The results of radium therapy up to the present has been disappointing. Deep x -ray exposure and telerradium—that is, exposure to the radium bomb—has been tried before operation, but the lowered state of nutrition, the risk of the increased sepsis, and the fact that the inflammatory reaction after radiotherapy delays operation counteract any possible beneficial result of such exposures. Treatment with radium immediately after operation delays healing, and the severe sepsis which follows makes the patient desperately ill. The implantation of radium is unsatisfactory, and has increased the pain and discomfort. The surface application of radium—that is, radium in small doses fixed to the upper surface of the dental obturator and applied for a prolonged period some weeks after diathermy—may produce better results. The combination of electro-surgery and x -ray and radiotherapy is now advocated. A free access to the growth is of course essential.

It is generally found at the operation that the tumour is more extensive than anticipated; on the other hand, cases which appear to be hopeless often do better than expected. The difficulty of early diagnosis and the inaccessibility of ethmoidal carcinoma make it doubtful whether such a mutilating operation is worth while. Nevertheless, the number of successful cases seen in Professor Holmgren's Clinic at Stockholm is encouraging. Operation relieves the patient of pain, and he has the satisfaction of knowing that determined effort has been made to rid him of the disease with a hope of success. The condition of the inoperable patient is truly a miserable one.

REFERENCE

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THE LABORATORY DIAGNOSIS OF ENTERIC INFECTION

WITH REMARKS ON THE PERSISTENCE
OF INFECTION

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Although the incidence of enteric infection in this country has greatly diminished during the present century, the continued occurrence of small outbreaks of sporadic cases indicates the endemic nature of this disease. The reason for such persistence of infection is largely the presence of carriers or undiagnosed cases in the community, as demonstrated in an unfortunate manner by the recent outbreak at Malton (Shaw, 1933). A recently published study of enteric carriers in Glasgow (Browning *et al.*, 1933) gives details of individuals who were excreting bacteria of the enteric group over a period of years. As the ultimate source of infection must always be the discharges of human beings harbouring the particular organisms it is certain that unrecognized carriers are responsible for many of the sporadic cases of the disease.

It is thus obvious that control of enteric infection in a community depends largely on early diagnosis of cases, examination of contacts, and repeated examination of convalescents until they can be pronounced free from infection. The following report illustrates the necessity for this measure, and deals with the laboratory examination of specimens from cases in the north-west of England. Only cases which have been proved by the isolation of

the infecting organisms have been considered. Cases in which diagnosis was by agglutination tests have been omitted.

MATERIAL REVIEWED

During the last three years the following organisms have been isolated from individual cases under examination:

<i>B. typhosum</i>	...	...	...	25 cases
<i>B. paratyphosum</i> A	...	...	...	1 case
<i>B. paratyphosum</i> B	...	...	...	48 cases
<i>B. enteritidis</i>	...	...	...	6 cases
<i>B. aertrycke</i>	...	...	...	13 cases

The last two organisms were associated with food poisoning, except in two cases of prolonged fever from which *B. enteritidis* was isolated by blood culture. These bacteria are not considered further in this paper. The typhoid and paratyphoid infections occurred in twenty-seven municipalities; their sporadic distribution indicates the endemic nature of the diseases.

Cultures were isolated from the blood, faeces, or urine, but only certain of the results of the faeces and urine are considered in detail. These serve to illustrate the persistence of infection after the febrile period.

BLOOD EXAMINATION

1. *Culture*.—In all cases where blood was received for serological examination the serum for agglutination tests was removed from the clot, which was then placed in a tube containing 10 c.cm. of MacConkey's double strength bile-salt-lactose-peptone-water medium. After twenty-four and forty-eight hours' incubation at 37° C. subcultures were made from this medium on plates of MacConkey's agar or tubes of Russell's double sugar medium. By this technique the infecting organism was frequently recovered in pure culture. Table I shows the number of positive results obtained, and the stage of the disease at which the examination was made.

