ON THE
PRESENCE OF THE TYPHOID BACILLI
IN THE URINE OF PATIENTS SUFFERING FROM
TYPHOID FEVER

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THE subject of this paper is one of considerable importance, and although in England it has been almost entirely neglected, it has already received some attention from bacteriologists on the Continent.

The first persons to work at the subject were Seitz (1) and Hüppe (2), who, in 1886, both published papers on the subject. They were followed in 1889 by Konjajeff (3), and in 1890 by Neumann (4) and by Karlinski (5), and in 1892 by Silvestrini (6), and lastly, in 1895, by Baart de la Faille (7) and by Dr. Wright (8), Professor of Pathology at Netley.

These observers all stated that in a certain percentage of cases, varying with each observer from $5\frac{1}{2}$ to 100 per

cent., they found the typhoid bacilli in the urine of patients suffering from typhoid fever. Neumann, for example, believed that he found them in eleven cases out of forty-eight examined, Karlinski in twenty-one out of forty-four; while Silvestrini examined seven cases and found them in every one, and in all stages of the disease, and this is practically also the result which Wright obtained, working so late as 1895. This observer examined seven cases, and found the bacilli "easily" in six,—finding them, indeed, in eight out of twelve examinations made. His cases were not examined during the first week, but he had no difficulty in finding the bacilli, which he regarded as typhoid, as early as he looked for them, namely, on the tenth and eleventh days of the disease.

Unfortunately, however, these results, which, if true, would be of extreme importance, cannot be accepted as of much value at the present day, for the simple reason that the observers quoted above had not the means which we now possess for distinguishing the typhoid bacillus from others resembling it, and especially from *Bacillus coli*, a bacillus which is to be found by no means uncommonly in urine. Most of the observers relied on the potato culture as their means of diagnosis, a method which is now entirely set aside, since we now know that many varieties of *coli* grow on potato in what used to be called the "typical typhoid manner."

De la Faille and Wright also, the two most modern observers, though using the three negative tests for typhoid,—the absence of gas formation in dextrose-gelatine cultures, the absence of the indol reaction, and the failure to clot milk,—did not stain the cilia of the bacilli which they regarded as typhoid, though this very important positive test had been introduced as far back as 1892. They did not also prove that their bacilli produced acid, thus failing to distinguish them from Petruchsky's *Bacillus fæcalis alkaligenes*. (9) And lastly, they did not leave their milk and broth cultures for as long as a month before deciding whether no coagulation had oc-

curred, and whether no indol had been formed ; and yet this is a matter of great importance if reliance is placed only on negative tests, for some varieties of *coli* only give these reactions, if indeed they ever give them, after being incubated for three weeks or even longer. They were unable also, of course, to use the serum test, since it had not then been introduced. It is evident, therefore, that we cannot accept as final any statements made by the observers who have so far worked at the subject. They found bacilli in the urine of typhoid patients which somewhat resembled typhoid bacilli ; but whether or not they were so really we cannot say, for the simple reason that the tests applied were insufficient to determine this point. Judging from my own experiments, I should say that sometimes they really were true typhoid bacilli, but that very often they were not.

Considering the importance of the subject, and the fact that we now can with certainty distinguish the typhoid bacillus from others resembling it, I determined to investigate the matter, and to test in all available ways the bacilli which I might obtain, so that I might, once for all, settle the question *whether true typhoid bacilli do appear in the urine, and if so in what quantities, and at what periods of the disease.*

My method was as follows :—Typhoid cases were taken as early in the disease as they could be obtained, and the urine was then examined every second or third day until about a week after the temperature had fallen to normal. The urine was not, as a rule, drawn off by catheter, since it did not seem right to expose the patients to any possible risk, but it was passed direct into a sterilised flask. With one exception male cases only were used, to avoid any contamination from the vulva, and in the one exception, Case 2 of my series, the urine was drawn off by catheter, the orifice of the urethra being first carefully washed with soap and water, and then with carbolic lotion.

The urine having been thus obtained, it was examined as follows:

First, a drop was placed on a slide, allowed to dry, and then stained with gentian violet. It was then examined for bacilli under the microscope.

Secondly, gelatine plates were made. The gelatine was first poured out and allowed to solidify in the plate, and then the urine was dropped on to the surface of the gelatine and smeared all over it. In this way it was insured that all the colonies should be superficial ones—an important point, since a deep typhoid colony would certainly be missed. Two gelatine plates were always made, one containing as a rule one or two drops of urine, and the second about twenty. The exact number, however, of course depended on whether or not bacilli were found in the stained specimen, first made as explained above.

