

61ST CONGRESS, 2D SESSION  
1909-1910

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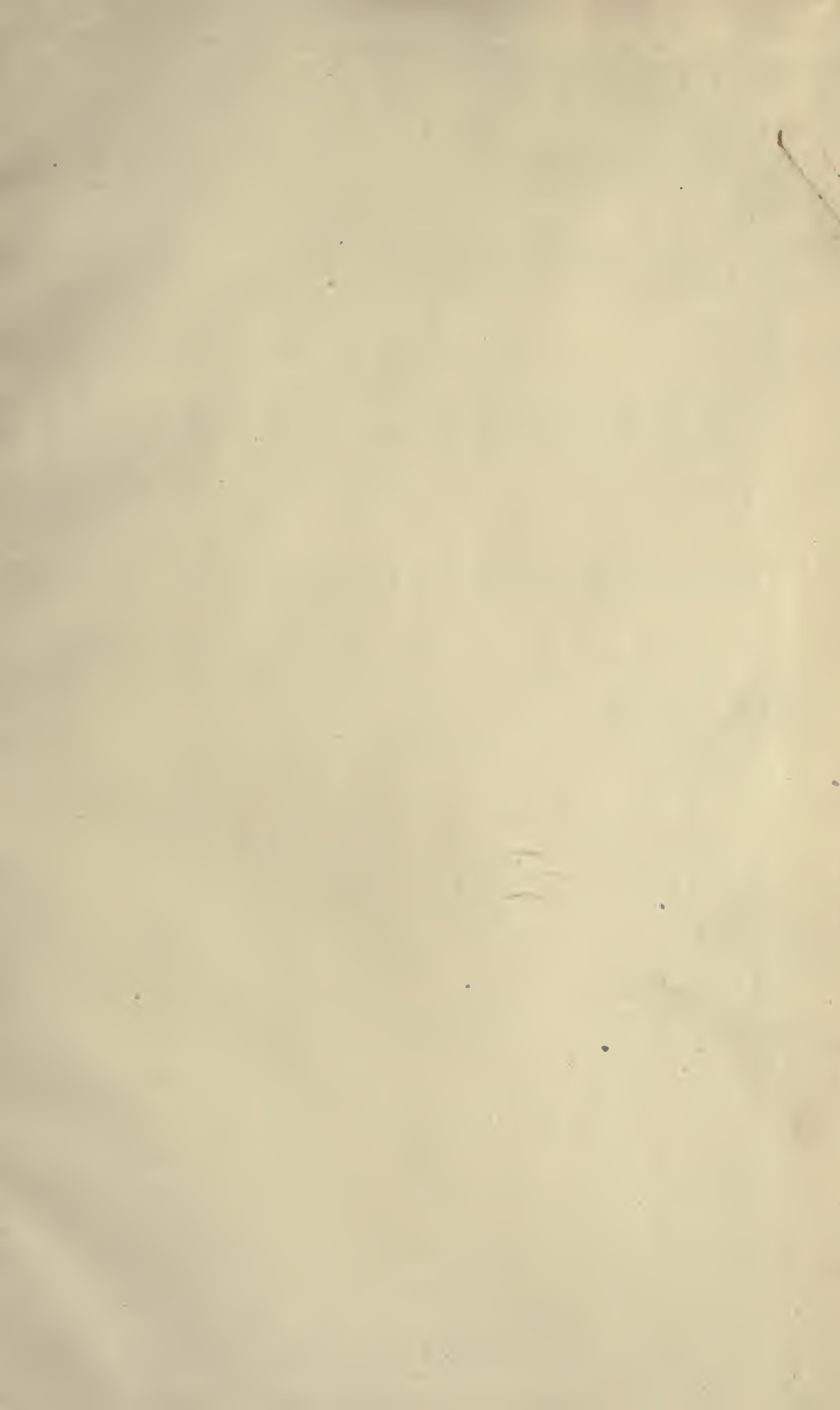
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1909-1910

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61ST CONGRESS }  
2d Session }

SENATE

} DOCUMENT  
} No. 645

REPORT ON CONDITION  
OF  
WOMAN AND CHILD WAGE-EARNERS  
IN THE UNITED STATES

IN 19 VOLUMES

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VOLUME XVII: HOOKWORM DISEASE AMONG  
COTTON-MILL OPERATIVES

---

Prepared under the direction of

CHAS. P. NEILL

Commissioner of Labor

by

CH. WARDELL STILES, Ph. D.

*Willard Library,  
Evansville, Ind.*

WASHINGTON  
GOVERNMENT PRINTING OFFICE

1912

IN THE SENATE OF THE UNITED STATES,

June 15, 1910.

*Resolved*, That the complete report on the condition of woman and child wage earners in the United States, transmitted and to be transmitted by the Secretary of Commerce and Labor in response to the act approved January twenty-ninth, nineteen hundred and seven, entitled "An act to authorize the Secretary of Commerce and Labor to report upon the industrial, social, moral, educational, and physical condition of woman and child workers in the United States," be printed as a public document.

CHARLES G. BENNETT,  
*Secretary.*

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## LETTERS OF TRANSMITTAL

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DEPARTMENT OF COMMERCE AND LABOR,  
*Washington, June 11, 1912.*

SIR: In partial compliance with the Senate resolution of May 25, 1910, I beg to transmit herewith a report showing the results of an investigation of hookworm disease among cotton-mill operatives in the United States.

This report has just been completed and is the seventeenth section available for transmittal of the larger report on the investigation carried on in accordance with the act of Congress approved January 29, 1907, which provided "That the Secretary of Commerce and Labor be, and he is hereby, authorized and directed to investigate and report on the industrial, social, moral, educational, and physical condition of woman and child workers in the United States wherever employed, with special reference to their age, hours of labor, term of employment, health, illiteracy, sanitary and other conditions surrounding their occupation, and the means employed for the protection of their health, person, and morals."

The remaining parts of the general report are being completed as rapidly as possible and will each be transmitted at the earliest practicable moment.

Respectfully,

CHARLES NAGEL,  
*Secretary.*

HON. JAMES S. SHERMAN,  
*President of the Senate, Washington, D. C.*

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DEPARTMENT OF COMMERCE AND LABOR,  
BUREAU OF LABOR,  
*Washington, June 11, 1912.*

SIR: I beg to transmit herewith Volume XVII of the Report on Woman and Child Wage-Earners in the United States, which relates to hookworm disease among cotton-mill operatives in the United States. This is the seventeenth section transmitted of the report of the general investigation into the condition of woman and child workers in the United States, carried on in compliance with the act of Congress approved January 29, 1907.

This volume of the report is the work of Ch. Wardell Stiles, Ph. D.

I am, very respectfully,

CHAS. P. NEILL,  
*Commissioner.*

THE SECRETARY OF COMMERCE AND LABOR,  
*Washington, D. C.*



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HOOKWORM DISEASE AMONG COTTON-MILL  
OPERATIVES.

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## HOOKWORM DISEASE AMONG COTTON-MILL OPERATIVES.<sup>1</sup>

### SUMMARY.

The so-called "cotton-mill anemia" and the "typical cotton-mill child" are, in the judgment of the writer, both products to a very considerable extent of hookworm disease. In general, the physical condition of the people improves with their residence in mill villages, due largely to the fact that the change from life on the farm to life in the mill village results in a very great improvement in sanitary conditions.

A correction of the conditions in question is not difficult, if the problem is properly handled; the remedy lies in three factors in particular: (1) Erection and use of sanitary privies on the farms (the chief source of the evil); (2) remodeling of the privies now in use in cotton-mill villages, to correspond with modern ideas of sanitation; (3) medical treatment of existing cases.

### INTRODUCTION.

The discovery of the fact that hookworm disease is exceedingly common in certain parts of the United States has so changed conceptions in respect to certain of the causes of the anemia and of the retardation in development observed among some of our people, that the question naturally arose whether this infection is present among cotton-mill laborers, and whether on this account any portion of the anemia known to exist among these mill workers and sometimes called "cotton-mill anemia," also whether any portion of the "stunted development" reported as existing especially among minors working in cotton mills, should be attributed to hookworm disease rather than to other causes.

In order to obtain data on this subject a number of factories were visited both in New England and in the Gulf-Atlantic States.

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<sup>1</sup> During the studies reported upon at present, many physicians in the various mill cities and towns have done everything in their power to aid in the work. It was only through their influence that certain of the mill hands consented to examination. Acknowledgments are due to all these physicians for their cooperation, and especially to Dr. Lewis (formerly secretary of the North Carolina State Board of Health), Dr. Williams (formerly secretary of the South Carolina State Board of Health), Dr. Weston (of Columbia, S. C.), Dr. Coward (city and State bacteriologist, Columbia, S. C.), Drs. Hull and Goodrich (of the Augusta city Board of Health), Dr. Harris (secretary of the Georgia State Board of Health).

For discussions as to the nature, cause, symptoms, treatment, methods of spread, and methods of prevention of the disease in question, the reader is referred to the already extensive literature on the subject. The reality of the disease and the fact of its prevalence in the United States are now so thoroughly established by so many independent investigators that discussion on these two phases of the subject may be omitted from the present report. If after reading the existing literature on the subject a person still remains skeptical as to whether hookworm disease is a reality or a product of the imagination, it is doubtful whether a restatement of the facts would have any influence upon him, and to such person the contents of this report will be of no practical interest.

For the person who accepts the work and statements of numerous physicians, of the officials of the State boards of health of the States in question, and of the medical and scientific investigators of the Army, the Navy, and the Public Health and Marine-Hospital Service, who have given special attention to the study of uncinariasis, this report may contain facts of interest in regard to hookworm disease and the extent to which it is prevalent among cotton-mill employees.

