A SMALL EPIDEMIC OF TYPHOID FEVER IN CONNECTION WITH SPECIFICALLY INFECTED FLIES.

By Major E. W. W. Cochrane.
Royal Army Medical Corps.

The possibility of the spread of infection in enteric fever by flies has been generally acknowledged for some years, but few records are to be found of cases where enteric bacilli have been recovered from infected flies in connection with an outbreak of the disease. Even in the case of infected flies being found it is difficult to state definitely the exact means by which the infection has been carried to the individual. The probability is that food is the medium through which the specific germs reach the person infected; and the article of food which offers the best medium for the growth and multiplication of the bacilli is milk. The chief difficulty in tracing the exact channel of infection in a series of cases of this disease, is that the incubation period is long, i.e., in most cases over ten days, so that investigations cannot be commenced for at least a fortnight after the actual infection has taken place. After this time there will be no remains of the food which has been the actual means of infection, and unless the contamination of food continues to take place it is improbable that infected food will be found. It is therefore difficult to prove the connection between infected flies and cases of the disease, but the finding of the former certainly suggests the source. It has been shown by Graham Smith in a recent Local Government Board Report that the house fly may continue to be infective for at least eleven days after being in contact with specific organisms, and he concludes that with non-spore bearing organisms the infection is carried in the alimentary tract of the fly. The results of experiments as regards the range of flight of flies show that the distance may be as great as 1,700 yds., the direction being determined chiefly by the prevailing wind.

It is proposed to give an account of a small outbreak of eight cases of enteric fever which occurred in April and May, 1911, at St. George's, Bermuda, where the probable carriers of infection were flies, since, on investigation, a focus was discovered in which flies infected by the Bacillus typhosus were found. The following

1 Local Government Board Report, new series, No. 53.
A Small Epidemic of Typhoid Fever

Table shows the cases, their residences, occupations and date of commencement of illness:

1. Child of Captain C., aged 2, residence Kington House, Cut Road; first day of illness, April 15, 1911.
2. Gunner C., 3rd Company, Royal Garrison Artillery, residence No. 4b Royal Barracks; occupation, duty; first day of illness, April 21, 1911; admitted to hospital, April 27, 1911.
3. Gunner T., 3rd Company, Royal Garrison Artillery, No. 4b Royal Barracks; occupation, Groom to Major T.; first day of illness, April 23, 1911; admitted to hospital, April 27, 1911.
4. Miss A. G., residence Belvedere Cut Road; occupation, cook to Major T.; first day of illness, April 24, 1911.
5. Mrs. L., residence 21a, Staff Block Married Quarters; wife of Private L., A.O.C.; first day of illness, May 1, 1911.
6. Miss U. T., age 12, residence Belvedere Cut Road, daughter of Major T.; first day of illness, April 24, 1911.
7. Gunner D., 3rd Company, Royal Garrison Artillery, residence No. 4b, Royal Barracks; occupation, groom to Captain C.; first day of illness, May 2, 1911; admitted to hospital, May 5, 1911.
8. J. T., residence Belvedere Cut Road, son of Major T.; first day of illness, May 8, 1911.

The first case was not seen by a medical officer until April 27, 1911, when a blood capsule was taken and sent to the District Laboratory for a Widal's reaction. The serum gave a positive reaction with B. typhosus, and the case was typical clinically. Blood cultures were made in cases 2, 3 and 4, from each of which the B. typhosus was recovered. Case 5 gave a positive Widal's reaction with the B. typhosus, but was clinically of a mild type. A blood-culture made from Case 7 was sterile, but the Widal's reaction was positive at a later date. Cases 6 and 8 were clinically typical, and their sera reacted with the B. typhosus in high dilutions.

Investigations made at St. George's on April 30, 1911, suggested no definite source of infection for the first four cases, but it was found that there had been a fatal case of enteric in a coloured woman's house (Mrs. P.) near Alexandra Battery in September, 1910, and that in December, 1910, Gunner O., who lived as caretaker in the Battery, contracted the disease. The occurrence of further cases amongst the coloured people in the vicinity of the Cut Road since that date could not be ascertained.

The possibility of the infection of Cases 3 and 4 from Case 1 was carefully gone into, but no connection as regards personal
contact, common food, milk or water supply could be traced. The houses of Major T. and Captain C. are within 200 yds. of one another. The water supply (rain stored in tanks) is distinct. Each officer owned a cow whose milk supplied his household.

At Captain C.'s house there are two dry earth latrines situated close to the house. The buckets were emptied daily by a contractor who buried the night soil in the garden about 100 yds. from the house. Since no particular precautions as regards disinfection of excreta were taken during the early part of the child's illness, there was a possibility of fly infection at this period, and infected flies might have carried germs to Major T.'s house.

The source of infection in Case 2 is difficult to explain. The man occupied the same barrack room as Case 3, but according to clinical observation was infected at least two days before the latter. He had not taken any food or drink in houses on the Cut Road, nor had he been to either officer's house. Since Cases 3 and 4 were probably infected at the same time it is reasonable to assume a common source, and this could only have been at Major T.'s house where his groom had tea, but not other meals.

The infection in Cases 6 and 8 can be directly attributed to Case 4, as the cook was probably infective in the early stages of the disease, and was then preparing their food.