In the first four cases, I may add, some of the urine was set aside and left to incubate at 37° for forty-eight hours, after which plates were made with it. This is the method recommended by Professor Wright, by which he so often found bacilli, which he regarded as typhoid. I may say at once, however, that this method in my hands proved valueless, for *always*, whether the urine had been drawn off by catheter with every precaution, or passed direct into a sterilised vessel, or whether it was incubated alone, or after the addition of carbolic acid, *always* after forty-eight hours it became turbid, *swarmed* with micrococci, and was also often ammoniacal; and I never, as a matter of fact, found the typhoid bacillus in the incubated-urine plates, when I had not already found them in the ordinary unincubated urine. I therefore gave up this additional method.

I felt, however, that even if I made a gelatine plate with twenty drops of urine (*i. e.* about $\frac{1}{2}$ c.c.), and failed to find in it colonies of typhoid bacilli, I was *not* therefore justified in saying that they were necessarily absent altogether from the urine, for the quantity of urine taken might have been too small. I therefore modified slightly

the method which Dr. Klein has invented for water analysis, and adapted it to the urine, and this method I used in the last three cases in addition to making plates with the ordinary urine. The apparatus employed was, of course, carefully sterilised before use.

The method consists in filtering by means of a force-pump about 200 c.c. of urine, which had been obtained as described above, through a Chamberland's bougie, then washing by means of a sterilised brush the micro-organisms and mucus left behind on the bougie into 3 or 4 c.c. of sterilised broth; from this two surface-gelatine plates were made, one with two, the other with fifteen drops of the washing: fifteen drops would correspond to about 750 drops, or about 25 c.c. of the pure urine; hence if no typhoid bacilli were found in a plate made with this large amount of urine, it seemed reasonable to conclude that they were really absent from the urine, and had not merely been missed from examining too small a quantity. [I may state also that it was impossible to take *more* than fifteen drops of the washing, for, as a rule, surface plates made with this quantity were thickly covered with micrococci, and had more been present it would have been impossible to detect a stray typhoid colony.]

I may at once here add that these filtering experiments simply confirmed the results obtained from the plates made with $\frac{1}{2}$ c.c. of urine. When the typhoid bacilli are not found by this method, they are also not found by the more tedious filtration method, for the simple reason that when the bacilli do occur in the urine they occur, as a matter of fact, in considerable numbers.

The plates having been made in the manner described above, they were set aside to incubate at 20°, and were examined after twenty-four, forty-eight, and seventy-two hours. If after this period no colonies resembling *B. coli* or *B. typhoid* had appeared, they were set aside. If, however, any suspicious colonies were seen, they were examined further as follows.

First, a trace of the colony was taken and examined under the microscope unstained. If the microbes proved to be bacilli, even although hardly any movement might be present, a shake culture in dextrose-gelatine and a stroke culture in ordinary gelatine were made. If after twenty-four hours gas had formed in the shake culture, the culture was set aside; if, however, none had formed, further cultures were made in broth and milk, and set aside for one month for the indol and coagulation tests. A culture was also made on agar, and after eighteen hours the motility of the bacilli was examined in a drop of broth. Also the cilia of the bacilli in this culture were stained by van Ermengem's method. Lastly, the serum test was applied.

Supposing, then, a bacillus obtained from the urine of a patient suffering from typhoid fever answered these tests—that is to say, proved to be a *bacillus*, *which often showed long threads, which possessed high motility, which was provided with eight to twelve or more cilia, which, however long kept, did not produce gas in gelatine or dextrose-gelatine shake cultures, while growing well in the substance of these media, which even after one month did not produce indol in broth cultures, nor clot milk, which, however, did produce slight acidity in milk after twenty-four hours, and which, lastly, gave a positive reaction when tested with typhoid serum,—then, and not till then, I think one is justified in saying that it is really the typhoid bacillus. Such has been the method which I have adopted in testing my bacilli, and all those which in this paper are called typhoid have answered correctly to these tests.*

I may add that *they were also pathogenic, for they killed guinea-pigs when injected into the peritoneal cavity, just like typhoid bacilli derived from other sources. Also they were decolourised by Gram's method.*

Results.—The results of my observations on the urine are as follows:—7 cases have been examined, and in all 61 observations have been made. In three cases I have

found the typhoid bacillus in the urine, and in four not. In no case have I found the bacillus before the beginning of the third week of the disease, although 17 observations were made during the first and second weeks. In one case the bacilli did not appear until the thirty-ninth day, although in this case ten observations had been made before this date. On some rare occasions the urine was rendered quite turbid by the numbers of bacilli excreted, but in others not so many were passed, though on eight occasions a drop of urine dried and stained showed the bacilli under the microscope. The urine containing bacilli was in two cases non-albuminous or contained but a cloud of albumen; in the third case, however, it was highly albuminous.

