THE EPIDEMIOLOGY OF BACILLARY DYSENTERY *

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Bacillary dysentery takes a heavy toll of the infants of large cities every summer. The disease is not spectacular, for it usually does not spread over large areas, but strikes at random here and there and passes by almost unnoticed. During a period of ten years, however, the case incidence is probably higher than the greatly feared poliomyelitis, and the death rate is equally high.

The cause of the disease is well recognized, and its treatment has received careful study, but the mode of transmission has excited only indifference, or, at most, random speculation. Epidemics of adult dysentery have received much attention, particularly during the present war, for the disease has at times wrought havoc among the soldiers. The source and the mode of transmission of the casual case, the sporadic case, the usual type of summer bacillary dysentery of infants is unknown. Kendall¹ believes that the disease in infants is spread by the factors which cause other intestinal infections and emphasizes the importance of contact with carriers. Zinsser² has described a small milk epidemic in children, and Amoss and Lucas³ have established the menace of fly transmission. The Floating Hospital has felt that the most important step in preventing the constant stream of cases of bacillary dysentery that flows to its wards every summer was to undertake the study of the mode of transmission of the disease and the source of infection of the infants.

There are several inherent factors which were most favorable to such a study. The victims were infants, usually under 18 months of age, and therefore their activities were limited; they travel but little, come in contact with few people, and eat only one, or at most but a few articles of food. In fact, we soon found that it was comparatively easy to trace the infection of a baby under 1 year, though much more difficult after the child was old enough to walk, for then they run up and down the street, come in contact with other children, and eat whatever they pick up.

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1. Kendall: Boston Med. and Surg. Jour., 1913, **69**, 741.

2. Zinsser: Proc. New York Path. Soc., 1907, p. 162.

3. Lucas and Amos: Jour. Exper. Med., 1911, **13**, 486.

Another advantage of the study was that the diagnosis of bacillary dysentery is clear cut; with, first, a definite clinical story; second, by means of the isolation of the dysentery bacillus from the stools, and third, the development of specific agglutinin in the blood. It is true that the clinical picture is not always definite, the isolation of the bacillus from the stools is difficult, and the agglutinins develop slowly—in ten to twelve days—and in the mild cases may not appear at all.⁴ In this study, no case is reported as positive without showing at least two of the three positive factors.

There are certain well-established facts about the disease which furnish a good working basis.

1. The disease is due to the dysentery bacillus, which has been well described and is readily recognizable.

2. The dysentery bacillus is found in the feces only and not in the other excretions, as in typhoid fever. Thus every case must represent some short path between the infected feces and the mouth of the victim.

3. The incubation period of bacillary dysentery, in adult cases, at least, is short—from three to seven days.

4. The disease in infants is in most instances a summer disease, with highest incidence in July, August, and September.

5. Bacillary dysentery is more common in children of poor parents.

There are certain assumptions that have been believed to play an important part in summer bacillary dysentery of infants.

1. The case incidence of bacillary dysentery bears a close relation to high temperature and high relative humidity.

2. Bacillary dysentery is most common in dirty, unhygienic homes, flourishing among the tenements.

3. Bacillary dysentery is particularly prevalent among the infants of foreigners.

With these facts and assumptions, we had a foundation on which we began to build, adding a few stones to the structure, and tearing down here and there a loose fragment. The investigation included: First, a study of the community conditions and factors affecting every individual. A daily record was kept of the maximum, minimum, and mean temperatures, and of the relative humidity and barometric pressure throughout the summer, in order to show the relation between these factors and the case incidence of bacillary dysentery. Second, beside community conditions, a record of neighborhood conditions was kept. A daily report was received from the boards of health of the city of Boston and all of the neighboring cities, and from the State Board of Health, of all reported cases of bacillary dysentery, in order

