ON THE PRESENCE OF THE TYPHOID BACILLUS IN THE URINE.*

BY MARK WYMAN RICHARDSON, M.D., BOSTON, MASS.

(From the Pathological Laboratory of the Massachusetts General Hospital.)

The fact that the urine of individuals sick with typhoid fever may, at times, contain the specific organism of the disease has, during the past decade, occupied the attention of a considerable number of observers. The results obtained, and the conclusions drawn, are briefly as follows:

Bouchard,† in 65 cases of typhoid fever, found in the urine no bacteria and no albumin in 44. In 21 cases there were bacteria, and these were always associated with albumin. They were bacilli and were assumed to be typhoid organisms.

Hueppe ‡ succeeded in obtaining the typhoid bacillus from the urine in only one out of 18 cases.

Seitz § obtained positive results in 2 out of 7 cases. The urine of both positive cases showed albumin, and in one case also casts. The organisms, when found, were present in large numbers.

Konjajeff ¶ found typhoid bacilli in the urine of 3 out of 20 cases. Albumin was present in only one of these positive cases. The organisms appeared generally in the later stages of the disease (third week), and were always in large numbers. He thinks that the presence of the bacilli is always associated with the so-called typhoid lymphomata in the kidney.

Karlinski †† examined the urine in 38 cases in which the symptoms were those of typhoid and where the specific bacilli had been cultivated from the stools. He also examined bacteriologically the bladders at 6 typhoid autopsies. Out of these 44 cases the typhoid bacillus was isolated in 21, and was always associated with albuminuria. When found...

* A partial report of investigations carried on under the provisions of the Dalton scholarship at the Massachusetts General Hospital.
† Bouchard, Rev. de méd., 1 (1881), 671.
‡ Hueppe, Fortsch. der Med., iv (1886), 448.
¶ Konjajeff, Ref. in Centrbl. f. Bakt., vi (1889), 672.
†† Karlinski, Prag. med. Woch., xv (1890), 437 and 432.
the bacillus was always in pure culture. K. claimed to have obtained a positive result as early as the third day of the disease.

H. Neumann * out of 48 cases obtained positive results in 11. He found the bacilli always in large numbers, but thought he probably failed to detect them when their number was small. In his experience albumin was not necessarily an accompaniment of the bacilli. Moreover, albumin was often present without bacilli. Furthermore, Neumann pointed out the fact that typhoid bacilli can reproduce themselves rapidly, even in an acid urine, and that the bladder, with its constant supply of fresh urine, offers a peculiarly favorable place for the multiplication of the organisms. The prognosis was not necessarily worse in consequence of the presence of the bacilli in the urine. Neumann made the important statement, also, that the typhoid organisms may persist a considerable time after the cessation of fever, and that the urine of typhoid convalescents ought, therefore, to be subject to very careful supervision. He thought the bacilli were finally removed mechanically. In some cases cocci were found, and these were supposed to indicate a complication.

Geisler,† from a review of the literature, concluded that typhoid bacilli could be isolated from the urine in about 26 per cent of the cases.

Borges ‡ obtained positive results in 2 out of 10 cases. In both cases there was albumin in the urine. B. thought that the albumin and the bacilli disappeared together. In one-half of the cases there was evidence of pathological change in the kidneys, whereas in only one-fifth of the cases were there bacilli.

Baart de la Faille § obtained typhoid bacilli in the urine of 4 out of 27 cases. In 4 other cases he found colon bacilli.

G. Blumer || found pus in the urine in 10 out of 60 cases, and this pus was always associated with bacteria. The colon bacillus was present 7 times, 6 times alone and once together with the typhoid bacillus. The typhoid bacillus was found twice, once with the colon bacillus and once alone. The staphylococcus pyogenes albus appeared in one case, and in another an unrecognized coccus was observed. Blumer thought the bacteria reached the bladder perhaps through the recto-vesical wall.

---

* Neumann, Berlin, klin. Woch., xxvii (1890), 121.
† Geisler, Ref. in Centralbl. f. Bakt., xiii (1893), 707.
‡ Borges, Ueber die Durchlässigkeit der Typhusniere für den Bacillus typhi abdominalis. Inaug.-Diss., Würzburg, 1894.
|| Blumer, Johns Hopkins Hospital Reports, v (1895), 327.
The pus in the urine he considered important only because of its possible association with the typhoid bacillus, and therefore recommended that the patients should be kept in the hospital till the pus had disappeared.