In more detail the results are as follows :

CASE 1.—James C—, aged 18, admitted into St. Bartholomew's Hospital under Dr. Hensley with typhoid fever on the eighth day of the disease. The patient had rather a severe attack. A certain number of rose spots were present, but the rash was *not* copious. Death occurred on the twenty-third day from perforation. A post-mortem showed the usual lesions of typhoid fever, together with perforation and peritonitis. The kidneys after death were engorged, but otherwise natural. The urine was examined first on the thirteenth day, but only micrococci were obtained on the plates. On the fifteenth day, however, typhoid bacilli were found in the drop of urine which had been dried, stained, and examined under the microscope. The number, however, was not very large. Cultures confirmed their presence. The urine was non-albuminous. On the seventeenth day exactly the same result was obtained. The urine was again non-albuminous. After this the number of typhoid bacilli decreased very much in number in the urine, and on the twenty-third day, *i. e.* the day of his death, only a very few colonies were obtained; they proved, however, to be still true typhoid

bacilli. The urine on this day contained a slight cloud of albumen.

CASE 2.—Ellen T—, aged 21, admitted into St. Bartholomew's Hospital under Dr. Gee on the seventh day of her illness. The urine in this case was drawn off by catheter, with full antiseptic precautions.

A very mild case of typhoid fever. The temperature reached normal by the fifteenth day; a few spots were present. The patient recovered without relapse.

The urine was examined on the ninth and twelfth days, and again two days after the temperature had reached normal for good, but no typhoid bacilli were ever found; micrococci were, however, always present, though the urine had been drawn off by catheter with full antiseptic precautions. And I may here mention that this is my invariable experience, namely, that however the urine is obtained, whether antiseptically by catheter or by being passed directly into a sterilised vessel, it always contains, even when unfiltered or incubated, a certain number of micrococci, which have probably come from the urethra. A few *B. coli* were also found in the urine of this case, one of which did not even after one month clot milk, nor give the indol reaction, nor bubble dextrose-gelatine. Its cilia were, however, those of *B. coli* and not those of *typhoid*.

CASE 3.—Frederick James R—, aged 18. In this case the urine was obtained antiseptically from the bladder on the post-mortem table, the patient having died about the twenty-eighth day, not from hæmorrhage or perforation, but apparently from the severity of the disease. Typhoid bacilli were found in the stained specimen, and many typical colonies were obtained on the plates made. The urine was highly albuminous.

At the commencement of his illness the patient had had a fair eruption of rose spots, but the number of spots was not in any way unusual.

Post-mortem.—The autopsy revealed typhoidal ulcera-

tion of the Peyer's patches, but the pure typhoid fever had become complicated by a secondary pyæmic infection. For, in addition to the intestinal lesions, recent endocarditis was present. The kidneys also were large, swollen, and deeply coloured, and showed many small infarcts; some of these latter had also broken down, and had formed small abscesses. The heart's blood was found by Dr. Kanthack to contain typhoid bacilli, but in addition proteus and streptococci. It is evident, therefore, one is not justified in attributing the kidney lesions to the unaided action of the typhoid bacillus.

CASE 4.—John S—, aged 15, admitted into St. Bartholomew's Hospital under Dr. Church on the sixth day of the disease. The patient had a severe attack of the disease, but recovered without relapse. The temperature reached normal by the twenty-first day. There were numerous spots. The urine was examined on the seventh, tenth, thirteenth, fifteenth, eighteenth, and twenty-first days, and also on the twenty-fourth day, that is three days after the temperature had reached normal, but no typhoid bacilli were ever found, only micrococci.