4. Villard and Dopfer: *Ann. de l'Inst. Pasteur*, 1903, **17**, 463.

Chart 1.—Spot map of bacillary dysentery of infants in Boston and vicinity during the summers of 1915 and 1916. Each black dot represents a case of dysentery. The nests of infection in certain portions of the South End, A, and in South Boston, B, are striking. Sanitary conditions are equally bad in the North End, C, and West End, D, but the former neighborhoods are occupied largely by first generation Irish-Americans, and the latter by foreigners—Italians, Poles, and Russian Jews. Most factors affecting the health of infants in both neighborhoods are the same, the same water, the same milk supply, the same temperature and humidity, and equal number of flies, etc. The only factor that is not common to both neighborhoods is food, for most foreign mothers nurse their babies, while many American mothers do not.

to expose nests of infection in various parts of the city and state. A spot map was kept of all cases to show the infection centers. Third, the housing conditions of each case were studied, and a score card system of recording the conditions in each home was devised. The nationality of the parents was recorded. Finally, a careful investigation was made of the activities of each infected baby for a period of ten days before symptoms developed. This investigation included food eaten, contact with individuals, places visited, and the history of any illness in the house or neighborhood.

The investigation was begun in each instance from a definite point, a proved case of bacillary dysentery by means of the isolation of the bacillus from the stools. This meant a delay of three to four days, which, together with the three to four days from the beginning of symptoms until entrance into the hospital, made an interval of a week between the onset of symptoms and the beginning of the epidemiologic work. This delay was a serious handicap to the study, but was compensated for by the great advantage of dealing only with proved cases of the disease.

We are able to report the study of seventy-five cases in all, forty-nine of them being hospital cases, while twenty-six cases were discovered in the course of the investigation. The first case developed June 15. The last case studied developed September 1. There was a continuation of the disease after September 1, but the hospital closed September 15, so no more stool diagnoses could be made, and automatically the work stopped.

It is obvious that seventy-five cases are not a sufficient number from which to draw conclusions as to the effect of temperature and humidity on the case incidence of bacillary dysentery. Grover⁵ has reported the statistics of several thousand cases of diarrhea in Greater Boston and believes there is close relation between diarrhea of infants and a high humidity and temperature, but so far as our brief studies go, there seemed to be no relation between high temperature and humidity and dysentery. There was one period of severely hot weather, with a corresponding increase in the number of hospital admissions and of infant deaths in the city, but there was no increase in bacillary dysentery. The case incidence is more closely related to the incidence of flies, for the disease had hardly begun before the hot weather was over, and the cases lasted well into September and long after the humid weather was past, though flies were still in abundance.

The disease was not more common in children of foreigners. The most ignorant and destitute foreigners in Boston are the Poles, though the Italians and Russian Jews in certain quarters are living under

5. Grover: *Jour. Am. Med. Assn.*, 1916, **67**, 1562.

almost as unfavorable conditions. One would expect, therefore, a high case incidence among these people, but on the contrary, the families chiefly affected were not the illiterate foreigners, but the careless and neglectful poorer class American families, or more particularly the first generation families. A summary of the parentage in the cases is interesting:

American, including Canadian.....	33	Polish	2
American-Irish, first generation...17		French Canadian	2
American-Italian, first generation.. 4		Negro	1
Irish	4	Greek	1
Italian	4	Unclassified	4
Jewish	3		
		Total	75

Chart 2.—Diagram illustrating the method of introduction of bacillary dysentery in a community in the early summer, and its mode of transmission. The W. family lived in a miserable unscreened tenement in Thorn Alley. The oldest sister had dysentery in the summer of 1915 and was a carrier. June 26 the younger sister developed dysentery, and since the stools were not disinfected, and flies swarmed into the sick room from a stable across the alley, it is not surprising that the baby brother developed dysentery June 30. J. G., living 150 feet away, also developed dysentery. The two families had nothing in common, but J. G. played in the back yard and was probably infected from the W. family by means of flies.

I do not attribute this surprising situation to the greater uncleanness or worse sanitary conditions of the American homes, for quite the contrary is the case. It is due to the simple fact that most foreigners nurse their infants, while American mothers often do not. It is interesting to note in this connection that but one of our cases of

bacillary dysentery was a nursing baby, and this child was nursed only at night and was fed condensed milk during the day.

