouse on the hillside is to be placed. These vaults when they contain enough water to cover the excreta are nearly odorless. All hook-worm larvae die, and the contents are rendered harmless by the fermentation that takes place. Such outhouses can be placed near the house without being offensive, where a metal tank on tracks can be hauled up; the liquid fecal matter is then pumped into this tank by means of a hand sewerage pump. It is then hauled away to a suitable place.



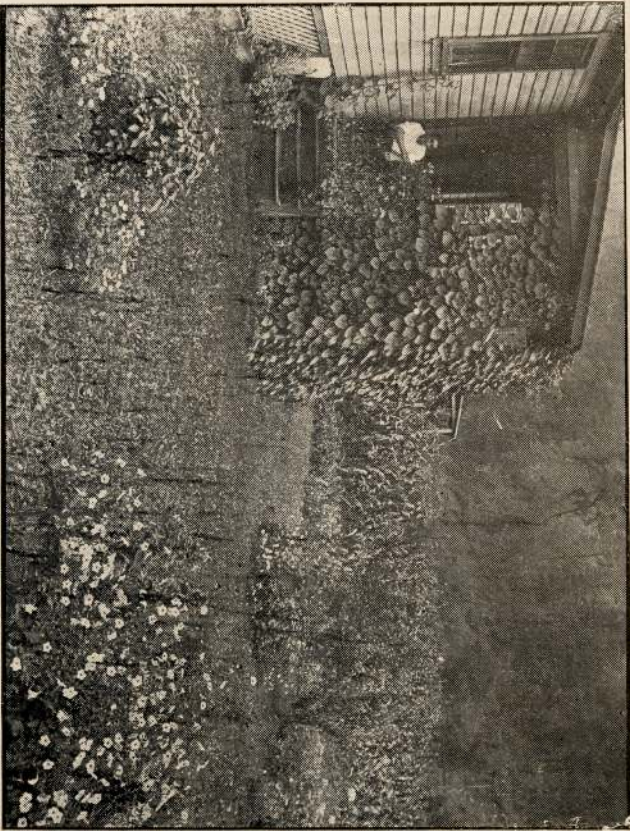
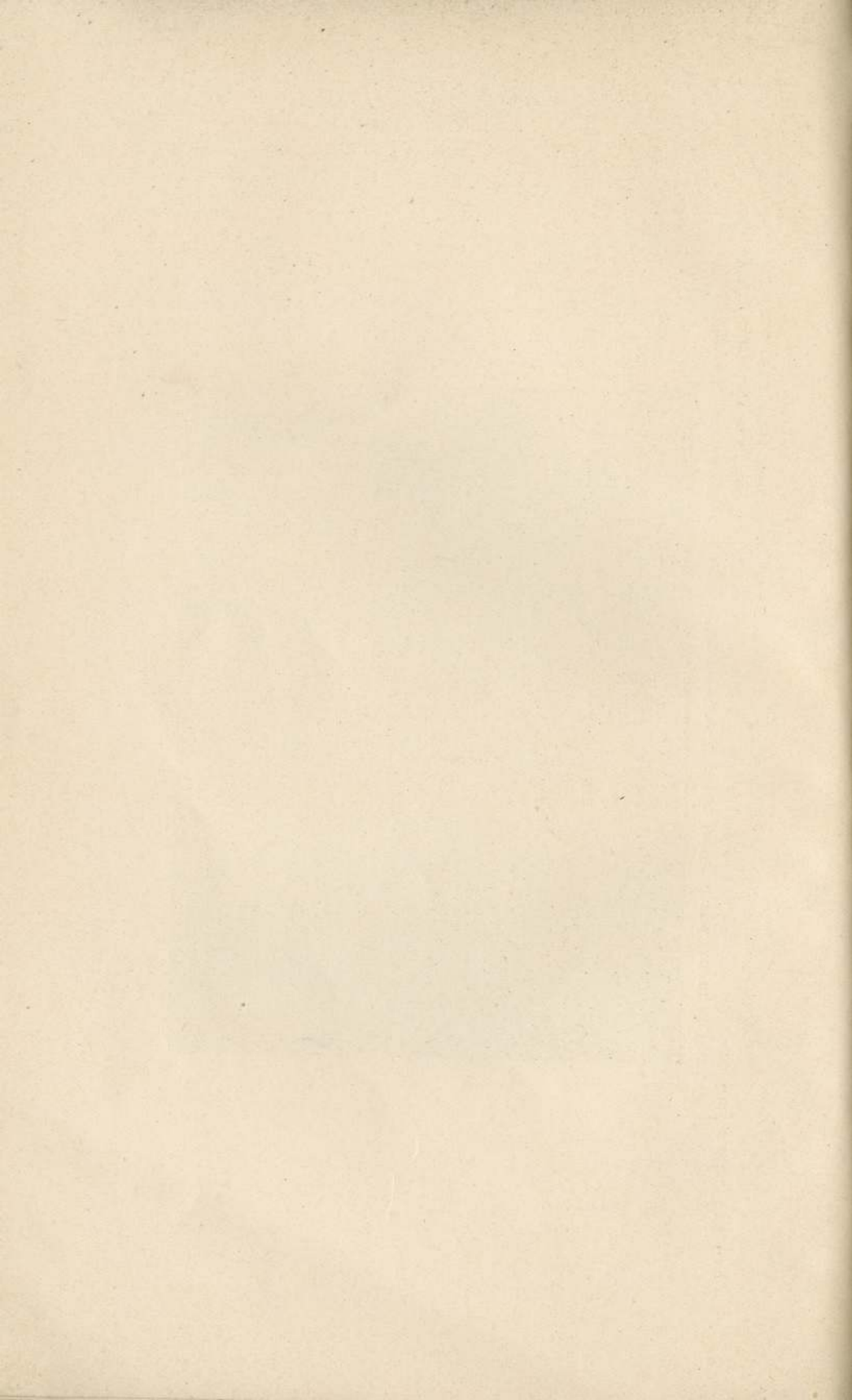