Wright * had the unusually good fortune to find typhoid bacilli in 6 out of 7 cases.

Besson † examined the urine of 33 typhoid patients and obtained typhoid bacilli in 6. In 12 urines containing only slight traces of albumin bacilli were found but once. In 12 cases with considerable amounts of albumin the bacilli were present in 5.

As we look over the writings of these observers we find that the following general facts were brought out by their work:

(1) The typhoid bacillus was demonstrated in the urine of typhoid patients in about 25 per cent of the cases.

(2) The bacilli, when demonstrated, were present nearly always in large numbers and, in the great majority of cases, were associated with albuminuria. On the other hand considerable amounts of albumin were often present in the urine without bacilli.

(3) The organisms appeared generally in the later stages of the disease, but, having appeared, they might persist for a considerable time into convalescence.

These conclusions, then, represent in the main the results obtained up to the year 1898.

Of course we must take into consideration the fact that in the early days of the literature relating to the typhoid bacillus the positive identification of this bacillus was much more uncertain than at present, and that confusion of the typhoid organism with other bacilli, especially those of the colon group, must have occasionally taken place. We must, therefore, view with some suspicion such results as those of Karlinski, ‡ who obtained positive results in 50 per cent of his cases, and that, too, in very early stages of the disease. On the other hand the results of Wright § were no less unusual (6 positive

---

* Wright, Lancet, 1895, ii, 196.
† Besson, Rev. de méd., xvii (1897), 405.
‡ Karlinski, loc. cit.
§ Wright, loc. cit.
cases out of 7), although, in this instance, the more important of the modern differential tests were used.

The following details of my own investigations and results will be found to confirm substantially the conclusions stated above.

The methods employed in the work were briefly these: In the case of male patients (by far the larger number) the glans penis was first thoroughly cleansed with corrosive sublimate solution 1:1000. The urine was then passed in two portions into sterilized test tubes. Only the second portion was used for bacteriological purposes. The female patients were catheterized with all possible antiseptic precautions, and in these cases also only the second part of the urine was used.

The urine obtained in this manner was then plated, with as little delay as possible, upon plain agar. Two plates were made for each specimen, one representing a single loop of urine and the other 1 cc. (approximately). After being left for 18 to 24 hours in the incubator the plates were examined under a low power of the microscope (Zeiss AA or Leitz No. 3).

It might be thought that difficulties similar to those encountered in making cultures from the stools might be met with also in the case of the urine, and that, therefore, a differential medium, such as that of Elsner, Capaldi or Hiss, would be necessary in this work. But it has been found that in nearly all cases we have to do with but a single organism (rarely two or three), so that ordinary media answer our purpose perfectly well. The colon colonies are, naturally, the ones most easily mistaken for the typhoid, but a little experience makes it possible to tell them apart.

In cases of doubt I have made use of the following procedure with great satisfaction as a preliminary test: If we examine closely the rent in a typhoid colony, which we make in the process of inoculation with the platinum needle, we can see oftentimes, even with the low power, a marked seething motion resembling very much that of a swarm of bees. This phenomenon is due, of course, simply to the setting free of the very motile bacilli, and becomes much more evident with a higher power of the microscope (Zeiss DD or Leitz No. 7). The amount of motility varies in different colonies, but it is very
rare that one is not enabled by this procedure to say whether the organism is or is not actively motile. In my experience with typhoid urine and faeces, motile bacteria of other varieties have not been sufficiently numerous to invalidate the procedure as a preliminary test.

The cultures of cocci isolated during the work were examined only as to their shape and arrangement. The typhoid and colon cultures were subjected to the following differential tests:

1. Hanging drop for size, shape and motility.
2. Growth upon gelatin slant and in stab cultures.
3. Growth upon the tube medium of His<sup>*</sup> for the presence or absence of general clouding and gas production.
5. Growth upon potato. Presence or absence of visible growth.
6. Growth in the two test solutions of Proskauer and Capaldi.
8. Reaction to typhoid serum.<sup>†</sup>

Coming now to a presentation of the results of the investigation we find that 172 specimens of urine, representing 38 cases of typhoid fever, were examined. Of these 172 specimens 44, representing 9 cases, showed the presence of typhoid bacilli. In 2 cases, one positive and the other negative as far as the presence of the typhoid organism was concerned, the urine was examined first at autopsy (Cases II and XXI).