#### THE SO-CALLED "COTTON-MILL ANEMIA."

The term "cotton-mill anemia" is not in general use in medical literature, but is not infrequently heard in certain parts of the United States. It is adopted in this report for the reason that it is the only term with which I have become familiar as applied to the particular cases under discussion as found in the mills.

That there is a widespread and in numerous cases a severe anemia found among the cotton-mill hands of certain districts is and must be frankly admitted by any fair-minded investigator who studies any large number of mills in the States involved. Opinion has, however, differed as to the cause of the condition. Among the explanations as to its cause may be mentioned the following in particular: Poor food, poor ventilation, long hours of work, beginning work too young, use of tobacco (including snuff), and especially "breathing in the cotton lint." In discussing the subject with various persons, including the mill hands themselves, the "cotton-lint" hypothesis has been presented to me more frequently than have all other explanations combined.

So far as I am aware, the first explanation ever offered that was based upon diagnosis made by aid of the microscope was one presented by myself before the Pan American Sanitary Conference in Washington, D. C., in 1902, namely, that the so-called "cotton-mill anemia" and the stunted development of many of the cotton-mill minors of the Gulf-Atlantic States are the direct result of hook-



worm infection rather than of millwork. This explanation I have reaffirmed in a number of articles dealing with this disease. It has been accepted and confirmed by some persons and has been questioned by others. The confirmations have been by physicians. Thus far I know of no physician or scientifically trained observer whose investigations have raised doubts as to the correctness of the interpretation under discussion. So far as I am aware, the doubts cast upon the results of the microscope have been raised by persons who have considered the anemia from points of view that were based neither upon an interpretation of symptoms by search with the microscope for evidence of infectious organisms in connection with which similar symptoms are reported elsewhere, nor upon results of medical treatment based upon the hookworm explanation.

From a practical point of view, the question might legitimately be raised as to how extensive the area is in which the hookworm explanation might come into consideration and to what proportion of cases of apparent anemia this applies.

#### TERRITORY COVERED IN THE INVESTIGATION.

The present report deals with investigations which covered about six months field work conducted in eight States as follows:

*Gulf-Atlantic States.*—North Carolina, South Carolina, Georgia, Alabama, and Mississippi.

*New England States.*—Massachusetts, Rhode Island, and Connecticut.

The establishments visited were divided (from practical reasons connected with the work) into three classes, only two of which (A and B) will be considered in the statistics of this report.

Class A includes establishments in regard to which record was made both of the number of hookworm cases or suspects observed, and also of the total number of *white*<sup>1</sup> hands or inmates observed.

Class B includes establishments in regard to which record was made of the number of cases or suspects observed and also of the total number of *white*<sup>1</sup> hands on the pay roll or the total number of *white*<sup>1</sup> inmates, but not of the total number of persons seen.

The classification resulted as a necessity of the conditions under which the work was carried out in various places. It is self-understood that the statistics of institutions of Class A are of more value than those of Class B.

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<sup>1</sup> It is exceedingly difficult to classify Negroes into "suspects" and "not suspects" (see pp. 12-15), and the few records attempted at first were soon rejected as unreliable.

The southern establishments under consideration may be tabulated as follows:

SOUTHERN ESTABLISHMENTS OR INSTITUTIONS VISITED.

Kind of establishment or institution.	Establishments or institutions visited in—					Total establishments or institutions.
	North Carolina.	South Carolina.	Georgia.	Alabama.	Mississippi.	
Cotton mills:						
Class A.....	17	18	16	7	1	59
Class B.....		28	15	14		57
Total.....	17	46	31	21	1	116
Knitting mills:						
Class A.....	3		1	3		7
Class B.....			1			1
Total.....	3		2	3		8
Mattress factories: Class A.....			1			1
Overall factories: Class B.....			2			2
Paper factories: Class B.....			1			1
Candy factories: Class A.....				1		1
Tobacco factories.....	2					2
Mill schools: Class A.....		1	1	3		5
Public schools: Class A.....			1			1
Nurses' training schools.....	1	1	1	1		4
Orphanages.....	1	1	1			3
Colleges.....	2	1	5			8
Hospitals.....	1	2	1	2		6
Almshouses.....			1			1
Houses of prostitution.....				4	1	5
Farms.....		1	4			5
Grand total.....	27	53	52	35	2	169

The New England establishments visited may be tabulated as follows:

NEW ENGLAND ESTABLISHMENTS VISITED.

Kind of establishment.	Establishments visited in—			Total establishments.
	Massachusetts.	Rhode Island.	Connecticut.	
Cotton mills: Class A.....	12	3	1	16
Knitting mills: Class A.....			1	1
Woolen mills: Class A <sup>1</sup> .....	1	1		2
Watch factories: Class A.....	1			1
Shoe factories: Class A.....	3			3
Silk factories: Class A <sup>1</sup> .....			1	1
Paper factories: Class A.....			1	1
Silverware factories: Class A.....			1	1
Total.....	17	4	5	26

<sup>1</sup> These entries are given as 1 each, although some of them should probably be counted as more than 1; but while subdivided cotton mills are frequently numbered, I failed to make notes as to whether this custom obtained in these entries.

From this point to page 37 this report deals with southern mills; the New England mills will be discussed separately (see p. 37).

CLASSIFICATION OF CASES AND SUSPECTS, AND DETERMINATION OF THEORETICAL ERROR.

For theoretical, mathematical exactness, it is, of course, desirable to have a microscopic diagnosis in every case. As a practical proposition, however, such detailed examination was not within the limits



of possibility for several reasons, namely: (1) From many persons it was impossible to obtain specimens for microscopic study; (2) before a definite negative opinion can be given on a microscopic examination it was advisable to study the case microscopically for nearly one hour;<sup>1</sup> accordingly, such an undertaking would have greatly limited the number of cases observed and the number of mills visited; (3) even when microscopic examinations were attempted it was frequently necessary to go to the house two to four times before the specimen could be obtained, as at the time there was widespread popular prejudice against or distrust in the examinations, hence this work entailed a great loss of time; (4) work of this character nearly always involved a delay of at least a day before it could be started, hence its general adoption would have greatly reduced the number of mills visited and the geographic area covered. It seemed advisable, therefore, to adopt some method of study which would be more practical and of general application, and though not mathematically exact, still of sufficient exactness to give trustworthy results.

The method adopted was to go through mills and classify the hands who almost at first sight appeared to be either suspect cases of hookworm disease or nonsuspects.

A judgment was usually reached without asking questions and without making any manual examination, but simply by what could be seen in looking at the person for, say, 30 to 60 seconds. In these cases judgment was based chiefly on the following points: Anemic appearance, tallowlike complexion, dry parchmentlike skin, dry hemplike hair, peculiar dull "hookworm stare," anxious and hopeless expression, cervical pulsation, winged shoulder blades, prominent abdomen, presence of ground itch, tibial ulcers or scars, and underdevelopment.

In quite a number of cases the people were drawn into conversation, and in that event the following additional points in particular were taken into consideration: Mentality as evidenced by repeating questions or asking to have them repeated, tendency to tire easily, history of ground itch and tibial ulcers, response to pressure in the epigastric region, history of edema ("legs swell"), "buzzing in the ears," "swimming in the head," "dizziness," "fluttering of the heart," "indigestion," and difficulty in breathing.

In still other cases it was possible to make more careful examination at the people's homes, and in these instances the following additional points in particular were considered: History of constipation, growth of axillary and pubic hairs, development of genitalia, and history of menstruation.

<sup>1</sup> With the use of certain apparatus, this time can now be greatly reduced, but it was not feasible then to take the apparatus on the trip.

In a number of cases microscopic examination was made. In typical cases it is not difficult to form a definite opinion without a microscopic examination, an opinion which will be confirmed in a very large proportion of the cases upon microscopic study. It becomes more difficult, however, to reach a definite opinion in proportion as the cases are lighter in degree. Then a class of persons is seen in regard to whom the observer reserves all judgment and demands microscopic examination before expressing any view. Finally there are people in regard to whom a momentary examination does not give rise to any suspicions of hookworm disease.

The classification finally adopted was as follows: (1) "Suspects," in whom hookworm disease was considered probable; (2) "doubtfuls," in whom hookworm disease was considered possible, but all judgment was reserved subject to microscopic examination; (3) "former cases," in whom there was probably a distinct history of hookworm disease, but its present activity was uncertain; (4) "others," in whom no trace of hookworm disease was discernible upon basis of a momentary examination.

For practical purposes in this report the "suspects" form the important group, and since an important subjective element is concerned it becomes necessary to determine my "theoretical error." In other words, what percentage of the "suspects" can reasonably be assumed to be actual cases of hookworm disease?

With good, bright sunlight, my personal error was about 17 per cent; in other words, of 100 persons selected as "suspects," about 83 are in all probability actual cases of active hookworm infection.

One does not, however, always have a bright sunlight in the mill; on the contrary, one must sometimes be content with a much less degree of light (as, for instance, in the middle of a weave room), or in some cases with, in part, artificial light. In case one is working with incandescent light great precaution must be taken or the error will be very high; under arc light the difficulty of forming a fair judgment is so great that attempt to select "suspects" under such conditions was abandoned.

Taking, now, 108 "suspects"<sup>1</sup> in different towns, microscopic examination confirmed suspicions in 79 of these persons, or 73.1 per cent; under these circumstances, it may be fairly assumed that there is an error of not more than 27 per cent in my suspects, and that at least 73 per cent of these persons have the disease in question.

<sup>1</sup>This included several cases in which hookworm infection was not really suspected, but microscopic examination was made in order to determine whether the condition found might be explained by hookworm infection.

In addition to these examinations, frequent examinations were made of specimens taken from the privies of families to which "suspects" belonged. As it was impossible to determine whether the specimen actually came from the person suspected, these cases were not used as confirmations of suspicions, but the positive examinations were of value in establishing the fact that the observation was made in infected territory.