CASE 5.—Thomas P—, aged 18, the most interesting case of all. The patient was admitted into St. Bartholomew's Hospital under Dr. Lauder Brunton with a mild attack of typhoid fever. This ran its course, and the temperature reached normal by the twenty-fourth day. It almost immediately, however, began to rise again, and patient had a relapse, accompanied by a fresh eruption of spots. The latter, indeed, had been very numerous during the attack, and fresh crops kept coming out during the relapse. The temperature did not again reach normal until the forty-first day of his illness, after which it did not rise again. The urine was examined by the ordinary and by the filtration method on the following days:—the tenth, eleventh, thirteenth, sixteenth, nineteenth, twenty-second, twenty-fifth, twenty-seventh, thirty-first, and thirty-fifth

days of the disease, but no typhoid bacilli were ever found. Micrococci were, however, always present, and in the last five examinations a variable though small number of *coli*. Many of these on each day were examined with great care, but they all proved to be *coli*, not *typhoid*. I had by the thirty-fifth day almost given up hope; however, I went on with the case, and was rewarded by observing a most wonderful change which suddenly took place. My next examination was made on the thirty-ninth day of the disease, two days before the temperature reached normal for good at the end of the relapse. I at once noticed on obtaining the urine that whereas it had before been quite clear, on this day it was turbid; and on examining a specimen under the microscope I was astounded to find that it was literally swarming with bacilli. In short, the urine presented very much the appearance of a broth culture of typhoid turbid with growth. Cultures revealed the fact that the bacilli in the urine were, in fact, true typhoid bacilli.

The urine was examined again on the fortieth and forty-first days of the disease, the last being the day on which the temperature reached normal for good. On both of these occasions it was still turbid and contained typhoid bacilli in the stained drop, though not nearly in such large quantities as before.

The temperature had now reached normal for good, but still typhoid bacilli were excreted in the urine. Examinations were made three days, five days, eight days, ten days, thirteen days, seventeen days, and twenty-two days after the temperature became normal; but typhoid bacilli were always found, although in diminishing quantities, in the urine. After this date none were found, and the patient left the hospital. I should mention here that *while the bacilli were being passed the urine was acid, and contained either a faint cloud of albumen or none at all*. There was also never any cystitis.

The bacilli, when stained in the urine, as a rule seemed quite natural. On one occasion, however, they appeared

a little altered, taking the stain most irregularly. This, however, was only temporary, for the micro-organisms in the colonies obtained from them stained as usual, and presented all the characteristics of true typhoid bacilli.

CASE 6.—Alfred F—, æt. 28, admitted into St. Bartholomew's Hospital under Dr. Lauder Brunton. The case was a simple uncomplicated case of typhoid fever; some though not many spots were present. The temperature reached normal on the twenty-second day. There was no relapse.

The urine was examined by the ordinary method, and also by the filtration method on the following days:—the tenth, twelfth, fourteenth, seventeenth, nineteenth, and twenty-first day, and also two days, four days, and eight days after the temperature had reached normal, but no typhoid bacilli were ever found, only micrococci.

CASE 7.—George W—, æt. 19. The patient was admitted into St. Bartholomew's Hospital under Dr. Church. He had a mild attack of typhoid fever. A few spots only were present. The temperature, however, was rather late in coming down; it reached normal only on the twenty-seventh day. The patient then quite recovered without relapse.

The urine was examined on the ninth, eleventh, thirteenth, sixteenth, eighteenth, twentieth, twenty-fourth, and twenty-sixth days of the disease, and also when the temperature has been down two, four, and seven days, but on no occasion were typhoid bacilli found, although on all occasions micrococci were present.

Conclusions.—Such, then, are the results which I have obtained, and which I have arranged at the end in tabular form. These results, I think, justify the following conclusions:

(1) That true typhoid bacilli do occur in the urine in some, though not in all cases of typhoid fever.

(2) That when they do occur they are present in considerable numbers, so that a plate made with $\frac{1}{2}$ c.c. urine is amply sufficient to detect them; more laborious methods, such as the filtration method, being therefore unnecessary. Not uncommonly, also, if a drop of such a urine be dried and stained, the bacilli may at once be seen under the microscope. Occasionally, also, the urine may be rendered turbid by the enormous quantities of bacilli passed.

(3) My experiments also show that when the bacilli do occur they only appear towards the end of the disease,—that is to say, during the third week or later; their presence, therefore, can rarely, if ever, be an assistance in diagnosis. Observers who have discovered them as early as the third day have probably mistaken *B. coli* for them, or possibly Petruschsky's *Bacillus fæcalis alkaligenes*.

Lastly, in view of these facts, I should suggest that some antiseptic should always be added to the urine of typhoid patients as well as to their fæces, this precaution being taken at the present time, so far as I know, only with regard to the latter.