TABLE I

Organism	No. of Cases Examined	No. Positive	Day of Illness
<i>B. typhosum</i> ...	20	11	7th-8th
<i>B. paratyphosum</i> B ...	24	6	5th-12th

The proportion of positive blood cultures corresponds very closely to that obtained by Smith (1932), using a similar technique.

2. *Agglutination Tests*.—In the early stage of enteric infection examination of the faeces and urine frequently gives negative results. More useful information can usually be obtained at this time by the examination of the blood, first, by cultural examination for the presence of the infecting organism, and, secondly, for the presence of agglutinins in the serum. Cultural examination of the blood has already been mentioned, and in the typhoid cases, as shown in Table I, it proved particularly useful. Specimens of blood were not received from all the proved cases in this series, but in those examined the agglutination test gave definite evidence of infection. Since the method of qualitative receptor analysis was introduced by Weil and Felix (1920), the value of the method has received ample confirmation. Our routine procedure has been to combine the qualitative and the quantitative methods by testing dilutions of the serum from 1 in 20 to 1 in 2,560 with both "H" and "O" suspensions of various organisms of the enteric group. The suspensions used were obtained from the Standards Laboratory, Oxford. In Tables II and III, however, only the results with the suspensions of *B. typhosum* and *B. paratyphosum* B have been given. In all cases the infecting organism was isolated from the blood, faeces, or urine.

In Table II the agglutination reactions obtained in cases of *B. typhosum* infection are given.

TABLE II.—*Typhoid Fever: Agglutination Tests*

Case	Sex and Age	Day of Illness	Titre			
			T "H"	T "O"	B "H"	B "O"
1	M 9	9	80	0	0	320
2	F 5	14	640	1,280	0	0
3*	M 47	12	40	0	0	0
4*	F 43	9	320	160	0	160
5	M 60	10	0	0	0	0
		35	0	80	0	0
6*	M 17	18	2,560	180	0	80
7	F 8	? 2	0	320	0	0
8	F 30	11	40	320	0	160
9	M 10	12	1,280	1,280	0	160
10	M 60	8	0	80	0	0
11	M 21	10	640	640	0	0
12	F 56	—	2,560	0	0	0
13*	F —	14	40	80	0	160
14*	M 18	12	640	320	0	0
15*	M 76	7	160	320	0	0
16*	M 60	8	320	320	0	160
17*	M —	8	320	0	0	0
18*	F —	10	80	640	0	0
19*	F 15	—	160	320	0	0
20*	M 53	8	2,560	640	0	0

* *B. typhosum* recovered by culture of blood clot.

T "H" and T "O" = suspensions of *B. typhosum*.

B "H" and B "O" = suspensions of *B. paratyphosum*.

— = not known.

0 = negative in 1 in 40 dilution.

It is seen from the above table that the "O" titre was in several instances higher than the titre of "H" agglutinins, and in three cases "O" agglutinins were present in the absence of the latter. In one case (Case 5) the agglutination reaction for both suspensions was negative ten days after the onset, and positive only for "O" on the thirty-fifth day of illness. Cross-agglutination with "O" suspensions of *B. paratyphosum* B occurred in seven of the twenty cases, but cross-reactions with the corresponding "H" antigen were never observed. These results support the findings of others, that, in certain cases, "O" agglutinins only are produced in response to infection, and also that these may appear earlier in the disease than the "H" agglutinins (Smith, 1932; Wylie, 1932).

The results in infection with *B. paratyphosum* B were somewhat different, as will be seen from a study of Table III.

Here "H" agglutinins for *B. paratyphosum* B were constantly present; the titre was generally much higher than in the typhoid cases. Agglutination of the "O" suspension of *B. paratyphosum* B occurred with all sera, except two, but the titre was never greater than that given by the "H" suspension. Cross-agglutination with the "O" suspensions of *B. typhosum* occurred in a similar proportion of sera as shown for *B. paratyphosum* B in Table II. These serological findings are similar to those recently recorded by Smith (1932), Gardner and Stubington (1932), and others. Numerous other serum tests on cases, which were diagnosed as typhoid or paratyphoid fever, but from which the organisms were not isolated in our laboratory, have not been included here. These gave findings similar to those recorded in Tables II and III.