As the theoretical error in the "doubtful" and "former" cases was not established, those cases are omitted from the summaries. The nature of the theoretical error is discussed on pages 40 to 42.

From the foregoing it will be seen that the present study involves *minimum* statistics. It does not take into consideration the numerous cases which must necessarily have escaped observation; nor the numerous cases which ran away in order to escape examination; nor numerous cases in which the symptoms were so obscured or so slight that they could not be recognized in a "street car diagnosis," based in the majority of cases on not over 35 to 45 seconds' study. Thus, in reality, the number and percentage of "suspects" recorded must be considerably below the actual conditions present. In fact, it may be assumed that, on the average, for every suspect recognized by this rapid diagnosis, there was at least one other case, so light that it would have required 10 to 60 minutes' study to recognize it.<sup>1</sup>

Further, as the cases in sand districts are more pronounced as a rule than those in clay districts, the "error" in the sand districts is doubtless lower than that in the clay districts; finally, the error is naturally lower in persons from about 10 to 18 years of age than in adults.

#### FREQUENCY OF ANEMIA IN THE SOUTHERN MILLS.

In an address before the North Carolina Medical Association in 1903 the writer stated that:

We must face the fact squarely and fairly that there is a tremendous amount of anemia among the mill hands in the South, and that the average health and strength of many of these workers are below par.

Speaking now from a wider experience, gained from a study of 116<sup>2</sup> cotton mills and 8 knitting mills located in five of the Gulf-Atlantic States, that statement is reaffirmed, and attention is invited to the very important fact that distribution and intensity of this anemia are very uneven in different localities and follow certain rather well-defined general rules.<sup>3</sup>

#### COTTON MILLS.

During the entire trip, cotton-mill<sup>4</sup> cases and suspects of hookworm disease were seen, as follows, for mills of Class A, namely,

<sup>1</sup> The studies on "hookworm carriers" and light cases, conducted by Bass, Siler, Willetts, Ferrell, and others, clearly confirm the conservatism of this statement. See also footnote, p. 18.

<sup>2</sup> These are the 116 Class A and Class B mills mentioned on p. 12. (In addition, there were 5 mills which were omitted from the statistics because of insufficient data.)

<sup>3</sup> Since the report was completed, I have visited a number of other mills, with the same general results.

<sup>4</sup> Five mills are omitted from consideration because of lack of proper details, and a considerable number of cases and suspects observed in mill villages are not included in the statistics.

those for which both the number of suspects and the number of hands seen were recorded:

HANDS SEEN AND NUMBER AND PER CENT OF SUSPECTS IN SOUTHERN COTTON MILLS OF CLASS A, BY STATES.

[Class A—Establishments for which record was made of number of employees observed and of hookworm suspects.]

States.	Estab- lishments visited.	Hands seen.	Suspects.	
			Number.	Per cent of hands seen.
North Carolina.....	17	1,588	337	21.2
South Carolina.....	18	3,154	240	7.6
Georgia.....	16	2,125	138	6.4
Alabama.....	7	962	209	21.7
Mississippi.....	1	240	90	37.5
Total.....	59	8,069	1,014	12.56

Thus, among 8,069 cotton-mill hands of all ages and both sexes observed in 59 Class A mills distributed in 5 States, 12.56 per cent, or 1 person in about every 8 persons seen, showed symptoms in sufficient degree to lead to the provisional diagnosis of hookworm disease.

For mills of Class B, namely, those for which the number of suspects was recorded and number of hands on pay roll was obtained, but the number of hands seen was not recorded, the data secured were as follows:

HANDS ON PAY ROLL AND NUMBER AND PER CENT OF SUSPECTS IN SOUTHERN COTTON MILLS OF CLASS B, BY STATES.

[Class B—Establishments for which record was made of total employees on pay roll (but not of employees observed), together with hookworm suspects.]

States.	Estab- lishments.	Hands on pay roll.	Suspects.	
			Number.	Per cent of hands on pay roll.
North Carolina.....				
South Carolina.....	<sup>1</sup> 27	11,055	389	3.5
Georgia.....	15	5,143	180	3.4
Alabama.....	14	2,712	174	6.4
Mississippi.....				
Total.....	56	18,910	743	3.9

<sup>1</sup> One of the Class B mills referred to on p. 12 is omitted, as the records were lost.

KNITTING MILLS.

During the entire trip cases and suspects were seen in knitting mills as follows:

NORTH CAROLINA:

3 (Class A): 19 suspects in 141 hands=13.4 per cent; 9 suspects in 35 children<sup>1</sup>=25.7 per cent.

1 at — (Class A): 2 suspects in 57 hands=3.5 per cent; no suspect in 18 children=0 per cent.

<sup>1</sup> "Children," in this report, refers to any person under 16 years of age.

**NORTH CAROLINA—Continued.**

- 1 at — (Class A) : 7 suspects in 52 hands=13.4 per cent; 3 suspects in 8 children=37.5 per cent.
- 1 at — (Class A) : 10 suspects in 32 hands=31.2 per cent; 6 suspects in 9 children=66.6 per cent.

**SOUTH CAROLINA.—None visited.**

**GEORGIA :**

- 1 at — (Class A) : 31 suspects in 45 hands=68.8 per cent.
- 1 at — (Class B) : No suspect in 75 hands=0 per cent.

**ALABAMA :**

- 3 (Class A) : 15 suspects in 253 hands=5.9 per cent; 5 suspects, or 33.3 per cent, under 16 years.
- 1 at — (Class A) : 10 suspects in 145 hands=6.8 per cent; 4 suspects, or 40 per cent, under 16 years.
- 1 at — (Class A) : 5 suspects in 40 hands=12.5 per cent; 1 suspect, or 20 per cent, under 16 years.
- 1 at — (Class A) : No suspect in 68 hands=0 per cent.

**TOTAL :**

- 7 mills (Class A) : 65 suspects in 439 hands=14.8 per cent.
- 4 mills (Class A) : 14 of 34 suspects=41.1 per cent under 16 years.
- 3 mills (Class A) : 9 suspects in 25 children under 16 years=36 per cent.
- 1 mill (Class B) : No suspect in 75 hands.

Thus it is seen that in the knitting mills practically 1 person out of every 7 hands observed showed symptoms of hookworm disease.

It will be noticed that a slightly higher average percentage (14.8 per cent) was found in the knitting mills than in the cotton mills (12.56 per cent). This is due to the excessive infection found in one mill. It will be shown later, however (p. 35), that when cotton mills and knitting mills in the same town are compared, the infection in the knitting mill was in reality lower than that in the cotton mills.

**OTHER FACTORIES.**

During the entire southern investigations cases and suspects were found in other factories as follows:

- 1 mattress (Class A) : 1 suspect in 100 hands=1 per cent.
- 2 tobacco (Class A) : 6 suspects in 114 hands=5.2 per cent; 2 suspects in 21 children=9.5 per cent.
- 1 candy (Class A) : 4 suspects in 125 hands=3.2 per cent.
- Total: 4 factories (Class A) : 11 suspects in 339 hands=3.2 per cent.
- 2 overall (Class B) : 12 suspects=3.3 per cent of 360 hands on rolls.
- 1 paper (Class B) : No suspect=0 per cent of 100 hands on rolls.

**FREQUENCY OF ANEMIA IN DIFFERENT SEX AND AGE GROUPS.**

The following tabulation in reference to sex and age groups is confined to persons connected with cotton mills.

**CASES AND SUSPECTS ARRANGED IN AGE GROUPS.**

During the trip records were made for the age groups of 1,470 suspected persons as follows:



18 HOOKWORM DISEASE AMONG COTTON-MILL OPERATIVES.

NUMBER OF SUSPECTS IN SOUTHERN COTTON MILLS FOR WHOM AGE DATA WERE SECURED AND PER CENT IN EACH SPECIFIED AGE GROUP.

Age groups.	Suspects.	
	Number.	Per cent of total.
Over 20 years.....	272	18.5
16 to 20 years.....	338	23.0
Under 16 years.....	860	58.5
Total.....	1,470	100.0

Thus nearly 60 per cent of all the persons classified as suspects were under 16 years of age.

If the statistics are confined to the cases and suspects of the Class A mills for whom age groups were recorded, a more exact idea of the relative frequency of the disease in the three age groups is obtained, as shown in the following table:

NUMBER AND PER CENT OF SUSPECTS AMONG HANDS FOR WHOM AGE DATA WERE SECURED IN SOUTHERN COTTON MILLS OF CLASS A, BY AGE GROUPS.

[Class A—establishments for which record was made of number of employees observed and of hookworm suspects.]

Age groups.	Hands.	Suspects.	
		Number.	Per cent of hands.
Over 20 years.....	1,268	107	8.4
16 to 20 years.....	565	109	19.2
Under 16 years.....	828	226	27.2
Total.....	2,661	442	16.6

Thus, it appears that about 1 in every 4 children under 16, about 1 in every 5 hands from 16 to 20, and about 1 in every 12 hands over 20 years old came within the suspect class.<sup>1</sup>

<sup>1</sup> The following statistics for Georgia (based exclusively on microscopic examination) are instructive in this connection; they further demonstrate the ultraconservatism of the statistics given in the present report.

D. G. Willetts (unpublished manuscript) examined microscopically 1,124 persons for intestinal parasites in a State sanitarium in Georgia. His hookworm infections, arranged by age groups, are tabulated as follows:

- Under 15 years old, 52 per cent infected.
- 15 to 30 years old, 29.76 per cent infected.
- 31 to 50 years old, 11.92 per cent infected.
- Over 50 years old, 10.92 per cent infected.

C. A. Wells (1910) reports the following hookworm infections found among 498 persons (chiefly of school age) in Georgia:

- 6 to 16 years old, 48.9 per cent infected.
- 17 to 26 years old, 38.9 per cent infected.