In conclusion, I should wish to thank Dr. Klein for having allowed me to work in his laboratory, and for the interest which he has throughout taken in my work. My thanks are also due to the physicians of St. Bartholomew's Hospital for having so kindly permitted me to make use of their cases.

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Day of disease on which the examination of the urine was made.	Urine, characters of.	Result given by a drop of urine dried, stained and examined under microscope. 0 = no micro-organisms seen.	Plates made with 1 drop and $\frac{1}{2}$ c.c. of the fresh urine. 0 = no typhoid cols. (some micrococci always present).	Plates made from urine incub. for 48 hours at 37°. 0 = no typhoid cols. (micrococci cols. always present).
CASE 1.—J. C—, 18. Death from perforation on 23rd day; temp. never reached normal. Typhoid bacilli excreted from the 15th day onwards	Clear, acid, no albumen idem idem idem Clear, acid, cloud of albumen	0 Many typhoid bacilli Many typhoid bacilli 0 0	0 Many typhoid cols. Many typhoid cols. 0 A few typhoid cols.	0 Many typhoid cols. Many typhoid cols. 0 A few typhoid cols.
CASE 2.—E. T—, 21. A very mild case; temp. normal by 15th day. Recovery. Typhoid bacilli never found	Clear, acid, no albumen Clear, acid and faint cloud of albumen Clear, acid, no albumen	0 0 0	0 0 (2 Coli colonies) 0	0 0 0
CASE 3.—F. J. R—, 18. Urine obtained antiseptically at the autopsy, v. text. Many typhoid bacilli found	Highly albuminous	Many typhoid bacilli	Many typhoid cols.	Many typhoid cols.
CASE 4.—J. S—, 15. Severe but straightforward case; temp. reached normal on 21st day. Recovery. Typhoid bacilli never found	Clear, acid and faint cloud of albumen idem Clear, acid, no albumen idem Clear, neutral, no albumen Clear, acid, no albumen Clear, faintly alkaline, no albumen	0 0 0 0 0 0 0	0 0 0 0 0 0 0	0 0 0 0 0 0 0

						Plates made from the sediment left on bougie after filtration. 0 = no typhoid cols (micrococci cols. always present). — = method not employed.	
						The attack.	The relapse.
CASE 5.—T. P.—, 18. A mild attack of fever followed at once by a mild relapse. The temperature reached normal only on the 41st day of the disease. Complete recovery. Typhoid bacilli excreted from the 39th day until the temp. had been normal for 22 days	10th	Clear, acid, no albumen	0	0	0	0	—
	11th	Clear, acid, faintest trace of albumen	0	0	0 (1 Coli col.)	0	—
	13th	Clear, acid, faint cloud of albumen	0	0	0	0	—
	16th	Clear, acid, faintest trace of albumen	0	0	0	0	—
	19th	Clear, acid, faintest trace of albumen	0	0	0	0	—
	22nd	Clear, acid, faint cloud of albumen	0	0	0 (several Coli cols.)	0 (many Coli)	—
	25th	Clear, acid, no albumen	0	0	idem	idem	—
	27th	Clear, acid, faint cloud of albumen	0	0	0 (4 Coli cols.)	idem	—
	31st	Clear, acid, thickish cloud of albumen	4 small bacilli seen, probably coli	0	0 (many Coli cols.)	idem	—
	35th	Clear, acid, distinct cloud of albumen	Crowded with typhoid bacilli	0	Innumerable typhoid cols.	—	—
	39th	Turbid with typhoid bacilli, acid, distinct cloud of albumen	Many typhoid bacilli	0	Many typhoid cols.	—	—
	40th	idem	Many typhoid bacilli	0	Many typhoid cols.	—	—
	41st	Slightly turbid, faintly alkaline, no albumen	Many typhoid bacilli	0	Many typhoid cols.	—	—
	Temp. down 3 days	Clear, neutral, faint cloud of albumen	Very many typhoid bacilli	0	Many typhoid cols.	—	—
	5 "	Clear, acid, no albumen	0	0	Many typhoid cols.	—	—
	8 "	Turbid with bacilli, faintly alkaline, faint trace of albumen	Very many typhoid bacilli	0	Innumerable typhoid cols.	—	—
	10 "	Clear, faintly alkaline, no albumen	0	0	Many typhoid cols.	—	—
	13 "	Clear, acid, no albumen	0	0	Many typhoid cols.	—	—
	17 "	idem	0	0	Many typhoid cols.	—	—
	22 "	idem	0	0	0 (1 Coli col.)	—	—
							A few typhoid cols. (also a few Coli).

