

A PROBLEM IN TYPHOID FEVER PROPHYLAXIS AND THE SOLUTION OF SAME.

By EMMETT I. VAUGHN, M.D., DISTRICT PHYSICIAN,
Gatun, Canal Zone.

Member of Department of Sanitation, Isthmian Canal Commission.

A brief description of the topography, inhabitants, and water-supply of the district of Gatun is necessary to enable one to intelligently grasp all the intricacies of a sanitary problem arising in the community. Roughly speaking, the district is bound east and west by ranges of hills, extending north towards the Atlantic Ocean, and on the south joining other ranges that zig-zag in various directions.

Seven miles from the Atlantic, the Gatun Dam extends across the low country connecting the two ranges of hills and entirely cutting off the flow of water, except for one opening, and it is through this that the output of the southern watersheds must find exit. The territory between the high lands presents miles of low marshy ground, intersected by small streams, which join the Chagres River before reaching the opening in the dam. During the months of November and December (our time of greatest precipitation) the streams overflow their banks and miles of territory are submerged anywhere from three to thirty feet. A rise of twenty feet in twenty-four hours has been recorded for the Chagres River, and as the work on the dam progresses the outlet for the water becomes less and less able to provide an adequate exit for the immense volume flowing from the

watersheds. When these floods, as described, subside there remains a residue of small ponds covering all the low territory, and proving excellent haunts for the mosquito.

On the high ground eastward of the dam is located the American town of Gatun, a model of tropical sanitation, provided with sewers, electric lights, modern plumbing, macadamized roads, streets, and all improvements that go to make up a civilized community. One mile north-east of Gatun is located a native town (called New Gatun) containing some 2,300 inhabitants, of which number 1,700 are Commission employees.

The total number of employees of the Isthmian Canal Commission in this district will average 6,900, of which number over 600 are natives of the United States, who occupy the higher class of professional, mechanical and clerical positions. The remaining 6,300 employees may be classed as "laborers," and it is from among these men that nearly all sanitary problems arise. These laborers represent the majority of the ethnological and theological variations of the human race.

All of the West Indian Islands, every Latin country of the Western Hemisphere, every country of southern Europe and every race of western Asia, have furnished their quota. Even Madagascar, Zanzibar, Ashantee, the Punjab and the Soudan have their many-hued denizens wearing the brass check of the Commission laborer.

With the various races, languages and grades of intelligence represented among this body of men, it is easily perceived with what facility epidemics spread, and how difficult they are of control.

The water supply for the district is furnished by the Gatuncilla River, one of the tributaries of the Chagres,

and it is this former stream that has been the chief source of our typhoid infection. A pumping station located on the low-lying banks of the Gatuncilla, about one mile south of the town of Gatun, supplies water to a 500,000 gallon tank, and from this latter it is piped to dwelling-houses, barracks, kitchens, messes, and all parts of the works.

The general preliminary work on the dam commenced during the fall of 1906, and the medical history of the district for the ensuing year was free of typhoid fever. On November 6th, 1907, our first case of typhoid fever was diagnosed, and in rapid succession new cases appeared until by December 26th we had a total of twelve cases—three Europeans and nine West Indians. In about 50 per cent. of these cases the clinical symptoms were so pronounced that there was little difficulty in making a diagnosis. I bring this point out as these cases presented an entirely different symptomatology from those in the succeeding epidemic, one year later.

At this time (1907) the facilities for the manufacture of distilled water were so limited that it was available only for the American employees and their families—the laborers drinking from the water taps or streams direct.

The area of work was, of necessity, spread over such a large territory that only in congested centres of operation were pit-closets in use. In many parts of the field men were defœcating and urinating whenever the spirit moved them, and it was utterly impossible for the foreman to accompany each individual laborer to a closet to make sure that he used it.

If I remember correctly, an analysis of the reservoir or tap water proved negative for *B. Coli*, and at this time

there was almost a complete absence of flies, so that an infection from both drinking water and possible fly contamination were ruled out. Investigation showed that several of the cases diagnosed as typhoid fever had been visiting other stations on the Canal Zone on Sundays and holidays, and as it was ascertained that at some of the towns typhoid fever was present, it was reasonably concluded that these places were the extraneous sources of our local infection.