The following tables give the results in detail. The numbers refer to the day of the disease as nearly as it could be calculated from the history.<sup>‡</sup>

*<sup>Journal of Experimental Medicine, ii (1897), 677.</sup>
†<sup>In carrying out this test I have always made use of the dried serum, or "serum paper," described by me in the Centralbl. fur Bakt., xxi (1897), 445. The paper is now 14 months old and shows no appreciable decrease in its agglutinating power. It is certainly a most convenient form for preserving the test for laboratory use, especially in localities where typhoid cases are scarce, and where, therefore, fluid serum is not always to be had.</sup>
‡<sup>I am indebted to the records of the Massachusetts General Hospital for my information as to the presence or absence of casts, and as to the clinical features of the cases.</sup>
### Table I. Cases I to IX.—Positive Cases.

<table>
<thead>
<tr>
<th>Number of case</th>
<th>Cultivations made from urine.</th>
<th>Typhoid bacilli found.</th>
<th>Albumin present.</th>
<th>Casts.</th>
<th>CLINICAL FEATURES.</th>
<th>Remarks.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I M 38.42.47.54, 59.63.67.70.72 78</td>
<td>38.42.47.54 59.63.67.70.72 78</td>
<td>38.42.54.59 63.67.70.78 always in faint traces.</td>
<td>8 = no casts. No record thereafter.</td>
<td>+ 0 0</td>
<td>0 pneumonia 0 pyelitis 0</td>
<td>In relapse a pneumonia. Typhoid bacilli in sputum 44th, 47th, 49th days. Phlebitis 28th day. On 33rd day symptoms of perforation. Operated upon. Died same night. During convalescence urine averaged 70 ozs. daily. Catheterized upon 15th day.</td>
</tr>
<tr>
<td>II M 34</td>
<td>34</td>
<td>5 = faint trace</td>
<td>15 = present.</td>
<td>+ + + +</td>
<td>0</td>
<td>24 to 27 56 72</td>
</tr>
<tr>
<td>III M 23.25.28.33 41</td>
<td>23.25.28</td>
<td>33.38</td>
<td>3.19.29</td>
<td>+ 0 0 0</td>
<td>0 27 0</td>
<td>44</td>
</tr>
<tr>
<td>IV F 33.38.43.33</td>
<td>33.38</td>
<td>33.38.43 = very faint traces. 41 = present.</td>
<td>20.26.28 = present.</td>
<td>0 + 0 0 0</td>
<td>40 0 55</td>
<td></td>
</tr>
<tr>
<td>V M 20.30.36.40</td>
<td>30.36</td>
<td>30.36.40 = faint traces.</td>
<td>10 = present.</td>
<td>0 + + +</td>
<td>very slight.</td>
<td></td>
</tr>
<tr>
<td>VI M 8.11.15.30.35 27.30.31.33 34.36.37.39.43.66</td>
<td>15.20.25.27 20.31.33.34 34.36.37.39.43.66 = faint trace.</td>
<td>8.11.15.25 = a trace.</td>
<td>30 = absent.</td>
<td>+ 0 0 0</td>
<td>+ 19 0 43</td>
<td>Furunculosis. Cultivation showed staphylococci aureus in pure culture. Catheterized on the 14th and following days. Epididymitis on the 45th day. Urine during last week in hospital averaged 80 ozs. daily.</td>
</tr>
</tbody>
</table>
### TABLE II.—NEGATIVE CASES. CASES X TO XXXVIII.