Though squalor, poverty, and filth go hand in hand with bacillary dysentery, they are not necessary accompaniments of it, for the disease may be found in the better homes in the better portions of the city and may be entirely absent in the most unsanitary portion of the city. For example, Boston's West End tenement district had almost no cases in the summer of 1916, and the North End very few, though unsanitary conditions are fully as bad in either of these localities as in the South End, where the disease abounded. Young⁶ studied the geographic distribution of the Floating Hospital cases in 1910 and found a somewhat similar localization of cases. In 1915 there was a nest of cases in the South End, with twenty or more cases within a radius of only one-eighth of a mile, while in 1916 there were a few scattering cases within this nest, but another nest of cases was found directly across the river in the tenement district of South Boston (Chart 1). Unsanitary conditions, therefore, do not cause dysentery, but they are a fertile soil, needing only the introduction of the seed in order to produce a widespread harvest of cases.

To show the relation between bacillary dysentery and unsanitary household conditions, a housing chart was made of the homes of the infants, based on the score card system, similar to the dairy or market score cards, with a total of 100 points for ideal conditions. Records were kept, for example, of the number of rooms per person, allowing 5 points for a perfect score; of the number of windows per person, 5 points; screening, 5 points; ventilation of living-room, 2 points; of sleeping-room, 3 points; cleanliness and neatness of the house, 5 points; location of the toilet, if clean, well ventilated, and convenient, 5 points; provision for the care of the diapers, if protected from flies, 2 points, if boiled, 3 points. If pasteurized milk was used, 10 points were allowed, and the intelligence of the mother was graded for 10 points.

Forty-one homes were scored, the highest score being 94 per cent., the lowest, 15 per cent., the average 59 per cent. The average housing score in those cases of dysentery due to direct contact, however, was only 48 per cent., and the average housing score of those that were a source of infection to others was 41 per cent. This is but a complicated way of saying that a child is more likely to contract bacillary dysentery if it lives in a dirty, unhygienic house and has a careless and ignorant mother, and a baby with dysentery in a dirty, unhygienic home is most likely to be a source of infection to other children.

The study of the source of infection in the various cases was in the nature of a general survey rather than an intensive investigation.

6. Young: *Boston Med. and Surg. Jour.*, 1911, **164**, 299.

The activities of the infected child were studied for ten days before symptoms began, and a careful, detailed record was made of every place the child had been, of all contact with individuals, of all food eaten, or of any factor that might be a source of infection to the child.

Chart 3.—Map of Boston and vicinity illustrating the epidemiology of widely scattered and isolated cases of bacillary dysentery. Thus, there were fifteen cases in various parts of the city, some of them in isolated suburbs. The only factor in common was *S.* brand of condensed milk. A. Nine cases were due to the use of icecream cones. B. Twenty-seven cases were due to direct contact. Thus, though we studied seventy-five cases, the foci of infection of these cases were reduced to twenty-eight, and no doubt more intensive study of the cases from unknown sources would have reduced the number of separate foci of infection still more.

A summary of the probable source of infection of the cases is as follows:

Total cases	75
House cases	49
Discovered cases	26, of which 18 were children 8 adults
Average age of hospital case.....	1 to 2 years
Average age of discovered case.....	4 to 8 years (other than adults)

Etiology of the seventy-five cases is divided as follows:

	Cases
Contact with an acute case.....	21
Contact with a carrier.....	2
Contact with house cases.....	4
Condensed milk epidemic.....	15
Icecream "cones"	9
Flies	6
Milk	1
Water	1
Fruit	1
Unknown	15
Total	<hr/> 75

Contact with an Acute Case.—There were twenty-one cases in which the patients developed bacillary dysentery from direct contact with an acute case. These patients were usually of the same family or household and developed the disease during the time the child was at home, or shortly after it was sent to the hospital. Only two of these were hospital admissions, while the remainder were discovered in the course of the investigation. Most of the cases were in older children in the family, though eight of the cases were in adults. In most instances the disease was so mild as to be called "summer diarrhea," and the patients would seldom have seen a physician were it not for the hospital visitor. As a general rule, the older the child, the milder the infection, while only two of the adults were seriously ill, and none of the twenty-one contact patients died.