Figure 8. An excellent example of cooperation between landlord and tenant at Gary, W. Va. Not only is this place beautiful, but it is a yard safe for young children to play in. A yard well sodded and free from pigs is one of the best safeguards against many of the parasites discussed in the text.



ing data: In community (—) 40% of the children were carriers of intestinal worms (chiefly *ascaris* and *trichocephalus*). A canvas of these children and their parents (making 299 persons) showed that at one time or another in their lives 105 of them had had typhoid fever. In that community there were said to have been 70 cases of typhoid in 1912. In another community where only about half of the sample bottles were returned, but that in spite of this showed 25% of the children to be carriers of worms, as a result of open outhouses, an epidemic of typhoid fever broke out in 1912, in which between 20 and 30 persons were involved. These facts are suggestive and support the consideration that a company is only going half way in providing deep well water, if at the same time it furnishes open outhouses, or permits careless use of those with deep vaults. If a community and its management could but realize the danger of improper fecal disposal, its constant menace in producing either a slow, cumulative effect of disease on the one hand, or an epidemic effect on the other, they would consider it a thing to be despised and feared.

The data of Tables I, II, III, and IV, therefore, have considerable significance. The 806 worm carriers are constantly sowing the seed for a new crop of their kind. Among those who have had typhoid, also, there are doubtless numerous carriers. If, therefore, the character of the outhouses is such as to favor the spread of worms, as is evidenced by the 800 out of the 2500 persons examined, it is such as to favor typhoid fever and other intestinal diseases also. The explanation often given me for the cases of typhoid, dysentery, and other intestinal troubles was that of "coarse food." Coarse food? No, it is not coarse food that is the cause; it is what gets into the food. A saying that is almost proverbial among miners is, that children have a hard row to hoe until they pass the ages of five to eight years, because they have so many intestinal troubles.

It may be asked why hookworm is not more commonly found in these mining communities. There are several reasons. (1) The hill sides are as a rule steep and composed of a stony clay; hence if the fecal matter is washed into the open it dries out, this process being deadly both to the larvae and to the eggs. Where the houses are along sand creek bottoms, however, a careful investigation of this phase of the problem would doubtless reveal a larger number of infections in such locality. (2) Hook-worm larvae do not live long in closets with deep vaults, especially those with water in them. Neither do they live long in shallow ones with a stone or clay margin. Concentrated fecal matter is incompatible with their normal life processes,—the toxic substances developing within it kill them. If, therefore, they cannot find a moist, porous medium relatively free from these toxic substances, they die without reaching a host. (3). Long, cold winters are, of course, an important factor in keeping down the infection, but this is only a secondary consideration, since there is ample time for the spread of hook-worm infection, provided the infected material is dropped in locations favorable to growth and where the larvae can reach the skin of man.

(4) The low temperature of moist mines and the presence of salts no doubt inhibit the growth of larvae and lessen their motility.

It is doubtful if these factors are the only ones that have been responsible for the absence of epidemics in the mines of West Virginia. When additional data can be obtained to clear up certain points, this will be discussed more in detail in another paper. The system of working out coal areas and then allowing them to cave in, is a very important factor in preventing the spread of intestinal parasites that depend upon a larval stage for completing life history through skin infection.

This, however, is no reason why the problem should be ignored. On the other hand it should be worked out in both rural and mining communities, especially those bordering upon certain parts of Virginia from which much of our infection seems to be coming; also where new foreign labor is being introduced into the mines.

Summary.

1. The Commission interviewed 3108 individuals and examined 2507 samples of feces, making in all over 5000 microscopic examinations. Of the total number of samples examined, 1876 were men working within the mines, and 631 were children of these miners.

2. Of the total number of persons examined, 806 or 3% were found to be infected with worms. Of these 806, 226 were children and 580 men.