Investigation into the personal habits of the twelve cases disclosed the fact that nearly all of them had, at different times, been imbibing water from small puddles and ponds adjacent to their work. Further inspection of some of these ponds and puddles, pointed out as drinking places, disclosed faecal matter within short distances and, in one case, a pit-closet situated within ten feet of a much-used pond. From these facts it was reasonable to deduce that there lay the sources of infection of some of the cases.

Acting on the information gathered, steps were immediately taken to destroy the potability of this water by sprinkling crude oil on the surface, increase the number of pit-closets, and augment the supply of distilled water, so that each gang of laborers would have a safe water supply. In addition, every effort was made to impress on the laborers the dangers of drinking water indiscriminately, and the benefit of using only the distilled water. That these measures were in part successful is evinced by the fact that no more cases occurred in the district for one year.

During the period above described the average number of employees at work was about 2,800, and this number remained more or less stationary until the month of

August, 1909, when about 1,000 new laborers were thrown into the district to commence operations on the relocation of the Panama Railroad, which was to extend south from Gatun and traverse the watershed of the Gatuncilla River.

As long as this work was in close proximity to Gatun the men were quartered in cars, and availed themselves of the local pit-closet facilities; but, as the work advanced south, there was a proportionate disregard to the proper use of closets. Pit-closets were installed as rapidly as possible, and every effort made to force the men to use them, but without much success, while the use of distilled water was confined entirely to foremen, who had a day's supply sent out to themselves each morning.

It may be noted here that in the fall of 1907 the heavy rains had flooded the country, draining the watershed of the Gatuncilla, and it was this same water that was used most commonly by the laborers. This watershed area was at that time almost uninhabited, no engineering operations in force, and analyses of the water was negative for B. Coli.

As stated above, with the constantly increasing distance between Gatun and the camps of the railroad laborers, there was a corresponding increase in soil infection, with the result that, by November, 1908, when the heavy rainfall commenced, cases of typhoid fever appeared. Where the first cases originated that infected the watershed, I have never been able to ascertain, but they were probably the result of visits to infected towns.

It is reasonable to believe that, had any of the new laborers been infected on arrival here in August, the cases would have developed in the usual incubation period; but, as actually took place, our first case was reported on

November 6th, 1908, and a new one every third or fourth day thereafter, so that by January 1st, 1909, we had twenty-one recorded.

During the months of November and December we were unable to carry out typhoid prophylaxis to the best advantage because of the immense territory involved, and it was January 1st, 1909, before we had our system in good working order.

Analyses of the reservoir or tap water exhibited *B. Coli* in all samples, while the samples of distilled water taken from condensers, water carts, &c., were all negative. With the assurance that the distilled water was safe, attention was turned to the question of closets and flies.

A list was elaborated giving the location and number of all pit-closets in the district, including those on the railroad relocation, and measures taken to render each closet absolutely fly-proof. In addition to this, a daily disinfection of each closet was carried out—chloride of lime sprinkled over the outside premises, the whole interior washed down with 1-500 Bichloride solution, and crude carbolic poured into the pit. In the meantime dozens of new closets were erected on the line of the railroad, and policemen placed on duty to arrest anyone not using them.

All closets nearer than 100 yards to any kitchen or mess were removed and the site drenched with crude carbolic solution, the wire screening in these buildings examined daily for repairs, and warning notices regarding the accumulation of garbage and fly-breeding issued.

All peddlers exposing food for sale without a fly-proof covering were arrested and their licenses revoked and hundreds of circulars, in English, Spanish and French, warning against the use of impure water, distributed.

The distilled water for the living quarters was distributed by means of sixty-gallon barrels mounted on carts. The barrels were filled at condensers and carried to the various quarters where the water was emptied into the demijohns with which each house was provided. Each morning and evening the drivers of the carts had arms and hands thoroughly disinfected with bichloride solution, their temperatures taken, and exterior of the barrels washed down. In addition to these measures, each day steam at high pressure was turned into the barrels for a period of twenty minutes.