A typical contact infection was illustrated by the H. family. G. H., 3 years of age, developed bloody diarrhea June 15 and was prostrated and quite ill for several days. The source of her infection was probably an icecream cone. There was no physician in attendance, and the child received poor care. The housing conditions were very poor, scoring only 49 per cent.; a dirty, careless mother, and a dirty, slovenly house. June 19, the mother developed severe abdominal cramps and diarrhea. She took "patent" medicine and was never confined to her bed, though she had "some fever." June 21, Lillian, a daughter 12 years of age, developed diarrhea, but no blood was noted in her stools. She had no physician and was in bed only one or two days. Finally, June 29, Francis, the baby, 8 months of age, developed a severe bloody diarrhea and was brought to the Floating Hospital. The dysentery

bacillus of the Flexner type was isolated from his stools and our investigation begun. The blood from the other three members of the family agglutinated the bacillus isolated from the baby's stool in dilutions up to 1 to 300, and also agglutinated other strains of the Flexner type in lesser dilution — up to 1 to 160.

Chart 4.—Diagram illustrating the mode of transmission of the Shiga infection in Pine Heights. L. C. returned from the Haverhill Fresh Air Farm with severe bacillary dysentery and remained in the community three days (House 21). By direct contact she infected two sisters and a brother. A voluntary nurse carried the infection home to her husband (House 23). The infected feces were thrown into an open privy, and flies carried the infection to House 86 and House 2. Raymond G. in House 1 was infected by direct contact from House 2, and from the case of R. G. the investigation began.

Other examples of contact infection with an acute case might be given, but the one instance illustrates the points, and other examples will be mentioned in subsequent paragraphs. The important facts are that many of these contact cases were in older members of the family, and in these persons the course of the disease was mild, so mild that it was commonly called a simple "summer diarrhea." Undoubtedly many cases of summer "ptomain poisoning" are really mild bacillary dysentery. These sporadic cases are seldom serious in themselves, but the patients may be a great menace to the community, particularly to the babies of the community, for our studies have shown that mild adult cases may readily infect a baby, with rapidly fatal results.

It may be stated as a general rule that in every dirty, careless household visited, where the sick child remained more than one week, there resulted a contact case of bacillary dysentery. There were twenty-one contact cases, from forty-nine house cases, all proved by the isolation of the dysentery bacillus from the stools or by the development of specific agglutinins in their blood. There were other suspected cases, but agglutinins develop slowly, seldom appearing before ten to twelve days, and in mild cases they may not develop at all. No case is reported in which the agglutinins were not present in dilutions of at least 1 to 160. Whenever possible, the strain was used for agglutination which had been isolated from the stool of the corresponding case. In this manner, a greater number of contact cases were proved than would have been possible with the use of a stock strain for agglutinations. As a rule, the blood of the milder cases agglutinated the stock strains, but in lesser dilution than the corresponding strain.

Contact with a Carrier.—In all probability, bacillary dysentery is introduced into the community in the summer by a carrier, and once begun, other factors carry it on. We know there are carriers, but the isolation of the dysentery bacillus from the stool of a carrier is a very difficult thing. I have only two cases to report which seem to be due to contact with a carrier, both cases occurring early in the summer. The W. family is a good illustration of the introduction of bacillary dysentery into a community in the early summer.

M. W., 5 years of age, developed bloody diarrhea June 26 and was brought to the hospital July 2. The Hiss Y-type of dysentery bacillus was isolated from her stools. An investigation showed no illness in the neighborhood and none in the household. The food was not suspected. Her older sister, 15 years of age, had had a severe diarrhea ten months before, lasting about ten days but had no medical attention. We made repeated examinations of this older child's stool but failed to find the dysentery bacillus, though her blood readily agglutinated the strain of dysentery bacilli isolated from her sister's stool in dilution of 1 to 100.

The sanitary conditions of this home were very bad, the housing score being only 15 per cent. M.'s stools were not disposed of for hours at a time and were exposed to flies which swarmed in from a nearby stable.