<table>
<thead>
<tr>
<th>No.</th>
<th>Number of case.</th>
<th>Sex.</th>
<th>Cultivations made from urine.</th>
<th>Bacteria found.</th>
<th>Albumin present.</th>
<th>Cases.</th>
<th>CLINICAL FEATURES.</th>
<th>REMARKS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X F</td>
<td>49.</td>
<td>0</td>
<td>49 = large trace.</td>
<td>11.16 = present.</td>
<td>0 + 0 + 0</td>
<td>27</td>
<td>42 to 53</td>
<td></td>
</tr>
<tr>
<td>XI M</td>
<td>24.32</td>
<td>0</td>
<td>34.32 = 0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>XII M</td>
<td>18.23.36.31</td>
<td>0</td>
<td>18.23.36.31.40</td>
<td>54.65 = 0</td>
<td>0</td>
<td>0</td>
<td>28 to 79</td>
<td>58</td>
</tr>
<tr>
<td>XIII F</td>
<td>16.30.23</td>
<td>0</td>
<td>16.30.23.35 = a</td>
<td>8.28.33 = present.</td>
<td>+ + 0 0 + 0</td>
<td>30</td>
<td>62</td>
<td>Catheterized for a considerable time.</td>
</tr>
<tr>
<td></td>
<td>35.40.48</td>
<td></td>
<td>diplococcus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40.48 = colon bacillus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XIV M</td>
<td>14.26</td>
<td>0</td>
<td>14.26 = 0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>35</td>
<td>Phlebitis on 39th day.</td>
</tr>
<tr>
<td>XV M</td>
<td>26.38.45</td>
<td>0</td>
<td>26.38.45.54.57</td>
<td>18.29 = 0</td>
<td>0</td>
<td>0</td>
<td>70</td>
<td>78</td>
</tr>
<tr>
<td>XVI M</td>
<td>15.29</td>
<td>0</td>
<td>15.29 = 0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>24 to 31</td>
<td>53</td>
</tr>
<tr>
<td>XVII M</td>
<td>15.18.19.31</td>
<td>0</td>
<td>15.18.19.31.38</td>
<td>18.19.31 = a</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>38 = streptococcus</td>
<td></td>
<td>18.19.31.38 = 0</td>
<td>38 = colon bacillus.</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XVIII M</td>
<td>24.45</td>
<td>0</td>
<td>24.45 = 0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>48</td>
</tr>
<tr>
<td>XIX M</td>
<td>20.25.33</td>
<td>0</td>
<td>20.25.33.37.40</td>
<td>20.25.33.37.40</td>
<td>0</td>
<td>0</td>
<td>28</td>
<td>Pulse reached 147 at one time.</td>
</tr>
<tr>
<td></td>
<td>37.40</td>
<td></td>
<td>a diplococcus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XX M</td>
<td>24.31.39</td>
<td>0</td>
<td>8.24.31 = 0</td>
<td>8.24.31 = 0</td>
<td>0</td>
<td>+</td>
<td>28</td>
<td>Culture made from bladder at autopsy. A very severe case with high fever and pulse rate.</td>
</tr>
<tr>
<td>XXI M</td>
<td>38</td>
<td>0</td>
<td>39 = ft. trace.</td>
<td>25 = very faint trace.</td>
<td>0</td>
<td>0</td>
<td>Died 38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25 = present.</td>
<td></td>
<td>25 = present.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXII M</td>
<td>24.32.38</td>
<td>0</td>
<td>24 = faint trace.</td>
<td>0</td>
<td>+ 0 0 + 0</td>
<td>20</td>
<td>44</td>
<td>Catheterized on 18th day.</td>
</tr>
<tr>
<td></td>
<td>24 = colon bacillus.</td>
<td></td>
<td>9.16.24.33 = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXIII M</td>
<td>9.16.24.33</td>
<td>0</td>
<td>9.16.24.33 = 0</td>
<td></td>
<td>0</td>
<td>+</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXIV M 29.27</td>
<td>0</td>
<td>20.37 = 0</td>
<td>0</td>
<td>30</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXV M 19.31</td>
<td>0</td>
<td>10.21 = 0</td>
<td>0</td>
<td>31</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXVII M 42.45</td>
<td>0</td>
<td>33.42 = 0</td>
<td>0</td>
<td>35</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXVIII M 18.23.37</td>
<td>18.23.37.34.41</td>
<td>15.18.23.37 = faint trace.</td>
<td>15 = present.</td>
<td>+ 0</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXIX M 18.22.25</td>
<td>32.36</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXX M 33.35.32</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXI M 21.35.31.33</td>
<td>21.35.31.33.39</td>
<td>21.35.31.33.39 = faint trace.</td>
<td>21 = present.</td>
<td>0</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXII M 34.38.50</td>
<td>34.45.36</td>
<td>34.45.36</td>
<td>34.45.36</td>
<td>45</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXIII M 13.15.17.27</td>
<td>13.15.17.27</td>
<td>13.15.17.27 = faint trace.</td>
<td>39 = present.</td>
<td>0</td>
<td>56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXIV M 25.36.51</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXV F 24</td>
<td>24 = colon bacillus</td>
<td>24 = colon bacillus</td>
<td>24 = colon bacillus (autopsy).</td>
<td>+ + + +</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXVI M 9.13.30.34</td>
<td>9.13.30.34.49</td>
<td>9.13.30.34.49 = faint trace.</td>
<td>49 = present.</td>
<td>+ 0 0 0</td>
<td>37 0 52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXVII M 15.19.34</td>
<td>15.19.34.49</td>
<td>15.19.34.49 = faint trace.</td>
<td>48 = present.</td>
<td>0 0 0 0 0 36 0 50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXVIII M 33.38.43</td>
<td>33.38.43</td>
<td>33.38.43 = faint trace.</td>
<td>30 = present.</td>
<td>0 0 0 0 0 43 0 71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From an examination of the table of positive cases (I to IX) we see that, in 5 out of the 9, the bacilli were found on the first day of cultivation. How much earlier they may have been present it is, of course, impossible to say. The other 4 positive cases, although examined from a comparatively early period of the disease, showed no bacilli until the 15th, 24th, 32nd and 36th days respectively. The invasion of the urine by the typhoid organism seems to be, therefore, a late rather than an early occurrence. For this reason the examination of the urine bacteriologically for the purpose of diagnosis would seem to have but little value as compared with the specific serum test. All the cases under consideration showed at some time during the disease the so-called Widal serum reaction.