Thus, it is clearly demonstrated by microscopic examination (and still other statistics might be presented bearing out the same point) that for the area in question hookworm infection is more common among minors than among adults.

During the year 1911 microscopic examination of 37,267 children of school age (6 to 18 years) has been made in 87 counties in all by the State boards of health of Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. The percentage of infection by counties ranges from 2.5 to 90.2.



The question as to the relative frequency of infection in different age groups is probably dependent more upon the exposure to infection than upon the age. Thus, in mining localities we should not be surprised at published statistics which show a greater percentage of cases among adult males than among children. In rural and semi-urban districts, however, the children are in general more exposed to infection than are the adults for the reason that children are more likely to go barefooted a greater proportion of the time. At the same time it would be well to bear in mind the laboratory experience that young animals seem to contract certain infections more readily than do adults.

**CASES AND SUSPECTS ARRANGED ACCORDING TO SEX.**

During the work, sex was tabulated for 1,725 suspected hands as follows:

NUMBER OF SUSPECTS FOR WHOM DATA AS TO SEX WERE SECURED IN SOUTHERN COTTON MILLS, AND PER CENT OF EACH SEX.

Sex.	Suspects for whom sex was recorded.	
	Number.	Per cent of each sex.
Males.....	922	53.4
Females.....	803	46.6
Total.....	1,725	100.0

From this it is observed that the number of male suspects recorded was greater than the number of female suspects. This does not, however, necessarily mean that the percentage of suspects was greater among the males than among the females, for if the statistics are confined to the persons in the Class A mills, for whom sex data are given, the following results are obtained:

NUMBER AND PER CENT OF MALE AND OF FEMALE SUSPECTS AMONG HANDS FOR WHOM DATA WERE SECURED AS TO SEX IN SOUTHERN COTTON MILLS OF CLASS A.

[Class A = establishments for which record was made of number of employees observed and of hookworm suspects.]

Sex.	Hands seen.	Suspects.	
		Number.	Per cent of hands seen.
Males.....	1,583	242	15.2
Females.....	1,225	198	16.1

It is scarcely to be assumed at present that either sex has a natural predisposition to hookworm infection greater than that of the other sex. The statistics will vary rather according to the exposure to infection. Thus, in mining localities the statistics for the males will be greater than for the females, while in agricultural localities the statistics will vary according to conditions. So far as I can recall, laboratory experience does not as yet furnish any data to the effect that females contract nematode infections more easily than do the males. If, as suggested in literature, the young animals contract certain infections more readily than do adults because of the softer tissue of the former, it is not impossible that the same point may obtain for females.

#### TABULATION OF AGE AND SEX GROUPS TOGETHER.

A summary of 1,026 cases and suspects observed among 8,092 cotton-mill hands gives the following results:

NUMBER AND PER CENT OF SUSPECTS AMONG HANDS IN SOUTHERN COTTON MILLS, BY SEX AND AGE GROUPS.

Age groups.	Males.			Females.			Total. <sup>1</sup>		
	Hands seen.	Suspects.		Hands seen.	Suspects.		Hands seen.	Suspects.	
		Number.	Per cent of hands seen.		Number.	Per cent of hands seen.		Number.	Per cent of hands seen.
Over 20 years.....	809	47	5.8	459	60	13.0	1,268	107	8.4
16 to 20 years.....	246	51	20.7	319	58	18.1	565	109	19.2
Under 16 years.....	452	133	29.4	336	63	18.7	828	226	27.2
Total <sup>1</sup> .....	1,583	242	15.2	1,225	198	16.1	<sup>2</sup> 8,092	<sup>2</sup> 1,026	12.6

<sup>1</sup> In the foregoing table the totals do not, of course, agree with the sums of the respective columns, because in many cases a given mill may be a Class B mill for an age or sex group, but a Class A mill for a total group.

<sup>2</sup> 1,014 suspects in 8,069 hands of 59 Class A mills, plus 12 cases in 23 mill hands examined microscopically in A—; these 23 specimens were obtained by a local physician, and I saw some of the persons afterwards at their homes, but not in the mills.

Arranging these percentages serially, we have the following table of relative frequency of hookworm suspects in the various groups:

- 29.4 per cent in case of males under 16 years old.
- 27.2 per cent in case of males and females under 16 years old.
- 20.7 per cent in case of males 16 to 20 years old.
- 19.2 per cent in case of males and females 16 to 20 years old.
- 18.7 per cent in case of females under 16 years old.
- 18.1 per cent in case of females 16 to 20 years old.
- 16.1 per cent in case of all females combined.
- 15.2 per cent in case of all males combined.
- 13 per cent in case of females over 20 years old.
- 12.6 per cent in case of males and females, all ages combined.
- 8.4 per cent in case of males and females combined over 20 years old.
- 5.8 per cent in case of males over 20 years old.

## FACTORS OPERATIVE IN INTRODUCING HOOKWORM DISEASE INTO COTTON-MILL VILLAGES.

There are various factors which are operative in introducing hookworm disease into cotton-mill villages, as will be seen from the following discussion.

### EMPLOYMENT OF FARM FAMILIES IN THE MILLS.

It is well known that the cotton mills recruit their labor chiefly from the rural white tenant class. When such a family comes to the mills it naturally brings its hookworm infection with it, and part of this original infection may last for an undetermined period longer than  $6\frac{1}{2}$  years, and probably for 10, possibly not longer than 12 years. This doubtless accounts for a great part of the hookworm disease among cotton-mill hands.

The actual number of cases of hookworm disease introduced into the mills will naturally depend upon three points in particular: (1) The nature of the soil (clay, mountain, or sand) from which the people come; (2) the size of the families; (3) the proportion of people of different sex and age in the families in question.

For the first point, see the literature on the distribution of the disease.

Regarding the second point I have gathered no exact statistics, but Kohn has given a table which is based upon reports from the South Carolina cotton mills and which is interesting in this connection. He states that 52,769 mill hands involved a mill population of 123,868.<sup>1</sup>

On basis of these figures it would seem that for every 100 mill hands employed 134 additional persons come to the mill village. Thus every 100 mill hands brought from the farms to the mill villages involve an introduction of the infection contained in 234 average persons of that class. On page 20 of the present report it is shown that the average infection in the mill is at least 12.6 per cent; accordingly, for every 100 mill hands brought from farms to mills at least 29.4 cases of hookworm disease are imported to the mill village, thus bringing that amount of infection to the mill village, but at the same time reducing the soil pollution for that number of hookworm cases (see p. 31).

This estimate must be viewed as exceedingly conservative, although it is subject to the following theoretical errors:

(1) It is based upon percentage of suspects in whom symptoms are noticed upon quick observation; as shown on page 14, the theoretical error is somewhere between 17 and 27 per cent.

(2) It fails to take into consideration what is probably at least an equal, more probably a much greater, number of cases, in which the

<sup>1</sup> The Cotton Mills of South Carolina, by August Kohn, 1907, p. 89.



infection is so light that symptoms are not evident upon quick observation. (See also p. 15, with footnote on p. 18.)

(3) The persons coming to the mills from other mills will naturally show less infection than those coming direct from the farms (see pp. 31, 34), but the above estimate represents in reality the average of the two classes.

From the foregoing it is seen that the cotton mill not only plays an important rôle in bettering the sanitary conditions of at least 12.6 hookworm cases in every 100 hands it employs, but in addition it betters the sanitary conditions for 16.8 other sick people as well.

Regarding the third point I have no statistics covering the families in particular, but would refer to the tables on pages 18 and 20 as indication of the age groups of the hands seen.

From the foregoing it is clear that the cotton mills of the South are a tremendous factor in the reduction of hookworm disease, and if this fact is utilized intelligently they can be made to play even a greater sanitary rôle in eradicating the disease than they play at present.

#### "SUMMER FARMERS."

Not all persons coming to the mills remain there. In several instances I have seen mill families which had left the farm for the mill in order to earn money to pay off a mortgage, or in order to earn money with which to purchase land. In several instances I have known families which alternated more or less irregularly between the farms and the mills; if the price of cotton was high, they would go to the farms; if the price of cotton was low, they would return to the mills. In quite a number of instances I met families which alternated more or less regularly between the mills and the farms, working on the farms in summer and in the mills in winter. The percentage of this class of labor will naturally vary, to some extent at least, with the price of cotton.

The percentage of "summer farmers" varies greatly in different mills. One mill had, by actual count, 6.1 per cent summer farmers; 87 other mills gave estimates. These estimates may be tabulated as follows:

	Mills.		Mills.
None .....	13	5 per cent.....	12
" Few ".....	1	6 per cent.....	3
1 family.....	1	8 per cent.....	3
12 families.....	1	10 per cent.....	15
0.5 per cent.....	1	12 per cent.....	1
1 per cent.....	2	15 per cent.....	3
2 per cent.....	11	20 per cent.....	7
3 per cent.....	10	29 per cent.....	2
4 per cent.....	2		

It is evident that as these families return to the farms in the summer they return to a greater amount of soil pollution (see p. 30), and on this account to a greater danger of infection with hookworm disease; returning to the mills in the fall they will naturally introduce fresh infection into the mill villages. The amount of new infection actually introduced will naturally vary according to three factors in particular, namely: (1) According to the soil farm or soil region (sand, clay, or mountain) to which they return (see p. 33); (2) according to the size of the family (see p. 21); and (3) according to the proportion of people in different sex and age groups (see p. 20).

While this return from the mills to the farms is an unfortunate thing for the mills, it has another side which should not be lost sight of. During the mill residence of these families they have become accustomed to the use of the privy, and while many of the people will, upon returning to the farms, doubtless go back to conditions of maximum soil pollution, some of them will doubtless take to the farms ideas of better conditions, and as a result of the sanitary, elevating influences to which they have been subject they will doubtless increase the number of privies in the country districts and thereby contribute to a reduction of the soil pollution on the farms.