June 30, Baby W., 3 months of age, developed a moderate, greenish, slimy diarrhea, without blood. Nevertheless, he was sent to the Floating Hospital, and dysentery bacilli were isolated from his stools. July 5, the report came from the city board of health of a case of bacillary dysentery within 150 feet of the W. family, and investigation proved the case to be of the same type as the W. infection. This child, 2 years of age, lived in a clean, sanitary home, under ideal conditions, with a housing score of 86 per cent. He had not been away from home or in contact with other children, and all his food was well cooked. The child commonly played in the back yard, on the side toward the W. family tenement. Since flies were so prevalent in the W. household, since they had ready access to infected diapers, since there were no other cases of bacillary dysentery in that part of the city, the only connecting link between the cases would seem to be the flies (Chart 2).

Shiga Epidemic of Dysentery 1916
Illustrating different modes of transmission in one epidemic

Chart 5.—Diagram illustrating the various modes of transmission of bacillary dysentery in several communities during a single summer. The first infection was from icecream in Lawrence and was transmitted by direct contact to a dairy worker in Haverhill. The dairy worker infected the milk, which infected a large number of children in a fresh air home. One of these children returned to her home in Pine Heights and spread the infection by contact, by flies, and an intermediary carrier.

Another possible contact with a carrier case was R. S., 10 months of age, whose illness began June 30. There were no other cases in that part of the city, the child had not been away from home, and his only food was milk, which was pasteurized. Just one year previously, his sister had been a patient in the Floating Hospital with bacillary dysentery. The same type of bacillus had been isolated from her stools as was obtained from the baby brother's stool. At the time of the investigation, the older child was in perfect health, and repeated examinations of her stools were made for dysentery bacilli, with negative results. The father gave a history of bacillary dysentery during the Spanish-American war. Examination of his stools was also negative, and neither the father's nor sister's blood agglutinated the strain isolated from the baby's stool. Despite these negative findings, it seems probable that either the

sister or father was a carrier and infected the baby. This conclusion is open to question because of the difficulty of detecting dysentery carriers. The rest of the story is almost exactly that of the W. infection. After a proper incubation period, the city board of health reported three cases of bacillary dysentery within 100 yards of the L. tenement. In this family, the mother and 3-year-old sister were infected by direct contact with a baby brother. This baby was probably infected from the L. baby by means of fly transmission. These conclusions were reached because flies were abundant and had ready access to the infected stools, there were no other cases of dysentery in the neighborhood, the child had not been away from home, its food was thoroughly cooked, and other sources of infection were excluded.

Hospital Contacts.—Four babies developed bacillary dysentery in the wards of the hospital. Each child was admitted with quite a different diagnosis, and their stools were negative on entrance. Each developed the disease seven to ten days after admission, and in no instance did the child come from an infected home or neighborhood.

This is not a criticism of the hospital staff, but I simply mention these four cases to illustrate the remarkably contagious nature of the disease. In the homes, twenty-one cases were spread by contact with an acute case, and as a rule the infected baby remained in the home less than a week, while but four contact cases developed on the wards, though there were virulent cases on the boat all summer.

It is important to emphasize that extraordinary precautions must be taken to prevent ward infection, and no hospital has a right to admit cases of bacillary dysentery unless it has the facilities for their isolation, for rigid "enteric precautions," and particularly for absolute fly exclusion.

The Condensed Milk Epidemic.—About July 15, patients began to come to the hospital who gave a history of using one of the cheaper brands of a large producer's condensed milk. By August 15 there were fifteen cases from all parts of the city with a clear-cut history of using the S. brand of condensed milk. The epidemic ceased as abruptly as it began.

CASE 1.—A baby, 8 months of age, became ill July 8. The child had been fed on S. brand condensed milk for three months. July 5 the mother bought a fresh can, and three days later the child became very ill and was brought to the hospital, where a diagnosis of bacillary dysentery was made. The child had eaten nothing but S. brand condensed milk and boiled water, had not been away from home, and there was no sickness in the neighborhood. A sample from this can was obtained July 13, but no dysentery bacilli were found.