No direct connection could be traced between Case 5 and the other cases. The Staff Block of Married Quarters is within 400 yds. of Major T.'s house.

Case 7 contracted the disease from Case 1, as the excreta of the latter were not disinfected in the early part of his illness.

The theory of food infection by flies had been so strongly advanced here as the means of spread of the disease that this opportunity was taken to see whether any facts could be obtained in support of the theory. On May 3, 1911, five or six flies (the common house-fly *Musca domestica*) were caught at each of the following places, placed in a sterile test tube and numbered:—

No. 1, Major T.'s kitchen. No. 2, Captain C.'s kitchen. No. 3, 3rd Company, Royal Garrison Artillery cookhouse, Royal Barracks. No. 4, Mrs. P.'s washhouse, which is close to the dry earth latrine used by her household.

The position of these places is shown on the accompanying map.

The method of dealing with the flies in the laboratory was as follows:—

The flies from each place were put into 5 c.c. of sterile salt
solution in a test tube, the contents of the test tube were well shaken for a minute, and bile salt broth or "Fawcus medium" plates inoculated from the fluid. These tubes or plates were labelled "external washing," and numbered 1, 2, 3 and 4 respectively. The flies were now emulsified with a glass rod in sterile salt solution, and another series of tubes or plates made and similarly numbered. The growth in the liquid medium was plated out on the following day. The inoculated plates were examined after incubation in the usual manner. The final result was that from Nos. 1 and 2 no suspicious organisms were isolated. From No. 3 "fly emulsion" a non-Gram staining motile bacillus was recovered which
resembled the *B. typhosus* in cultural reactions in sugars, milk, gelatine and peptone solution; morphologically, it was very short, no filaments could be seen and it was more motile than a typical *B. typhosus*, gave a thicker and whiter growth on agar, and did not agglutinate with an antityphoid serum. From No. 4 "external washing" a non-Gram staining motile bacillus was recovered which gave the following reactions:

- Lactose litmus broth: No acidity.
- Saccharose: No acidity.
- Glucose: Acid, no gas.
- Mannite: No indol after six days.
- Peptone solution: No liquefaction in ten days.
- Gelatine: No fluorescence.
- Neutral red agar: Acid, no clot in ten days.
- Litmus milk: Acid, no clot in ten days.

Agglutination tests:

As no immunized animals or specific typhoid serum was available the specific serum was obtained from the patients. The sera of Cases 6 and 8 were found to give the most complete agglutination with the stock *B. typhosus*.

The bacillus under investigation was clumped completely in half an hour in 1 in 30 dilution of these sera as seen under the microscope, and completely sedimented in twenty-four hours in dilutions up to 1 in 180 in capillary tubes. Similar control results were obtained at the same time with the stock *B. typhosus*.

These reactions proved that a true *B. typhosus* had been recovered from the "external washing" of flies caught at Mrs. P.'s house on May 3, 1911. From this it may be concluded that flies at this house had access to some specifically infected matter, and that the organisms were probably carried on their feet or proboscis. Having definitely ascertained that a focus of infection existed at Mrs. P.'s house on May 3, 1911, it is reasonable to assume that this had existed previous to this date, and that infected flies were the probable carriers of infection to Captain C.'s child (Case 1). The distance between Captain C.'s and Mrs. P.'s houses is less than 300 yds. It is possible that Cases 2, 3, 4 and 5 were infected in a similar way from this house, but the infection in Cases 6, 7 and 8 was probably directly from other cases as mentioned above.

As regards the recovery of the *B. typhosus* from the "external washing" of the flies, and the failure to isolate it from the same flies after emulsification, it is possible that the coliform organisms from the intestines outnumbered the former to such an extent that
their isolation was rendered impossible. According to Graham Smith's experiments one would expect to recover the organisms from the "fly emulsion," as he says the infection is carried in the alimentary tract of the fly.

It is interesting to note that the prevailing direction of the wind during April, 1911, was north-east. An east wind would blow nearly directly from Mrs. P.'s to Captain C.'s house.

As soon as it was definitely ascertained that infected flies had been found at Mrs. P.'s house the Civil Medical Officer of Health was informed, and he took steps to have the house and especially the latrine cleaned and disinfected; since then no further cases have occurred in the vicinity.

Attempts were made to get samples of excreta from the occupant's house, but Mrs. P. refused to allow any investigation of excreta or a blood examination to be made.
A Small Epidemic of Typhoid Fever in Connection with Specifically Infected Flies
E. W. W. Cochrane

*J R Army Med Corps* 1912 18: 271-276
doi: 10.1136/jramc-18-03-04

Updated information and services can be found at:
[http://jramc.bmj.com/content/18/3/271.citation](http://jramc.bmj.com/content/18/3/271.citation)

**Email alerting service**

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

**Notes**

To request permissions go to:  
[http://group.bmj.com/group/rights-licensing/permissions](http://group.bmj.com/group/rights-licensing/permissions)

To order reprints go to:  
[http://journals.bmj.com/cgi/reprintform](http://journals.bmj.com/cgi/reprintform)

To subscribe to BMJ go to:  
[http://group.bmj.com/subscribe/](http://group.bmj.com/subscribe/)