Strict precautions were also carried out in all kitchens and messes, all eating and cooking utensils cleaned with boiled water only, and vegetables usually served raw, such as celery, lettuce, &c., cleaned with distilled water only.

Particular attention was also paid to garbage cans to see that the covers were kept in place, that the cans were properly emptied when full, and all débris on the ground removed.

Investigations were made into the personal history of all members of the kitchen and mess forces and examinations made to determine whether or not bacilli carriers were harboured in these places. Both urine and stool specimens were obtained, and a number of examinations made—all of which proved negative.

January, 1908, produced 17 cases, February and March together 11, and April only one. From these results we believed that we had controlled the epidemic to a certain extent, and therefore, in some directions, relaxed our sanitary measures. During all this time the question of an entirely new general water supply had been agitated, but it was not until the month of May that a safe watershed was agreed upon, plans and estimates made, and work commenced.

The month of May, very much to our surprise, developed eight new cases of typhoid fever, June followed with thirty-five, and July with eighteen. Following the first case in May we immediately returned to all of our previous prophylactic measures and added new features.

About this time hundreds of the laborers, becoming tired of living in Commission quarters, where they were subject to more or less discipline, removed to the native town of New Gatun and installed themselves in rented rooms. In order to do this as cheaply as possible a number would rent a room together and divide the rent.

This resulted in overcrowding, and inspections later disclosed sometimes as many as six or eight men living in a room twelve feet square. Sewage and plumbing had not yet been installed in the town, and each house was provided with one or more of the ordinary pit-closets.

A number of cases appearing in the town, the living methods of the inhabitants were carefully investigated, and it was decided that, under the conditions present, fly contamination as a means for the spread of typhoid fever, was ideal. With this in view, daily inspections of each room in the town were inaugurated on June 17th, and continued until July 17th, and all cases in the slightest manner suspicious, immediately removed and forwarded to the base hospital at Ancon. Each case was considered as a dangerous one and isolated at once as though it were yellow fever or small-pox.

Daily examinations were also made of each individual working in the kitchens, messes, and engaged in carrying water. Temperatures were taken, physical examination made, and on the slightest suspicion of illness of any kind the men were forwarded to a hospital.

In the meantime samples of both distilled and tap

water were being analysed each ten days, and although the tap water continued positive for B. Coli and the distilled negative, yet the latter at times exhibited a high bacterial content, indicating contamination in handling. Whenever we noticed this condition in a sample from a certain cooler or cart steps were immediately taken to ascertain the cause and correct it.

In August the number of cases dropped to three, the last being reported on August 17th, and with the exception of an isolated case on October 2nd, the station has been free of typhoid fever to the date of this writing—December 8th, 1909. The daily inspections of kitchen, mess and water carrier personnel have been discontinued, as also those of living quarters; but analyses of water, disinfection of closets, supervision over the preparation and serving of food, garbage accumulation, and the regime of distilled water, are still in force. The town of New Gatun has now a well-equipped sewage and water system, modern flush closets have been installed in all houses and the old pit-closets demolished, set on fire, and the site disinfected.

The following table gives the list of our cases from November 6th, 1907, to December 1st, 1909:—

	Cases.		Cases.
1907—November ...	7	1909—May ...	8
December ...	5	(<i>contd.</i>) June ...	35
		July ...	18
1908—November ...	10	August ...	3
December ...	11	September ...	0
		October ...	1
1909—January	17	November ...	0
February ...	5		
March ...	6		
April ...	1		
		Total ...	127

It is interesting to note that of these 127 cases there were only six members of the white race—two Americans and four Europeans (Spaniards and Italians). The few cases among members of the white races is attributed to the superior intelligence of these people, which enabled them to grasp the seriousness of conditions and protect themselves accordingly; while, on the other hand, the other races by eating and drinking promiscuously, and taking of their own accord no precautions at all, naturally fell prey to infection.

The most remarkable feature in connection with the epidemic of 1908-09 was the almost entire absence of the characteristic symptoms of typhoid fever in the majority of the cases. On first seeing these cases most of them gave a history of having had a slight malaise for about a week, but with no particular impairment of strength or appetite. Bronchial and abdominal symptoms were, as a rule, absent, and the thermometer usually registered 100° or under.