CASE 2.—Baby 5 months old developed bacillary dysentery July 14, came to the hospital July 26, and died soon after. The baby had eaten nothing but S. brand condensed milk for three months, had not been away from home, and there were no cases in the neighborhood. Other members of the family, mother, father, and two children, aged 9 and 7, used the same milk, but only in tea or coffee. One child, 2 years of age, used the condensed milk diluted with water. The 2-year-old child developed bacillary dysentery July 24, whether from the milk or from contact with the baby is not known. The father developed bacillary dysentery July 27, the disease running a mild course.

CASE 3.—Baby boy 7 months old, became ill July 17 and was brought to the hospital, where the diagnosis was made. The family lived in an isolated suburb, and the baby was not in contact with other children. The mother was a trained nurse and was intelligent and very cleanly. She carefully boiled the baby's water, then cooled it and added S. brand condensed milk. This was the only food the child had.

CASES 5, 6, 7, 8, 9.—The F. family consisted of mother, father, and four children, aged 4, 3, and 2 years, and the baby of 10 months. The father was a fisherman and was out at sea. August 2, the baby was brought to the hospital with severe bacillary dysentery. The child had been fed on nothing but S. brand condensed milk and boiled water for three months. The mother obtained a fresh can July 24. July 26, the mother and all four children developed a prostrating diarrhea. All recovered in two to five days except the baby. The only food used in common by all was S. brand condensed milk. The only food the baby had had was condensed milk, but the older children had been given bread, butter, eggs, and cooked vegetables, though they had had no icecream, fruit, nor fresh milk. There was but one case of sickness in the neighborhood, a child of 2 years, reported by the city Board of Health as bacillary dysentery. This child's mother had bought a can of the same milk from the same store at about the same time as the F.'s did, and her baby became ill July 23. The parents were noncommunicative and would not permit taking blood for agglutinins, though the history was typical.

Blood was obtained from all the F.'s, however, and all agglutinated the strain isolated from their baby's stool in dilutions of 1 to 160 or higher.

CASE 10.—Mary R., a baby 6 months old, became ill August 3. The mother customarily heated the water to boiling and then added S. brand condensed milk. During the week of July 27 the mother went to work, leaving the baby with a 12-year-old sister. The amateur nurse mixed the S. brand condensed milk with cold water and gave the mixture to the baby without warming it at all. One week after the baby became ill, a 2-year-old sister developed bacillary dysentery, but no physician was called. When seen by the hospital visitor, the 2-year-old child was well, but her blood showed agglutinins in a dilution of 1 to 160 for the strain isolated from her baby sister's stool. This child may have been infected by contact with her baby sister or from the condensed milk. One week later, a cousin 7 years of age developed a moderately severe diarrhea. He had played with his cousin during her convalescence and was probably a contact case. His blood also showed agglutinins in dilution of 1 to 160.

CASE 11.—Another mother reported that she had not used S. brand condensed milk in the child's food for a month, having substituted a pasteurized milk formula. Later she admitted that the new mixture had not been sweet enough to suit the baby's palate, and though she carefully sterilized the food, she afterward added one-half teaspoonful of S. brand condensed milk to each feeding.

CASE 12.—In one instance, a child of 18 months lived in a suburb under excellent home conditions and was given only pasteurized milk. On two mornings, however, the milk delivery was late, and the mother gave the baby a feeding of S. brand of condensed milk. Four days later the baby developed bacillary dysentery.

The finding of dysentery bacilli in the milk is the only evidence lacking to prove that the epidemic was due to S. brand of condensed milk, and without this evidence my case collapses. Stock samples of milk were repeatedly examined, with negative results, and in two instances I was able to obtain the can from which the infection was

supposed to have come seven to ten days before. Both samples failed to show dysentery bacilli.

Nevertheless, the evidence is very suggestive. Fifteen cases of dysentery of the same type, from all parts of the city, some of them in isolated communities, developed about the same time, and with but one factor in common, the use of S. brand condensed milk, and in most instances it was the only food of the infected child. None of the hospital admissions for dysentery before July 10 or after August 15 used this brand of condensed milk.

For these reasons, it seems most probable that one portion of one shipment of one brand of condensed milk, delivered about July 10, was infected with dysentery bacilli.