Day of disease on which the examination of the urine was made.	Urine, characters of.	Result given by a drop of urine dried, stained, and examined under microscope. 0 = no micro-organisms seen.	Plates made with 1 drop and $\frac{1}{2}$ c.c. of the fresh urine. 0 = no typhoid col. (some micrococci always present).	Plates made from the sediment left on bougie after filtration. 0 = no typhoid col. (micrococci col. always present). — = method not employed.
CASE 6.—A. F.—, 28. Mild case; temp. reached normal on 22nd day. No relapse. Recovery. Typhoid bacilli never found	10th Clear, acid, faintest trace of albumen	0	0	—
	12th Clear, faintly alkaline, faintest trace of albumen	0	0	0
	14th Clear, faintly alkaline, no albumen	One small mass of short thick bacilli, not typhoid	0	0 (2 col. of short thick bacilli—not typhoid or Coli).
	17th Faintly alkaline, no albumen, slightly turbid with phosphates	0	0	0
19th Clear, no albumen, faintly alkaline	idem	0	0	0
21st Temp. down 2 days	Clear, no albumen, neutral	0	0	0
5 days	Faintly alkaline, no albumen, turbid with phosphates	0	0	0
8 days	Slightly alkaline, no albumen, turbid with phosphates	0	0	0

CASE 7.—G. W—, 19.	9th	Clear, acid, no albumen	0	0	0
A mild case, but temp.	11th	"	0	0	0
came down to normal	13th	"	0	0	0
only on the 27th day.	16th	"	0	0	0
No relapse. Recovery.	18th	"	0	0	0
Typhoid bacilli never	20th	"	0	0	0
found	24th	"	0	0	0
	26th	"	0	0	0
	Temp. down				
	2 days	"	0	0	0
	4 days	"	0	0	0
	7 days	"	0	0	0

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,'
Third Series, vol. ix, p. 55.)

DESCRIPTION OF PLATE XX.

On the Presence of the Typhoid Bacilli in the Urine of Patients suffering from Typhoid Fever (P. HORTON-SMITH).

FIG. 1.—The urine passed by Case 5 on the thirty-ninth day of the disease.

A drop of the urine was taken soon after it was passed, evaporated to dryness, and stained with gentian violet. $\times 400$.

Innumerable typhoid bacilli are seen in it.

FIG. 2.—From the same preparation as Fig. 1, but more highly magnified. $\times 1000$.

(Photographed by E. C. Bousfield, Esq.)

FIG. 1.

FIG. 2.

DESCRIPTION OF PLATE XXI.

On the Presence of the Typhoid Bacilli in the Urine of Patients suffering from Typhoid Fever (P. HORTON-SMITH).

FIG. 1.—The urine passed by Case 5 three days after the temperature had fallen to normal for good.

A drop of the urine was taken soon after it was passed, evaporated to dryness on a cover-glass, and stained with gentian violet. $\times 400$.

Many typhoid bacilli are still seen.

FIG. 2.—The urine passed by Case 5 eight days after the temperature had fallen to normal for good. Specimen prepared in the same way as Fig. 1. $\times 400$.

Many typhoid bacilli are still present.

(Photographed by E. C. Bousfield, Esq.)

FIG. 1.

FIG. 2

DESCRIPTION OF PLATE XXII.

On the Presence of the Typhoid Bacilli in the Urine of Patients suffering from Typhoid Fever (P. HORTON-SMITH).

FIG. 1.—The urine passed by Case 1 on the seventeenth day of the fever.

A drop of the urine was taken soon after it was passed, evaporated to dryness on a cover-glass, and stained with gentian violet. $\times 400$.

A fair number of typhoid bacilli are seen.

FIG. 2.—A specimen showing the cilia of the typhoid bacilli obtained from the urine of Case 3 (twenty-eighth day of the disease).

Prepared by Van Ermengem's method. $\times 1000$.

The cilia are typically typhoidal.

This specimen would represent equally well also the cilia of the typhoid bacilli obtained from Cases 1 and 5. In all cases the cilia were exactly like those represented in this figure, and were thus typically typhoidal.

(Photographed by E. C. Bousfield, Esq.)

FIG. 1.

FIG. 2.