The results seem to justify the conclusion that in the majority of cases evidence of infection may be obtained after the first week of the disease, or even earlier, by means of the agglutination test.

In the course of our work the sera of individuals who had received prophylactic T.A.B. vaccine—mostly between 1914 and 1918—have frequently been examined, but these rarely gave rise to any difficulty. In the absence of infection in such persons agglutinins, if present, were usually of a low titre (1 in 640 or less), and reacted with the "H" suspensions of both *B. typhosum* and *B. paratyphosum* B, and frequently also with *B. paratyphosum* A, while agglutinins for the "O" antigens were almost invariably absent.

FAECES AND URINE EXAMINATION

Culture was made from the faeces directly on MacConkey's agar medium, and also by the brilliant-green technique using 1 in 150,000 and 1 in 300,000 concentrations of the dye. In the typhoid cases no advantage was observed by the brilliant-green method, which always gave negative results when direct culture was negative, and even in a few instances when the direct method was positive. In all the paratyphoid cases, when the organism was recovered by direct culture it was also isolated by the brilliant-green method; but in seven cases where direct culture failed brilliant-green enrichment gave positive results. Culture of the urine was made directly on plates of MacConkey's agar, and again after incubation of the urine for twenty-four hours in the presence of brilliant green added to make a final concentration of approximately 1 in 250,000. All cases positive by the brilliant-green technique were also positive by direct culture.

TABLE III.—*B. paratyphosum* B: Agglutination Tests

Case	Sex and Age	Day of Illness	Titre			
			B "H"	B "O"	T "H"	T "O"
1	M 70	? 5	640	160	0	0
2	F 9	9	2,560	640	0	0
3	M 25	9	2,560	640	0	0
4	M 12	8	2,560	320	0	0
5	M 32	11	2,560	80	0	0
6	F 21	8	2,560	320	0	80
7	M 23	15	2,560	2,560	0	2,560
8	M 51	8	2,560	320	0	320
9	F 27	10	2,560	160	0	0
10	F 53	11	2,560	160	0	0
11*	M 19	12	640	160	2,560	320
12	F 10	12	2,560	80	0	0
13	F 48	11	2,560	0	0	0
14	M 22	12	2,560	80	0	0
15	F 50	7	2,560	80	0	80
16	M 21	15	2,560	320	0	0
17*	M 18	8	2,560	320	0	0
18*	M 20	5	1,280	160	0	0
19	M 18	7	1,280	80	0	0
20	F 32	? 25	2,560	40	0	80
21*	F 15	7	2,560	320	0	0
22*	M 22	11	2,560	0	0	80
23*	F 29	8	2,560	160	0	0

* *B. paratyphosum* B recovered from blood clot.

The results of culture from faeces and urine in relation to the duration of the illness in the typhoid cases are

shown in Table IV. In Table V similar results are shown for those cases of paratyphoid fever where more than one examination was carried out. Of the total number of cases mentioned above, single examinations only were carried out by our laboratory in certain instances; these have been omitted here owing to insufficient data.

TABLE IV.—Typhoid Fever: Cultural Results

Case	Sex and Age	Faeces	Urine
1	M 9	+ (17), - (29), - (43), - (61), - (69), - (75)	- (17), + (13), - (31), - (69)
2	F 5	+ (210), - (255), - (289), - (332), - (382), - (472), - (540)	+ (210), - (255), - (289), - (332), - (382), - (472), - (540)
3*	M 47	- (48)	- (7), + (48), + (8), + (114), + (142), + (1/2), + (200), + (230), + (260), + (293), + (324), + (360), + (388)
4*	F 43	+ (48), + (59), + (74), + (375), + (555)	
5	M 60	+ (19), - (34), + (40), - (59)	- (19), - (34)
6	M 17	+ (51), - (65)	+ (51), + (66), + (74)
7	F 8	+ (4), - (98), - (110)	
8	F 30	+ (10), - (43), - (50)	
9	M 10	+ (14), - (47)	- 57
10	M 60	+ (21)	
11	M 21	+ (23)	
21	M 21	- (30), - (48), - (56), - (52), - (2)	+ (30), - (56), - (92)
22	F 3	+ (11), - (36)	- 11, - (36)
23	F 12	- (30), - (70)	+ (30), - (70)
24	M 67	+ (28), - (40)	
25	M 35	+ (10)	