These cases were, as a rule, retained in the detention camp from twelve to twenty-four hours before they could be transported to the base hospital, and the majority were provisionally diagnosed as malarial fever, though, it is true that quinine taken during their short sojourn with us did not, apparently, have any effect on temperature curves. Many of the cases which exhibited the parasite of Laveran were afterwards, on blood culture, diagnosed as typhoid fever, showing the existence of both infections simultaneously.

At Ancon Hospital the clinical symptoms of the Gatun patients were so unreliable that diagnoses were made only on positive blood cultures of the B. Typhosus, and all cases of fever from this district were treated as "typhoid suspects" until proven otherwise.

The number of employees on duty in the district seemed to have no bearing at all on the number of cases, as evinced by the below data:—

1907—November	...	2,800	...	7
December	...	2,900	...	5
1908—November	...	2,800	...	10
December	...	2,700	...	11
1909—January	...	4,000	...	17
February	...	4,200	...	5
March	...	4,700	...	6
April	...	5,700	...	1
May	...	7,900	...	8
June	...	6,800	...	35
July	...	6,800	...	18
August	...	6,300	...	3
September	...	6,900	...	0
October	...	6,800	...	1
November	...	6,900	...	0

Another interesting feature of the history of these cases, is, that exactly 75 per cent. of the cases dated their illness during the first and last ten days of the month, while 25 per cent. only were taken ill during the middle ten days. Pay-day is invariably on the 15th of each month, and the following week is usually one of great dietary and alcholic excesses on the part of the laborer, and it has been suggested that this may have had some bearing on the incidence of the cases.

A résumé of the various methods of typhoid prophylaxis as used in this district is as follows:—

- a. Provision for an adequate number of pit closets to be installed wherever needed, these to be supplemented by bucket closets and McCall Incinerators in places where the erection of the latter is

practicable. All closets to be disinfected daily and a number in sectional pieces to be kept on hand for immediate use whenever needed. An adequate number of foremen and laborers to supervise all work in connection with the closets.

b. An abundant supply of distilled water for all dwellings, kitchens and messes, together with a proper distribution of condenser plants, so that they will be available for water supply in any part of the works. A close watch to be kept on the handling of distilled water, to eliminate the chances of contamination, between the condenser and the receiver.

c. The prompt isolation of all cases—even those remotely suspicious.

d. Daily inspections of kitchens, mess and water carrier personnel and the prompt removal of any member on indications of illness.

e. Careful supervision of the methods of handling and cooking of all food supplies and the washing of cooking and eating utensils.

f. Daily room to room inspection of all living quarters and the immediate removal of all sick found therein.

g. Analyses of water samples each ten days.

h. Examination of certain suspect cases to determine whether they are "bacilli carriers" or not.

i. Close attention to pit-closet sites, as to their proximity to kitchens and messes.

j. Close supervision by police over food stuffs sold by peddlers, and prompt arrest of anyone violating sanitary regulations.

k. Distribution of posters in several languages, warning the employees of the dangers of using

impure water, and allowing fly-breeding to exist near living quarters.

1. The correct numbering of all houses and rooms therein so as to facilitate the tracing of cases advisable.

The question of anti-typhoid vaccination has not been discussed, for the reason, that, while its full value is realised, yet local conditions would militate against its effective use.

This article has, in no sense, been intended to be of a scientific nature, and all unnecessary technical terms have been omitted. It is simply a recital of a sanitary problem that frequently arises in tropical communities, and relates the steps taken to solve it from the standpoint of the general sanitarian rather than that of the physician dealing with individual cases.

DISCUSSION.

Dr. F. M. SANDWITH said this Paper was exceptionally acceptable to the Society because it came from a small but vigorous band of men who were fighting diseases under the Stars and Stripes. He thought the Fellows present were all authorities on the treatment of typhoid fever, but those who could stamp out an epidemic of this fever rapidly, or prevent its occurrence, deserved much more commendation than those who cured isolated cases.

Major S. LYLE CUMMINS said he could only speak with great diffidence on the matter. His present office, which was concerned with the preparation of a typhoid vaccine, had fixed his attention on the subject of typhoid in a particular manner, and he had only recently had charge