Thus the mill presents to the sanitarian an opportunity which ought by all means to be utilized to its full extent, for through these "summer farmers" it will doubtless be possible to reach some families which might not be reached through other channels.

#### REGULAR AND ANNUAL PAY ROLLS:

The cotton-mill hands in the South are an extremely independent set of people who do not hesitate, upon a slight provocation or from a pure whim, to leave one mill and go to another. In case of one mill I obtained the exact records of changes during the year 1907. On January 1, 1907, there were 712 white hands on the rolls. During the year 797 additional names appeared on the rolls, making an annual pay roll of 1,509. For 90 other mills estimates were obtained. The total statistics are:

In 91 mills, with a total regular pay roll of 28,893, the *estimated* annual pay roll was 50,786 hands, thus showing that for every 100 hands on the regular roll an *estimated* change of 75 hands takes place during the year. On basis of Kohn's statistics (see above, p. 21) to the effect that 100 mill hands involve 234 persons in the mill population, this would mean that for every 100 mill hands on the regular roll 75 new hands come to the mill annually, and these 75 new hands bring with them 100.5 additional persons, thus making an annual change of 175.5 persons in the mill population for every 100 hands on the regular roll.



The detriment to the mill involved in this constant change of hands does not come into consideration here, but the fact does come into consideration that, on an average, 9.45 of these 75 new hands are, according to present statistics, suspects of hookworm disease and that they bring with them an additional number of cases which on the basis of the foregoing estimates is 12.66. Thus, so far as can be estimated from the data at hand, for every 100 mill hands on the regular roll of the mill there is an average annual introduction of about 22 cases of hookworm disease into the mill village, due to the difference between the regular and the annual pay rolls.

Part of this difference is of course due to the importation of labor fresh from the farms, and in this event, for every 100 such hands on the roll (as shown on p. 21) at least 29.4 hookworm cases are introduced into the village. As these statistics do not give the actual number of hands who come from the farms and the actual number who come from the other mills the exact number of hookworm cases due to each class of laborers can not be deduced; it is to be expected, however, that there will be proportionally less hookworm infection introduced into a mill by 100 hands coming from other mills than by 100 hands coming direct from the farms. The estimates given above are the average of the two classes (see p. 34).

From the foregoing it is clear that the mills face a very serious difficulty, namely: Several mills, X, Y, and Z, might be located within a short distance of each other; mill X might not import any labor fresh from the farm and might make every effort to eradicate the hookworm from its mill village by giving treatment to all infected cases and by absolutely preventing soil contamination in its village; still, even under these circumstances, it is dealing with a very shifting class of labor and, according to the foregoing estimate, for every 100 hands on the regular pay roll there would be on an average 9.45 new cases coming into the mill every year, and there would also be 12.6 additional cases introduced into its village, simply because mills Y and Z, from which the hands would come to mill X, did not institute free treatment and because less stringent sanitary measures were in force in mills Y and Z.

The lesson to be drawn from this difficulty is clear. In considering the eradication of the hookworm from the mills not only must the question of treatment and prevention be considered by all the mills, but further, an effort within proper lines should be made to reduce this continual change of labor due to wandering of the people from one mill to another.



**DOES SOIL POLLUTION OCCUR AND DOES HOOKWORM DISEASE SPREAD IN THE MILL SETTLEMENTS?**

Now that it is seen that a great amount of hookworm infection is at present inevitably brought into the mill villages, the important question arises whether any soil pollution occurs in these settlements by means of which the disease may spread.

It should be recalled that many of the mill families have never used a privy before coming to the mills. For these families, therefore, almost anything in the shape of a privy is to be viewed as a sanitary improvement in their environments. As a matter of fact, however, many families are not only unaccustomed to the privy, but many of them are opposed to it. I have seen families which actually had to be "house broken" to the use of the privy. Such people will stool around and under their houses, or even on the privy floor, rather than use the privy properly; and not only have people themselves of this class told me that they disliked their use, but I have seen the effects of this dislike, and, further, mill managers have repeatedly told me of the difficulties with which they have had to contend in order to stop promiscuous defecation. I know at least one mill which starts in the families newly imported from the country in certain houses on the outskirts of the mill village, and does not move them into the better situated houses until after some time, a few months or a year or so, when the families have become less dirty in their habits. That these families will spread hookworm disease, through promiscuous defecation, is self evident. It may therefore be taken for granted that some hookworm infection does actually spread in this way in some mill villages by families recently imported from the farms.

Two factors in particular must be considered in inhibiting this spread.

**FENCES.**

It seems to be the exception rather than the rule that the mill villages have fences provided between the houses. Graniteville and Langley, S. C., and the Merrimack mills at Huntsville, Ala., may be mentioned as examples of the mills which have built fences. Some mills are opposed to them, and give as their reasons that (*a*) the mill families use the fences for kindling wood, and (*b*) the mill families keep on the fences bedding, clothes, laundry, etc., and thus render the village very unsightly.

Viewed from the standpoint of hookworm disease, the fence is an important sanitary factor, especially in the case of houses used for the heavily infected families, for the fence tends to confine the soil pollution by an infected family to its own yard.

## PRIVIES.

We must not deceive ourselves by overlooking the important fact that anything less than a complete sewer system is a compromise with the ideal. Still, sewers and septic tanks are not always financially practicable, and in such event we must consider the best compromise possible, namely the privy.

All of the mills which I have visited, and which have mill houses, have provided privies or closets for the use of the mill families and in the majority of cases these privies are cleaned regularly about once a week by the mills. Herein lies the secret of the great good which the mills are doing toward bettering the conditions of the rural whites, namely: The mills are taking these people from their soil-polluted farms, providing them with privies, teaching them to use these privies, keeping the privies clean, and by thus disposing of the infectious material preventing, or at least reducing, the reinfection with hookworm, thus giving the people the opportunity to outgrow the infection which they acquired on their farms and brought with them to the mills.

Reinfection will be prevented in proportion as soil pollution is prevented. Cleaning the privies once a week naturally removes the mass of infecting germs, no matter what system of privy is used. Certain systems are, however, better than others, and the soil pollution in the mill villages and hence the possibility of the spread of hookworm disease in these settlements vary with the system used. We may distinguish (A) surface privies (*a*) open in back, (*b*) closed in back, and (B) floor privies (*a*) open in back, (*b*) closed in back. These various types grade into one another.

## SURFACE PRIVY.

Under this head we may classify all privies in which the stools drop directly upon the ground or into a pit dug in the ground. The former is the case with the vast majority I have seen in the South, not only on farms and in towns but in mill villages also. It is impossible absolutely to prevent soil pollution by use of such an outhouse, although the pollution is of course very greatly reduced when compared with what takes place in promiscuous defecation. Despite the defects of this system surface privies are a vast improvement over no privy at all, and may be kept so clean as to very materially reduce the disease. In general, however, the surface privy is, though a vast improvement over promiscuous defecation, a miserable substitute for a sewer, hence a poor compromise.

(*a*) *Open in back*.—In the vast majority of cases I have seen the privies of the South, not only on the farm and in the towns but also in cotton-mill villages, belong to the system of surface privies which



are open in back. This system is the worst system of privy known and should not be marked over 10 on a scale of 100 in considering its sanitary value. Not only is it unsightly, but dogs, swine, and chickens have free access to the night soil, and may not only (in case of swine) infect themselves with parasites (tapeworms) which in turn are spread to man, but all three of these animals scatter the night soil around and thus spread infections of various kinds, including hookworms. Further, flies feed and breed here and carry infections of various kinds to the house. With this, in general, very poor substitute for a water-closet with sewer connection the danger involved is decreased in accordance with the frequency of cleaning the privies and with the dry or cold weather. Moist or warm weather increases the danger connected with soil pollution.

In some cases I found the resulting conditions filthy, swinelike, dangerous to health, and utterly inexcusable. Mill hands can not be expected to keep healthy when living under the conditions presented in such instances. On the other hand, in some other mill villages using the same system the conditions were really quite good, due to the frequent and thorough cleaning, the hauling in of fresh dirt, and the use of disinfectant. All possible gradations between the two extremes were seen.

(b) *Closed in back.*—A great improvement over the “open in back” system is brought about by the simple device of a hinged or sliding trapdoor in back, which not only hides the night soil from view and thus has a marked effect on the better appearance of the village, but also excludes dogs, swine, and chickens, and thus decreases soil pollution still further, although it does not entirely prevent it. The use of this trapdoor prevents the toilet paper from blowing around and thus materially inhibits still further the spread of infections. At the same time, even when a trapdoor is present, flies have free access to the excreta and may spread certain infections. All things considered, this style of privy may be marked 25 (on the scale of 100) in its sanitary value.

#### FLOOR PRIVY.

Under the term “floor privy” we may include all which have a floor under the seat. This floor may be the floor of a cement vault, or the floor of a tub, pail, or box; or it may be continuous with the floor of the rest of the structure, and on it is placed a water-tight pail, tub, barrel, or box. The back may be (a) open or (b) closed, as in the case of the surface privy, the closed back being of course very much better.

This floor privy when properly cared for has several important sanitary advantages over the surface privy, namely:

(1) Direct soil pollution is entirely excluded, since the discharges drop into a water-tight receptacle and can not therefore contaminate

the ground; further, the discharge may have some chance to ferment, hence to decrease in infectivity.

(2) A fluid instead of a powdered disinfectant may be used, and this fluid if of sufficient strength: (a) Kills disease germs, such as typhoid bacilli; (b) it keeps flies from feeding upon or breeding in the feces, hence prevents them from carrying fecal bacteria and material to the food in the house; (c) it reduces or destroys the offensive odor. In place of a disinfectant, water with a film of kerosene may be used; the water permits fermentation to continue and the oil keeps away mosquitoes and flies. Or the dry-earth or dry-lime system may be used.