* Cases still under observation.

+ = *B. typhosus* isolated. Figure indicates day after onset of illness.

TABLE V.—Paratyphoid Fever: Cultural Results

Case	Sex and Age	Faeces	Urine
1*	M 70	+ (13?), + (21), + (26), + (33), + (39), + (49), + (56), + (73), + (110)	
2	F 9	+ (12), + (35), - (54)	
3	M 25	+ (43), - (73)	+ (43)
4	M 12	+ (13), - (38), - (47)	- 13, - (38), - (47)
14	M 22	+ (15), + (21)	
15	M 50	+ (18), + (23), - (45), - (52)	+ (18), - (45)
16	M 21	+ (38), - (53), + (56)	- (53), - (56)
19	M 18	- (8), + (21), - (49), + (63), - (81)	- (81)
20*	F 32	+ (32?), + (122), + (157), + (247), + (300), + (310), + (373), + (420), + (470), + (510), + (630)	+ (122), + (157), - (247), + (300), + (310), - (373), + (420), + (470), + (510), + (630)
24	M 18	+ (15), - (25), - (32)	
25	F 21	+ (6), + (28)	
26	M 24	+ (30), + (47), - (64)	- (30)
27	M 6	+ (20), - (36), + (46), - (56), - (66), - (76)	- (50), - (76)
28	M 15	- (34)	+ (34), - (46)
29	M 41	- (35), + (70)	+ (35), + (70)
30	F 11	+ (7), + (21)	
31	M 11	- (10), + (26), - (32), - (37)	
32	M 47	+ (11), + (19), - (26), - (31)	
33	M 7	+ (55), + (69), - (83)	
34	M 18	+ (0), + (20), + (29), - (37), - (49)	

Figures indicate day after onset of illness. * Cases still under observation. + = *B. paratyphosus* isolated.

The examinations in Tables IV and V were incomplete in the sense that, although the majority of the cases apparently made a complete clinical recovery, the probability of freedom from infection was not established in all. Certain of the cases from which repeated exam-

inations were made showed positive cultures at the time of the last examination—for example, Cases 1, 16, and 20, Table V; of these Cases 1 and 20 are still under observation. Of the sixteen typhoid cases shown in the table the organism was recovered from the faeces, in one case six months, and in another eighteen months, after the onset of illness, and in two cases from the urine after four months and twelve months. Of the twenty paratyphoid cases shown in Table V, six were still excreting paratyphoid bacilli after two months; of these one had the organism in both the urine and the faeces after twenty months.

The results indicate that in the examination of convalescents it is necessary to emphasize the fact that a single negative examination of the faeces and urine is not sufficient to justify the conclusion that an individual is free from infection. Cases 19 and 27, Table V, illustrate this point. Here the excretion was intermittent; Case 19 gave positive cultures thirteen and twenty days after previous negative examinations. The results do not indicate that either age or sex plays an important part in determining the persistence of infection with either typhoid or paratyphoid bacilli.

DISCUSSION AND CONCLUSIONS

The fact that the control of enteric infection depends to a large extent on the early diagnosis of cases and the detection and control of carriers was mentioned above. In the diagnosis by laboratory examination the guiding principles, although perhaps not sufficiently appreciated, are well established, and are illustrated by the findings recorded above.