A more important point, and one to be very strongly emphasized, is the length of time that the bacilli may persist in the urine after its infection. Of the 9 positive cases 7 survived the disease and were discharged as well. In 5 of the 7 cases, however, the urine still contained, upon the day of discharge from the hospital, typhoid bacilli in undiminished numbers. This fact would be, perhaps, of less importance if each loop of urine harbored one or two bacilli, but when it is considered that in most cases a single loop contained many hundreds, or even thousands, of organisms, then the matter assumes an entirely different aspect, especially when viewed in its relation to disinfection and the public health. Modern sanitary regulations forbid that diphtheria patients in whose throats Klebs-Löffler bacilli persist shall be suffered to go abroad. Is it not just as important that there shall be a similar supervision of convalescent typhoids, who may be passing with every micturition pure cultures of the typhoid bacillus?

These patients were given careful instruction as to the disinfection of their urine and were urged to send weekly specimens for further examination; but, as so often happens, they have carried out these instructions very unsatisfactorily. In 2 cases the urine 10 days subsequent to discharge still showed bacilli. In another case after a similar interval the organisms had disappeared. Two cases have yet to be heard from. It is, therefore, impossible to say just how long
the bacilli may persist in these typhoid urines, but it is evident that
they remain long enough to make the infected individuals a source
of danger to those in their environment.

Neumann thought that the bacilli were finally removed mechani-
cally. Assuming, as seems probable, that the large number of
bacilli is due, not to excretion as such by the kidney, but to rapid
multiplication in the bladder, it would seem that the post-febrile
polyuria, with frequent and copious micturition, would, in the end,
tend to eliminate the organisms entirely. This theory would explain,
perhaps, the disappearance of the bacilli in Case VII. On the other
hand Cases III and IX averaged during convalescence 70 and 80
ounces of urine daily, without, however, any apparent diminution in
the number of bacilli. Nature does not, therefore, provide properly
for this condition. Can we, by any method of treatment, render these
cases innocuous?

My experience upon this point is confined to observations upon a
single case (VI), in which the bladder was washed out with antiseptic
solutions. At first boric acid was tried in the strength of 2 per cent,
but, although the solution was retained for 2 or 3 hours, no effect
upon the bacilli could be observed. Finally corrosive sublimate
1:7000 was injected, and although the fluid was passed out again
almost immediately, no bacilli could be discovered during the 30 days
following. It would seem, therefore, that in antiseptic irrigation of
the bladder we have a possible means of freeing these cases of their
dangerous character. Whether a like result can be obtained by the
internal administration of salol or other similar drugs must be deter-
mained by further observation.

From a further examination of Table I it will be seen that 3 of
the positive cases had been catheterized early in the disease. This
offers the possibility, of course, of a typhoidal infection from without.
The fact, however, that in these cases the bacilli were always found
in pure culture and unaccompanied by colon bacilli or other bacteria
would, as it seems to me, speak almost certainly for their internal
origin.

Case IX is especially interesting as having developed during con-
valessence an epididymitis. A venereal origin, gonorrhoeal or other- 
wise, was entirely improbable from the history, and the most plausible 
theory was that the affection of the epididymis was typhoidal in char-
geracter, having its origin in the infected urine. The inflammation sub-
sided without surgical interference, so that conclusive bacteriological 
investigation was impossible.