3. The intestinal parasites most common are ascaris, trichocephalus, and tape worm, and a smaller percentage of hook-worm, strongyloides, anguillula, oxyuris, and some undetermined types.

4. Hook-worm among the miners of the 17 different mines studied is not common, nor is it at present of economic importance. By this is meant that none of the miners or children were very heavily infected, none showing severe symptoms of anchylostomiasis. It may, however, become of economic importance under certain conditions mentioned in the text.

5. Some of the children were so heavily infected with ascaris as to be worm sick.

6. The large number of ascaris and trichocephalus infections among the men is doubtless due to contamination of the coal dust of the breakways within the mines, whereas that of the children is primarily due to open vaults, unclean seats and floors of the outhouses, and spread of fecal material by pigs, rodents, and various agencies.

7. A comparison of the number of people infected with ascaris and with trichocephalus with the number that have had typhoid fever, shows that there is a close relation between the two. This is associated with the unsanitary condition of the outhouses. Where the closets are unclean and open, there is a high infection with worms; connected with this there is evidence either of an epidemic of typhoid fever and a prevalence of intestinal troubles, or there is a sporadic type of typhoid that is gradually accumulative and eventually involves large numbers of individuals.

8. In some mining communities there is a system of keeping in touch with sanitary matters; in others there seems to be none. Even some of the doctors in charge consider this "welfare work", maintaining that they are paid to cure, and not to prevent, disease.

9. Aside from collecting data, the Commission offered many suggestions while inspecting the miners' yards and out-houses, and at all times that it was possible, criticism was offered concerning the danger of defecating in moist breakways and air passages within the mines; illustrated lectures were given by Professor Schultz in which it was explained how the individual contracts the most common parasites; emphasis was laid upon the dangers from fecal contamination and its importance in connection with typhoid and with other intestinal diseases; instructions were given to treat the rain-barrels with lamp-oil in order to kill mosquito larvae and so lessen the chance of malaria. In fact the Commission carried on an educational campaign which aroused the interest of all classes in health problems.

SUGGESTIONS.

1. It is suggested that at present what is most needed is a systematic educational campaign in public health matters. One of the most powerful influences for exciting interest is the delivery of illustrated lectures on subjects which have a direct bearing upon the welfare of the community involved. Nothing was more forcibly brought out in our work than the idea that if the public is to coöperate successfully in public health work, it must be made thoroughly conversant with the problems at issue; the practical value of it all must be made clear.

2. The burden of responsibility for proper sanitation must be laid upon the community, which in turn makes each person within its limits responsible to it. Both must be taught that they owe this to themselves and the state. Nothing can prove wiser from an economic standpoint than to instill into each community a pride in the health, cleanliness, and beauty of its surroundings.

3. The state should provide enough full-time health officers to make periodic inspection of small communities unable to employ full-time public health officials; in this way the smaller communities could yet have the value of expert advice on matters of vital interest to them. (The officers, also, to inspect larger communities.) Commercial concerns noted for efficiency have a system of periodic inspection, which insures an alertness and a degree of order not obtainable in any other way. The army employs the same method. The effect of a similar system, properly managed, would work wonders among colored people and the foreign elements of all communities. This has been proved by our own experience and by the experience of the highest types of coal companies within our state that have a system of inspection of equipment, and in a few instances a sanitation committee, which makes periodic inspections of living conditions in the camps.

4. A local committee for each community, composed of the two most influential miners or their wives, chosen by the miners themselves, and one man or woman chosen by the company, might be

organized. This committee's function would be to inspect the sanitary condition of the camp once a month or bi-monthly, and then meet with the superintendent, and advise with him as to conditions needing attention. If possible, a record should be kept of the more important proceedings.

5. Since many physicians are as a rule too busy attending the sick and fail to see the significance of "welfare work," it would be a good plan for the miner's hospitals to be supplied with extra nurses trained in social work to visit the homes, and by instruction and personal effort train the wives and children in matters of sanitation that prevent disease.

6. Hygiene should be one of the required subjects taught in the public schools. It should be begun in the primary department with practical talks by the teacher. No teacher should be given a certificate who has not been trained in this subject. "School hygiene" is not sufficient; it must be a training that can grasp the local problems so that there may be instilled into the children the importance of these local conditions upon their health. Such courses can be had from members of the medical faculty at the State University. This element of our public education should not be longer ignored.

7. Some means must be devised for safer methods of disposing of human excreta. The widely used method of contaminating the breakways, gobs, and entire entries of the mines should be substituted by more modern methods. For the outside there should be devised a regulation closet, the essential features of which should be required by public health regulation. Ample power should be given in each case to make such regulation effective.

8. The water supply of all corporations should be examined periodically, and the pernicious system of connecting the supply tank with two system of pipes, one supplying deep well water and one supplying surface water, should either be prohibited or strictly regulated.

(5) Such committees could meet with the state public health officer upon his periodic visit, and gain the benefit of expert advice; the difficulties that the local authorities could not handle alone might easily be solved by cooperation with the state authority.