The "floor privy," closed in back, provided with water-tight vault, box, pail, barrel, or tub, and with use of some cheap fluid disinfectant (or water and oil) is one of the best compromises we can make in cases where a sewer or septic tank is not practicable from financial or other reasons, and if introduced generally in the South it would unquestionably result in a marked decrease in hookworm disease and typhoid fever, and a decrease in the death rate, especially of children. This style<sup>1</sup> of privy, if not thoroughly fly proof may be marked 50 on a scale of 100, and if thoroughly fly proof it may be marked 75.

In a number of cotton-mill villages visited notes were made relative to the structure of the privies. It was of course impossible to examine every outhouse, and it is perfectly possible that the particular cases which I happened to see were not fair average samples (though I believe they were); further, a given mill village may have different styles of outhouses; again, one mill may have two villages, or two or more mills belonging to the same company may have only one village. For these reasons, it is difficult to draw an exact mathematical comparison between the mills, the mill villages, and the privies. But taking these matters into consideration, and making the comparison on the basis of the style of the privy, the following table results:

- A. Surface privies were found in 49 villages; of these,
  - (a) Open privies were found in 25 villages; and
  - (b) Closed privies were found in 7 villages; and surface
  - (c) Privies not classified were found in 17 villages.
- B. Floor privies (namely, box, tub, pail, pan, or cement, but not one was fly proof) were found in 13 villages; of these,
  - (a) Open privies were found in 2 villages; and
  - (b) Closed privies were found in 6 villages; and floor
  - (c) Privies not classified were found in 5 villages.
- C. Sewers (with water-closets) were found in 6<sup>2</sup> villages.

<sup>1</sup> The new L. R. S. type of privy is not considered here, as it was not in use when this report was prepared. See Public Health Reports, Washington, Nov. 11, 1910; also Farmers' Bulletin No. 463, United States Department of Agriculture.

<sup>2</sup> Not including the large sewered cities, such as Augusta, etc.



The foregoing statistics are significant. Of 68 observations, (counting each style in each village as one observation; in most cases this would be equivalent to one village) in only 6 cases (or 8.8 per cent) in mill villages (as distinguished from the mill itself) did I find water-closets with sewer connections. From this the conclusion must be drawn that, similar to action of the majority of villages in the South, a compromise has been made in 91.2 per cent of the cases.

Taking now the remaining 62 cases, in which sewers were not found, it is seen that in only 13 cases (or 20.9 per cent) were they of a style which would prevent direct soil pollution.

In 49 cases (practically equivalent to 49 mill villages), or 79 per cent, the privy corresponded to the average privy found in the South, namely, it was a surface privy, which was conducive to soil pollution. The conclusion therefore can not be escaped that in 72 per cent of all the (68) cases recorded (practically in 72 per cent of the mill villages) the privy facilities are such that soil pollution does or can occur and that hookworm disease (endemic helminthiasis) may spread in these villages. In this connection, however, it is only fair to recall that this condition is not peculiar to the southern cotton-mill villages, but it is found throughout the South.

Turning now to the surface privies, it may be noticed that of 32 classified observations only 7 involved cases in which the privies were closed in back. In other words, in 25 cases (78.1 per cent of the classified surface privies, or 36.7 per cent of all the observations) the surface privies were open in back, thus giving opportunity for increased soil pollution through the fact that chickens and dogs had access to the night soil, whereby the fecal material could be spread around to a considerable extent. In 36.7 per cent of all cases observed, therefore, while the soil pollution was greatly decreased as compared with that on farms, it still occurred to an inexcusable extent. This condition, again, is not peculiar to the cotton mills, but may be found at least to some extent in practically any city, town, or village in the entire area under discussion, and in fact throughout the United States.

Granting that the efficiency of any one of these styles of privies varies according to the intelligence exercised in its use and according to the frequency of and care of cleaning, but attempting to draw a fair average, the following score-card markings may be presented as representing an estimate of the relative sanitary development of the privy system of the mill villages in question.

ESTIMATED SANITARY DEVELOPMENT OF PRIVY SYSTEMS OF SOUTHERN MILL VILLAGES ACCORDING TO SCORE-CARD MARKINGS<sup>1</sup> USED BY STATE BOARDS OF HEALTH.

	Num-ber.	Score points.	Total score.	Remarks.
A. Surface:				
(a) Open.....	25	10	250	These are 90 per cent below modern ideas of sanitation.
(b) Closed.....	7	25	175	These are 75 per cent below modern ideas of sanitation.
(c) Unclassified..	17	10	170	These are 75 to 90 per cent below modern ideas of sanitation.
B. Floor.....	13	50	650	These are 50 per cent below modern ideas of sanitation.
C. Sewer.....	6	100	600	
Total.....	68		1,845	
Average.....			27	Or 73 per cent below modern ideas of sanitation.

<sup>1</sup> The score-card system adopted is that now in use by most of the State boards of health engaged in the campaign against hookworm disease.

<sup>2</sup> These privies would be marked between 10 and 25. The minimum mark is adopted here.

The 68 instances given are unselected cases and may be taken as representing the average privy conditions of southern mill villages. To avoid misinterpretation, the statement is emphasized that large cities are not included in this list, which represents only mill villages, the sanitation of which is directly or indirectly under control of the mill authorities.

It stands to reason that since good health is so important a factor in efficiency of labor, and since sanitation is so important a factor in permitting good health, the question of proper sanitation of a mill village is an important economic factor, quite aside from the higher humanitarian side of the subject. The shortsightedness of a business policy which permits a village to be 90 per cent below modern ideas of sanitation is somewhat difficult to grasp.

Since in the foregoing, comparison of the mill villages has been made on a basis of modern ideas of sanitation (and as its results are distinctly not flattering to the mill management), it is only fair to make a comparison on a widely different basis in order to see what these conditions mean to the mill hands. Since most of the mill hands come originally from farming districts, the privy conditions of farms from which they come must, in fairness to the subject, be taken into consideration.

#### PRIVY CONDITIONS ON THE FARMS FROM WHICH MILL HANDS COME.

In years of study in these same States, prior to finishing the mill inspections under consideration, I had never seen a sanitary privy on any of their farms.

Many may have existed, but they did not come to my notice. Many have been built during 1910 and 1911, and this improvement in rural sanitation is being pushed forward as rapidly as circumstances seem to permit.

During the studies in the mills I tabulated the privy conditions at 370 farm homes for four of the States visited. Of these 370 homes 68.9 per cent had no privy at all; of 77 tabulated as occupied by whites, 46.7 per cent had no privy; of 83 tabulated as occupied by Negroes, 79.5 per cent had none; of 210, for which the race of the occupants was not recorded, 72.8 per cent had no privy.

In 1910 statistics were collected from about 200 localities scattered over 6 different States from which the mills in question draw their labor. Of 4,825 farm homes, about 55 per cent had no privy; of 2,499 farm homes tabulated as occupied by whites, 35.2 per cent had no privy; of 2,326 tabulated as occupied by Negroes, 76.8 per cent had no privy.

It is a conservative statement that at least one-third of the cotton-mill hands have come from farm homes not provided with any privy, and that nearly all, if not all, of the remaining two-thirds come from farms on which the privy index is not higher than 10 on a scale of 100; further, that most of these privies are rarely or never cleaned.

Thus, of 100 average cotton-mill hands who come from the farms, about 33 have come from farm homes with a privy index of 0=000, and 67 have come from farm homes with a privy index of 10=670.

Giving a total score of_____	670.0
Or an average score of_____	6.7

These farm hands now change to cotton-mill villages with a privy index of 10 to 100, or, according to the statistics given on page 30, to an average privy index of about 27.

Thus, given present conditions, these people improve their sanitary conditions (in respect to the privy) from about 6.7 to 27, namely, an improvement of about 20.3 on a scale of 100, equal to an improvement of about 300 per cent over the sanitary conditions from which they came. Further, as will be shown next, they change from a privy which is rarely or never cleaned to one that is cleaned more or less regularly.

However severely we may be inclined to condemn the miserable sanitary conditions found in so many of the mill villages, it is only just to recall this great improvement that accrues to the sanitary life of the average mill hands.



**CLEANING THE PRIVIES.**

In a number of mill villages inquiry was made into the frequency of cleaning the privies, and the following statistics were obtained:

**FREQUENCY OF CLEANING PRIVIES IN CERTAIN SOUTHERN MILL VILLAGES FOR WHICH DATA WERE SECURED.**

Frequency of cleaning.	Number of villages.
Daily .....	1
2 to 4 times per week .....	1
2 to 3 times per week .....	1
Twice per week .....	7
Once per week in winter .....	2
Twice per week in summer .....	
Once per week .....	16
Once every two weeks .....	2
2 to 3 times per year .....	1

**DISINFECTANTS.**

In some instances it was found that disinfectants (chiefly lime) are used when the privies are cleaned. This fact was recorded in my notes in nine cases; but an absence of record in other cases does not necessarily signify that no disinfectant was used.

**DISPOSAL OF NIGHT SOIL.**

Various methods of final disposal of the night soil are adopted, but statistics were not collected on this point. In some cases it was thrown into a stream, in other cases it was buried, etc. Generally speaking, the method of disposal is very unsatisfactory from a sanitary point of view.

**CAN HOOKWORM DISEASE SPREAD IN THE MILLS.**

The question naturally arises whether hookworm disease can spread in the mills. This question comes up from two points of view.