Flies.—Indirectly, flies have already been mentioned as a means of spreading bacillary dysentery. It is a difficult thing to prove anything on a fly. Alice Hamilton⁷ found typhoid bacilli on the bodies of flies caught outside a typhoid patient's windows, and Amoss and Lucas⁸ caught flies "red-handed" with dysentery bacilli on their bodies.

I believe that seven of our cases are due to infection through the medium of flies, but the evidence is circumstantial only. Several instances of fly transmission have been mentioned in connection with other outbreaks. A typical example of fly transmission may be given.

T. C., 9 months of age, came to the Floating Hospital, August 17, with severe bacillary dysentery. The source of his infection was never discovered. He was taken home against advice August 25, though he was very ill, passing fifteen to twenty bloody stools a day. Ten days later, a baby 3 months old, living just around the corner, developed bacillary dysentery, came to the Floating Hospital, and died. The strain isolated from the stools of both babies were the same type. The two families did not know each other and had nothing in common. The second baby had not been away from home and had been given only pasteurized milk. The back doors of the two families were less than 50 feet apart, and the diapers of the first child were kept on the roof or in an open room for hours without cleansing or disinfection. Flies were in abundance, and neither house was screened. There is no direct proof that flies did carry the infection across that 50 feet from one house to another, but the circumstantial evidence is strongly against the fly.

The other six cases that I have classified as due to fly transmission are almost a repetition of this story. The tenement mother is too ignorant, or many times too careless to protect her baby's stools from flies, and the diapers are seldom boiled. Since flies are so abundant in the tenements, and screens are almost never seen, it is most extraordinary that more cases are not carried in this way. It is more than probable that some of the fifteen cases from unknown sources are due to flies, but as we said at first, it is hard to indict a fly.

7. Hamilton: Jour. Am. Med. Assn., 1903, 40, 576.

Icecream.—It is a curious thing that a city which is so careful about its milk supply and other foods should practically neglect a food that is almost as universally consumed, in the summer, at least, as milk itself. Icecream “cones” are the presumable source of infection in nine of our cases. The evidence is not absolute, for most of the children were older than in the other types of infection — between nine months and four years — and their activities were more varied. They played in the streets, ate various articles of food, and came in contact with many children, and thus their epidemiology is much more indefinite than that of infants.

In each case attributed to icecream, the infection came through the one cent icecream “horn” sold in the filthy basement confectionery shops. In each instance, the criteria were that the child had not been away from home, had not been in contact with sick children, there were no other cases of dysentery in the neighborhood, other food eaten was beyond suspicion, and the icecream was eaten within six days.

A good example is the Jack Frost Ice Cream Company's cones.

R. K., 15 months old, lived in a splendid home in a suburb. There were no cases of dysentery for miles, and the child had not been away from home. July 30 she was given an icecream “horn” of the Jack Frost Company, and August 3 developed bacillary dysentery and was brought to the Floating Hospital.

J. W., 4 years of age, lived in another part of the city in a sanitary home and under intelligent care, and there were no cases of bacillary dysentery in the neighborhood. The child ate a Jack Frost icecream cone July 22. Symptoms developed July 24, and he was taken to the Children's Hospital, where he died. Dysentery bacilli were isolated from the stools of both children and were of the same type.

August 3, a sample of icecream was obtained from the Jack Frost Icecream Company. There were seven million bacteria per cubic centimeter, with colon bacilli in 1/1,000 of a cubic centimeter. Dysentery bacilli of the Flexner type were actually isolated from the sample of icecream. This is the only instance in which we were able to isolate dysentery bacilli from icecream cones, though total bacterial counts and colon bacilli counts always showed very undesirable conditions.

Water.—The one outbreak that could probably be attributed to water was a short but severe one.