To proceed with the analysis of the tables, we find that the presence 
of bacilli in the urine was practically always accompanied by albu-
minuria, but that in nearly all the cases the amount of albumin was 
small, in only one case reaching \( \frac{1}{2} \) per cent.

Of the 29 cases in which the urine was negative, so far as typhoid 
bacilli were concerned, 15 had albumin in the urine, and that, too, 
in amounts larger, on the average, than those containing the typhoid 
organisms (XXXII, \( \frac{1}{2} \) per cent; XXXV, \( \frac{1}{4} \) per cent).

As to the presence or absence of casts, they were found in all albu-
minous urines except those of Cases I and VIII. The record of 
Case I is decidedly incomplete, however, and it is more than probable 
that casts were present at some time during the disease.

No parallel can be drawn, therefore, between the presence of 
albumin and casts and the presence of typhoid bacilli in any urine. 
On the other hand we can say that a non-albuminous urine very 
probably contains no typhoid bacilli. Case III was the only excep-
tion in this series, showing no albumin upon the 41st day in the 
presence of many typhoid organisms. Furthermore, Case VII dem-
onstrates the fact that albumin can persist after the disappearance of 
the bacilli.

Of the 29 cases in which no typhoid bacilli were found, 8 showed 
bacteria of other kinds. Of these 8 cases, 4 (XVII, XIX, XXVIII, 
XXXV) may be assumed to have derived their organisms from within 
the body. In the other 4 cases (XIII, XXII, XXVI, XXXII) the 
bacteria may have been of external origin (catheterization, operation). 
In these 8 cases a diplococcus (not further identified) was found in 2 
(XIX, XXVIII); colon bacilli alone in 4 (XXII, XXVI, XXXII, 
XXXV); a diplococcus followed by colon bacillus in one (XIII); a 
streptococcus followed by colon bacillus in one (XVII). The colon
bacilli presented no special points of interest except that isolated from Case XXVI. This organism was moderately motile, and grew upon litmus-milk, potato, gelatin and sugar-agar in a manner exactly similar to that of the typhoid bacillus. It might, therefore, according to criteria in vogue previous to 1890, have been called the typhoid organism. It was found, however, that upon peptone solution the bacillus produced immense amounts of indol; that it failed to react to typhoid serum; that it grew with acid reaction upon solution No. 1 of Proskauer and Capaldi, and that it failed to produce general cloudiness upon the tube medium of Hiss. This organism illustrates, then, forcibly the point referred to above, namely, that the results of investigations made in the eighties must be taken with a certain amount of reserve.

Cystitis was present in 7 cases and, with one exception (V), was always associated with bacteria and with a history of catheterization or operation. On the other hand the urine of 11 cases contained many bacteria with no evidence of cystitis.

In a general way the cases which showed typhoid bacilli in the urine were of a more severe type, as evidenced by the clinical course and mortality. Especially to be noted is the tendency to relapse and complication (I and IX).

The finding of typhoid bacilli in the sputum (I) is of interest in its possible etiological relation to the pneumonia which was present in this case.

Finally, the presence of typhoid organisms in the urine casts doubt, from a strictly scientific point of view, upon the work which has been done upon typhoid stools. Certainly, in my own investigations of the feaces in typhoid fever,* I never took into consideration the possible origin of the bacilli from the urine, and no effort was made to exclude the urine from the specimens examined. Nor have other observers, so far as I am aware, mentioned this possibility of error. From the point of view of diagnosis, of course, it makes no difference whether the bacilli come from the feaces or the urine.

CONCLUSIONS.

(1) Typhoid bacilli were demonstrated in the urines of 9 out of 38 typhoid patients (about 25 per cent). 172 specimens were examined with 44 positive results.

(2) The bacilli, when demonstrated, were always present in large numbers and in practically pure culture.

(3) The bacilli appeared first in the later stages of the disease and persisted in the great majority of cases far into convalescence.

The urines of typhoid patients should, therefore, not only be rigidly disinfected during the disease, but they should also be carefully supervised during convalescence.

(4) The typhoid bacilli were practically always associated with albuminuria and the presence of renal casts. On the other hand urines containing considerable amounts of albumin and casts in large numbers often showed no typhoid bacilli.

(5) Irrigation of the bladder with antiseptic solutions offers a possible means for removing permanently the bacilli from the urine.

In conclusion I wish to express my indebtedness to Dr. J. H. Wright, Director of the Pathological Laboratory, and to the physicians of the visiting and house staff at the Massachusetts General Hospital, for their kind co-operation in the work.