**CAN IT BE BROUGHT IN ON THE COTTON?**

On more than one occasion mill men have asked whether the soil pollution on the farm could, through dust, infect the cotton and then be carried to the mill on the cotton and breathed in with the lint. These questions can be definitely answered in the negative. In order to be blown around as dust the hookworm eggs or larvæ would have to become dry; but upon becoming dry they perish. Accordingly, even if it be assumed that the dust on soil-polluted farms carried hookworm germs to the cotton these germs would be dead long before they reached the cotton mills.



**CAN IT BE SPREAD FROM THE TOILET ROOMS?**

Nearly every mill visited was provided with a water-closet with flush or other system. In all these cases the discharges are carried directly away from the mills, hence a spread of the infection in the toilet rooms is excluded, except in so far as the mill hands defecate on the floor or seat—as I have seen on several occasions.

Five mills visited had privies instead of water-closets. In these cases soil pollution was occurring, hence the possibility was present for the spread of hookworm disease from these mill privies.

**SANITARY ADVANTAGES OF MILL VILLAGES, AS COMPARED WITH THE FARMS, IN DIFFERENT AGE GROUPS.**

On page 31 it is shown that by going from farms to mill villages the people improve their sanitary conditions approximately 300 per cent. This improvement is of special value to hookworm-infected cases and to the weaker individuals among the noninfected. Further, special benefits accrue to the different age groups approximately in the following ratio (p. 20):

To 8.4 per cent of adults over 20 years.

To 19.2 per cent of those from 16 to 20 years, and

To 27.2 per cent of minors under 16 years; further, also,

To 15.2 per cent of females of child-bearing age (above 16 years) as compared with 9.3 per cent of males of the same age.

These points must be carefully weighed in considering the disadvantages of the mill as compared with the farms.

**DISTRIBUTION OF CASES AND SUSPECTS IN RESPECT TO CHARACTER OF THE SOIL AND LOCALITY.**

In the United States hookworm disease is more prevalent and more severe in sandy and loose-soil areas than in clay areas, and in my experience it is more prevalent among rural mountaineers than among the people in the areas between the base of the mountains and the beginning of the sand. The sanitary advantages accruing to farm families which move to mills will, accordingly, be greatest to the sand-land farmers, next to the mountaineers, and least to the clay landers, if the comparison is based solely on hookworm disease. If the comparison be extended to typhoid fever, statistics indicate very strongly that the advantages in question would be increased for the mountaineers.

In view of the distribution of the disease according to sand, clay, and mountains, theory indicates that, in general, the mills drawing their labor from the sand-land farm areas will have the greatest amount of anemia, both in number and degree of cases; those with a preponderance of mountain labor will stand next; and those with a preponderance of clay-land farm labor will stand third. Upon plot-

ting the mills visited it was found that the distribution of the anemia actually corresponds, in general, to expectations. Thus the distribution follows certain rules as referred to on page 15.

#### COMPARISON OF PEOPLE IN FIRST AND SECOND GENERATIONS OF MILL LIFE.

Since the average sanitary conditions in cotton-mill villages are superior to the average on farms, it would naturally be expected on basis of the hookworm explanation of cotton-mill anemia that, in general, mills running on labor in its second generation of mill life would show "cotton-mill anemia" (namely, hookworm disease) in less intense degree (either in respect to the number or the severity of cases) than mills running on labor in its first generation of mill life, namely, direct from the farm. To find mills in the same locality which present conditions fair for a comparison in this respect is rather difficult, but two instances of apparently fair comparisons can be presented.

There are two mills of Class A at S—, under the same management and located about  $1\frac{1}{2}$  miles apart, which showed the following striking statistics:

#### DIFFERENCE BETWEEN PER CENTS OF HOOKWORM SUSPECTS IN FIRST AND SECOND GENERATION OF MILL LIFE IN TWO SOUTHERN COTTON MILLS OF CLASS A.

[Class A—Establishments for which record was made of number of employees observed and of hookworm suspects.]

	Per cents of suspects.		Remarks.
	All ages combined.	Under 16 years.	
First generation mill.....	21.6	43.7	This mill village is practically in the country.
Second generation mill.....	3.5	5.7	This mill village is practically in the city.
Difference.....	18.1	38.0	Due to lessened soil pollution.

Thus, in one generation the improvement of approximately 300 per cent in sanitary conditions has resulted in a tremendous improvement in the results (namely, hookworm infection) of insanitary conditions, for the first generation mill shows over 500 per cent more suspects in all hands and over 600 per cent more suspects among the children than does the second generation mill. Incidentally, but having a direct bearing on the question, it may be remarked that the first generation mill is the superior of the two, not only as to its lighting and ventilation, but also as respects the sanitary condition of the mill-house privies examined.

In another State a comparison was drawn between three mills of Class B, all under the same company; one of these had a considerable



proportion of labor imported from farms within three years, and among these persons about 15 cases (so pronounced that a microscopic examination was unnecessary for diagnosis) were found within half an hour; in the two other mills the labor was largely in its second and partly even in its third generation of mill life, and considerable difficulty was experienced in selecting suspects.

The foregoing findings correspond not only with what would be expected from a theoretical point of view, but also with the general experience of the mill men and the physicians who practice among mill families, namely, that families newly imported from the farms generally improve in condition with their residence in the mill villages.

The significance of these statistics can not be ignored.

**COMPARISON OF COTTON MILLS AND KNITTING MILLS IN THE SAME TOWN.**

On page 17 it was shown that when all the cotton mills visited were compared with all the knitting mills visited, the percentage of suspects was slightly higher in the latter than in the former.

As the percentages in different localities may vary according to the origin of the labor, fairer results are obtained if cotton mills are compared with knitting mills in the same towns. It is possible to make this comparison for mills of Class A in three towns, as follows:

PER CENT OF HOOKWORM SUSPECTS IN COTTON MILLS AND KNITTING MILLS OF CLASS A IN THREE SOUTHERN TOWNS.

[Class A = Establishments for which record was made of number of employees observed and of hookworm suspects.]

	Per cent of suspects in—	
	6 cotton mills.	3 knitting mills.
Town No. 1.....	12.4	3.5
Town No. 2.....	20.1	13.4
Town No. 3.....	43.9	31.2
Average based on number of hands.....	22.9	13.4
Total number of hands compared.....	584	141

The foregoing comparison indicates that the number of suspects in cotton mills is higher than in knitting mills.

The explanation of this higher percentage in the cotton mill is to be sought in several factors, one of the most important of which is the higher percentage of young males usually observed in cotton mills as compared with knitting mills.

### THE "TYPICAL COTTON-MILL CHILD."

On the basis of the facts presented in this report, supported by evidence contained in medical literature, the assertion is reaffirmed that the so-called "cotton-mill anemia" of the Gulf-Atlantic States, so often attributed to "breathing in the lint," is in the larger per cent of these cases in reality hookworm disease, and that the prevalence of this disease in the mills requires to that extent a readjustment of popular opinion in this respect.

In cotton-mill sections of the Gulf-Atlantic States it is not rare to hear a boy or girl referred to as a "typical cotton-mill child." This "typical cotton-mill child" is one who is more or less anemic, and very likely more or less underdeveloped for his age, but with rather an old expression; for instance, in extreme cases a boy of 14 may appear not over 7 or 8 years old, one of 27 may appear not over 17 years old, in respect to physical development, although the facial expression may be that of a person much older than the person actually is.

A study of the literature on hookworm disease should convince any reader, unprejudiced or prejudiced as he may be, that underdevelopment is a common feature of severe hookworm disease in case the infection takes place before puberty.

Given (1) the presence of hookworm disease in not less than one out of every four of the Gulf-Atlantic cotton-mill children, (2) the fact that this disease retards the development, (3) the fact that many hookworm sufferers on the farms are underdeveloped, (4) the fact that many farm families move to the mills, it follows that it is not unreasonable to expect that not an inconsiderable proportion of the underdevelopment noticed among the Gulf-Atlantic cotton-mill children, and usually attributed to "breathing in the lint," should be attributed to hookworm disease. A study of the children in question results, in fact, in confirming this expectation; further, experience shows that, in general, the condition of these children improves, as theory indicates that it should, with their life in the cotton-mill village, after their removal from the soil-polluted farms, a change which results in improving their sanitary environments on an average by about 300 per cent.

The conclusion to be drawn is that to the extent indicated above the so-called "typical cotton-mill child," like the so-called "cotton-mill anemia," is the product of hookworm disease. From a standpoint of improving the health of these children, this conclusion is most satisfactory, for we are here dealing with an easily recognizable disease which can be easily and satisfactorily treated in the vast majority of cases and which can be easily prevented by the simple means of a properly constructed, properly maintained, and properly used sanitary privy.



As the chief source of the trouble lies in the insanitary conditions on the farms, the most important point of attack in bettering conditions is the farm, where the present medieval privy conditions should be bettered to correspond with modern ideas of sanitation. The cotton-mill companies have resting upon them the duty of bringing their present low privy index (average 27) up to a more modern and more civilized basis of 75 to 100, and until they fulfill their duty the hookworm infection introduced by cases coming from farms will continue to spread to some extent.

Together with this improvement of farm and village sanitation, there should go hand in hand medical treatment of existing cases, especially those of heavy infection. From a practical standpoint, however, while it can be reasonably concluded that hookworm disease might eventually be entirely eradicated by improved sanitation alone, it is scarcely to be hoped that it can be eradicated by treatment alone. The two procedures should go hand in hand, the sanitation for the benefit of the entire population, the treatment more particularly for the benefit of the more heavily infected cases.

#### NEW ENGLAND MILLS AND FACTORIES.

In New England I visited 26 mills and factories of Class A, making records of 4,399 hands seen; of these, 1,437 hands were observed in a total of 16 cotton mills, located in 3 different States. Among all these persons not one was classified in the "suspect" category.