W. M., 3 years old, lived in a large suburban home in a newly constructed portion of the city, with ideal conditions for outdoor exercise. The child had not been away from home, and had played with no children except his older sisters. The building of new streets had opened up a spring which filled a pool in the roadside in front of the house, and from this the workmen used to drink, and sometimes also washed their hands in it. One day the child followed their example. There had been clogging of the nearby house sewers eight to ten days before, and the sewage had been pumped from the cellar into the street about 100 feet above the spring. Aug. 4, four days after the child drank from the spring, symptoms of dysentery developed, and he died

in three days. The child was nursed by his father and mother, and the older children frequently came to his bedroom. August 7 the mother and a 6-year-old sister developed dysentery, and the father became ill August 8. All were severely infected, but eventually recovered. The blood from both father and mother developed agglutinins for the Hiss Y-type of dysentery bacillus in dilutions of 1 to 320. This same type was isolated from the father's stool. A careful study was made of the food eaten by the family, and all other possible sources of infection, and the conclusions reached were that the three secondary cases were probably contacts from the baby, and that the baby was infected from drinking the water in the spring. This water was analyzed bacteriologically, August 24. Total bacterial count, 2,700 per c.c. Coli in $\frac{1}{100}$ of a cubic centimeter. Careful search was made for dysentery bacilli, but none were found.

The Shiga Epidemic.—There was one epidemic of dysentery due to the Shiga bacillus which threaded a devious and devastating path through several communities and gave us the best single example of the various modes of transmission of bacillary dysentery.

Baby H. P., 2 years of age, was taken to Lawrence, Mass., July 14, where he was given some icecream. The child developed acute enteritis, July 16, was taken to the Gale Hospital July 19, and died. The father developed diarrhea July 19, the mother July 20, and another child July 22. All were moderately ill, and the father continued to work throughout his illness. Mr. H. P., Sr., was a milker in the R. dairy, which sent almost its entire milk supply to a Fresh Air Home for children in Haverhill. There were about seventy-five children in this summer camp, from 7 to 14 years of age, most of them coming from Boston and vicinity. July 24 the first case of bacillary dysentery developed in the home, and within four days there were twenty more cases, all quite ill. The superintendent at once closed the Fresh Air Home and sent all the children to their homes.

One of the children, L. R., 9 years of age, was sent to her home in Pine Heights, an unsanitary Boston suburb. She was very ill and remained at home only three days, after which she was taken to the Children's Hospital. She remained at home long enough, however, to infect her two sisters, aged 5 and 7 years, and her brother, aged 11 years, who developed symptoms August 3, August 5 and August 6. August 8 all of them were taken to hospitals, the two younger being quite ill. A neighbor had helped in the care of these children, then returned to her home and prepared her husband's supper. August 9 he developed a moderately severe dysentery.

The dejecta from the C. children was thrown down the pit of an open privy without disinfection. August 12, a neighbor's child, L. E., 2 years old, living directly across the street from the C.'s, developed bloody dysentery and died in three days. This family had not come in contact with the C. family, but since flies were so prevalent, both in the E. kitchen and in the C. privy, I believe the infection was carried across the street by flies.

August 12 and 13 three adult neighbors in one family all developed severe diarrhea, which persisted for a few days only. These cases had not been in contact with the C. family and are possible fly infections.

August 20 the baby brother of L. E. developed a moderate diarrhea, but dysentery bacilli were never recovered from his stools. August 21 R. G., a 2-year-old child living next door to L. E.'s, developed bacillary dysentery. He had been playing with L. E. the week before and probably was a contact case. This child was brought to the Floating Hospital, August 25, and died that night. Shiga dysentery bacilli were isolated from his intestinal wall, and from this case our epidemiologic investigation of the Shiga epidemic began, gradually developing the various details that have been described (Charts 4 and 5).

CONCLUSIONS

1. Bacillary dysentery is a readily communicable disease which may be spread in a community by means of contact with an acute case or a carrier, by means of food, as milk, condensed milk and icecream, by water, and by flies.

2. The sporadic summer bacillary dysentery of infants may be transmitted to older children or to adults. Though the disease is severe in the infant, it is usually mild in older children or adults. As a general rule, the older the child, the milder the disease.

3. The dysentery bacilli from the stool of an adult with a mild case of dysentery may produce a rapidly fatal dysentery in infants. Thus the menace of the mild adult case to the community is considerable.

4. Bacillary dysentery is rarely found in a nursing baby.

5. Hospital contact cases are not uncommon. The disease is very readily transmissible by direct contact, and no hospital has a right to admit patients with dysentery unless it can make provision for their isolation.