It is submitted that the 1,437 hands seen in the 16 cotton mills visited in New England were breathing in cotton lint taken from the southern cotton fields and that this is the same kind of lint which is being breathed in by the hands in the southern cotton mills. If, now, the "cotton-mill anemia" of the South, found on an average in not less than 12.6 per cent of the hands of the southern cotton mills, were due principally to this lint, it is reasonable to assume that approximately the same proportion (12.6 per cent) of cases, or 181 suspects, would have been found among the 1,437 hands observed in the 16 New England cotton mills visited. While it is very possible that a few suspects might have been overlooked, it is scarcely reasonable to assume that 181 suspects would have escaped attention.

Taking the statistics based upon age and sex, instead of upon the total hands seen, in order to meet any objections which might be raised because the so-called "cotton-mill anemia" varies according to age and sex, I was entitled to find the following suspects among the cotton-mill hands in case the condition was due to "breathing in the lint":

	Suspects.
5.8 per cent of 345 males over 20 years-----	20.0
20.7 per cent of 94 males, 16 to 20 years-----	19.4
29.4 per cent of 91 males under 16 years-----	26.7
Total males-----	66.1
13 per cent of 625 females over 20 years-----	81.2
18.1 per cent of 194 females, 16 to 20 years-----	35.1
18.7 per cent of 88 females under 16 years-----	16.4
Total females-----	132.7
Grand total-----	198.8

It is unreasonable to suppose that I could have overlooked this number (198) of suspects if they had been present.

It was shown (pp. 16 and 17) that in the southern knitting mills cases of "cotton-mill anemia" were found, but in the one New England knitting mill inspected not one suspect was observed.

It has been shown further that in other industries and in other walks of life in the South this same "cotton-mill anemia" was observed, but not one suspect was observed in 2,962 persons employed in 10 New England factories other than the cotton mills, but including one knitting mill.

It is clear that we must look for some idea other than the "lint theory" in explaining this absence of "cotton-mill anemia" from the New England cotton mills, and it is submitted that the "hookworm" explanation meets the case to the extent brought out in this report.

#### RARITY OF HOOKWORM DISEASE IN NEW ENGLAND.

The secretary of the Massachusetts State Board of Health was out of the State when I called, but his deputy informed me that he had never heard of hookworm disease. The State boards of Rhode Island and Connecticut were familiar with the disease only from the literature, but they could recall no case for these two States.

Personally I know of no positive case of hookworm disease in these three New England States up to 1902. Stiles & Garrison (1906)<sup>1</sup> report two cases of hookworm infection for the State hospital at Middletown, Conn., one case among 502 males and one case among 508 females examined microscopically.

#### NUMBER OF NEGRO INHABITANTS.

According to the report for the Twelfth Census, 1900, the whites and Negroes in the three States in question are present in the following ratio:

<sup>1</sup>A statistical study of the prevalence of intestinal worms in man. Bulletin 28, Hygienic Laboratory, United States Public Health and Marine-Hospital Service, p. 19.



NEGROES PER 100 WHITES IN MASSACHUSETTS, RHODE ISLAND, AND CONNECTICUT, 1900.

[From Twelfth Census, 1900, Population: Part I, p. cxil.]

States.	Whites.	Negroes.	Negroes per 100 whites.
Massachusetts.....	2,769,764	31,974	1.2
Rhode Island.....	419,050	9,092	2.2
Connecticut.....	892,424	15,226	1.7
Total.....	4,081,238	56,292	1.4

Thus, in these three States there are only 14 Negroes to 1,000 whites, as compared with 899 Negroes to 1,000 whites in the Southern States mentioned in the foregoing on page 11.<sup>1</sup> It is evident, therefore, that the three New England States in question are not subject to such a serious sanitary handicap by the presence of Negroes (see privy statistics, p. 31) as are the Southern States, hence that there is present a lower number of reservoirs for hookworm disease. Given, therefore, other conditions as identical, theory calls for less hookworm disease in New England than in the South. As will be shown below, however, certain other conditions favorable to hookworm disease are not so marked in New England as in the South, hence there are additional reasons why this malady should be less common in New England.

**RURAL POPULATION.**

New England has, as compared with the South, a smaller proportion of rural population, and may accordingly be expected to show fewer cases of rural diseases, such as hookworm disease. Further, in New England the Negroes are primarily inhabitants of cities, not of farms. Accordingly the hookworm infection which might happen to exist among the Negroes would gradually be carried away to a great extent by the sewer systems, hence would not be so likely to spread to the whites. That cases of infection might arise in summer due to soil pollution in alleys or elsewhere must be admitted.

Further, although I can not present exact statistics supporting the statement, I know from my personal experience in New England that the absence of a privy is not so marked or common on New England farms as on southern farms.

**CLIMATE.**

Even admitting that hookworm disease might be carried into New England and distributed on the farms, the colder climate would be an important factor in holding it in check.

<sup>1</sup> Figures derived from Twelfth Census, 1900, Population: Part I, p. cxil.



## SOIL.

It will be recalled that the heaviest percentages in the South are found as we approached the seaboard or the Gulf, namely, in the sand lands. In New England the coastal sand area is very restricted as compared with the South, hence the soil is not so favorable to hookworm disease.

## MILL LABOR.

Most of the cotton-mill labor seen in New England was of foreign birth or foreign descent, and had hookworm disease been found among these people it would in all probability have been, chiefly at least, the Old World form, due to *Ancylostoma duodenale*, rather than the New World form, due to *Necator americanus*, and in all probability it would have been found chiefly among the Italians.

Again, the New England mills visited were older mills than most of those visited in the South, hence even among the Americans in these New England mills we would have been dealing chiefly with people who were not fresh from the farm (namely, they would not be in the first generation of mill life), hence the hookworm infection, if present at all, would have been reduced by their life in the mill village or by city life, as compared with life on farms, exactly as was found to be the case in certain southern mills.

It is thus seen that the negative results obtained in New England are entirely in harmony with the hookworm explanation, but absolutely at variance with the lint theory.

## TO WHAT WAS THE THEORETICAL ERROR DUE?

On page 14 the statement is made that under favorable conditions my statistics are subject to a theoretical error of 17 per cent, and that including unfavorable conditions this error averaged 27 per cent.

It is pertinent to the report to consider the factors involved in this error. As contributing factors, the following occur to me:

*Light.*—It is exceedingly difficult to judge hookworm cases under artificial light. The hands of a given mill may appear in fairly good condition in bright daylight, but if that mill is inspected after the electric lights (especially the arc lights) are turned on these same hands may look ghastly pale, and the observer is shocked at the apparently frightful influence of mill life. In the early part of my investigations I undoubtedly was misled in some cases because of the incandescent lights, but of course very special precautions were used under arc light, and except possibly in one mill I do not believe that I was led into error by this latter kind of light. I am therefore of the opinion that part of the theoretical error was due to attempting to judge certain cases when the light was not suitable.

*Sudden exercise.*—I have a distinct recollection of having made four errors in the case of four doff boys. The error was discovered within 24 hours, and I do not believe it was repeated; but as the error was actually made, the four boys were retained in my statistics and thus charged up against my work. Four doff boys came into a spinning room; they did not look exactly like hookworm cases, but because of the very rapid heart and despite their moist skin, I selected them for microscopic examination. Having negative findings under the microscope, I looked into the matter further to determine if possible the cause of this rapid heart beat and discovered to my chagrin that immediately prior to entering the room where I was working they had been running a race from the first up to the top floor of the mill.

*Malaria.*—If opportunity is given to make a careful examination, there is no difficulty in distinguishing between hookworm disease and malaria, even in a light case. But in rapid diagnosis it is not a difficult matter to fall into error of confusing the two conditions. When it is considered that malaria was known to be present in certain mill villages where I was studying, it seems very probable that I was led into error in some of the nontypical cases. In one case I am convinced of such error.

*Former cases.*—In two cases, in which I had opportunity to make a careful examination, a definite, unmistakable history of hookworm disease was obtained, but it was difficult to decide whether these persons should be classified as "suspects" or as "former cases." They were finally classified as "suspects," but the microscope failed to show infection.

The foregoing factors were undoubtedly involved in the "theoretical error." In addition of these, three other factors might possibly come into consideration, namely, the tobacco habit, gastric ulcer, and indigestion from various causes.

*Tobacco habit.*—Snuff dipping and tobacco chewing are exceedingly common among the young boys and girls, but it seems rather doubtful whether the effects of the tobacco would play much of a rôle in the error. Still, in view of its effect upon the digestion in particular, it is not absolutely excluded that some errors in nontypical cases are to be charged against it.

*Indigestion.*—During the microscopic work, abundant evidence was found of the important fact that numerous mill people swallow their food without even halfway chewing it. That this would have its effect upon the stomach and the general health is self-evident, and it seems not impossible that in some of the less typical cases this lack of chewing the food, with its consequent results, may have led into error. In some instances this bolting of the food is in no way attributable to mill life; in other cases it is at least favored by the

fact that some of the hands may live some distance from the mill and on this account they eat hurriedly during the noon hour.

*The lint.*—At the present moment it is difficult for me to assume that the effects of the lint played any appreciable rôle in the theoretical error, despite the widespread acceptance of the lint theory. If it did play any rôle, this must have been very slight, for otherwise a higher percentage of suspects would have been found in the clay-land mills, and some suspects would have been found in New England.

In spite of everything said in this report, the misinterpretation should not be made that it is here claimed that the cotton mill is per se a health resort, or that people generally are advised to go into cotton-mill life in order to build up their health. By comparison with the soil-polluted farms, it is a sanitarium; but by comparison with a farm in good sanitary condition its good effects tend to disappear.

Just what deleterious effects Southern cotton-mill life has upon the health it is exceedingly difficult to determine at the present moment, since to judge those effects we must first eliminate these other factors, heretofore so generally attributed to working in the mills, and in addition we must have a more constant mill population upon whom studies may be conducted.



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