Towards the end of the first week—and the patient is frequently ill a few days before enteric infection is suspected—examination of the blood by cultural methods and agglutination tests with the serum will in the majority of cases afford evidence of the nature of the disease. The evidence obtained by the agglutination test should, however, be confirmed by isolation of the infecting organism from the faeces or urine wherever possible. Later in the course of the illness agglutination tests with the patient's serum generally give more marked reactions and, while blood cultures are less frequently positive, the isolation of the causal organism from the urine and faeces is more readily effected, especially during the second and third weeks.

In the detection of carriers examination during convalescence is of the utmost importance. The carrier state may be merely temporary, the organisms being excreted for some weeks or months after the febrile period. Such cases tend to clear up spontaneously, but in order to prevent the spread of infection from these, adequate methods of testing for freedom from infection during convalescence must be employed. At least three successive negative reports on faeces and urine should be received at weekly or fortnightly intervals before a person can be considered probably free from infection. In the permanent carrier excretion of the organisms in faeces or urine, sometimes intermittent, persists indefinitely, and this presents a much more difficult problem. The only satisfactory method for removing the source of infection appears to be operation (Browning *et al.*, 1932).

The necessity for the examination of contacts is illustrated by Cases 1 and 20 in Table V. These had no clinical manifestations of infection, and were detected in the examination of members of the families where several cases of illness had occurred. The investigations on these two cases showed that they were carriers of the permanent class, and it would appear that they were probably the original source of the associated outbreaks.

Although there is nothing new in this communication the experiences of this laboratory may serve to emphasize

to physicians and laboratory workers alike the necessity for bacteriological control of enteric fever.

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COLLAPSE THERAPY IN BRONCHIECTASIS

A WARNING

BY

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Collapse therapy has earned a great reputation in the treatment of pulmonary tuberculosis. A bronchiectatic cavity, on the other hand, differs from a tuberculous one in that it is lined with epithelium, and, however long two epithelial surfaces are in contact, they will never unite. In bronchiectasis, therefore, the procedure cannot be regarded as a curative, but only as a palliative, treatment. Collapse therapy in bronchiectasis possesses, however, a disadvantage which I do not think is fully appreciated by those who advocate it—namely, that it greatly diminishes the possibility of a successful lobectomy, should this become necessary. In the modern one-stage lobectomy it is essential to obtain an early expansion of the remaining lobe, and so obliterate the pleural space before infection can set in. A paralysed diaphragm removes the principal factor in expanding the lung, and a prolonged artificial pneumothorax so anchors the remaining lobe that it will not expand quickly enough. I would like to quote two unfortunate experiences which have prompted me to give this warning to others.

Case 1.—A woman, aged 28, was admitted to St. Andrew's Hospital, Bow, on January 11th, 1933. Seven years ago she had a so-called pneumonia on the right side, followed by an empyema, which healed with rib resection and drainage. Since that time she had had a persistent cough, with about one ounce of offensive sputum every morning. Four years ago she started to spit up blood (about four ounces at a time), and this recurred three or four times every year. By 1932 the condition had become much worse, and the bleeding was more frequent. Her sputum was negative for tubercle bacilli. Lipiodol demonstrated severe bronchiectasis in the lower lobe. In November, 1932, a right phrenic evulsion was performed, but following this there was no improvement in the symptoms. In January, 1933, I saw her for the first time. She was then having severe haemoptyses every week, was anaemic, and it was obvious that something had to be done to try to relieve her condition. On February 8th I performed a right lower lobe lobectomy. Owing to the previous empyema there was a mass of adhesions round the lower lobe, particularly on the costal surface, but by entering the endothoracic space I managed to strip the lobe free. There were adhesions in the interlobar fissure, but none over the upper lobe. The diaphragm was absolutely rigid and board-like, and there was very little shift of the mediastinum. During removal of the lower lobe a little pus was spilt into the pleural cavity. At the end of the operation the chest was drained by a closed waterlocked drainage. The upper lobe in this case failed to expand, and the patient died on the eighth day after operation from a generalized infection of the right pleural cavity and a bronchopneumonia on the opposite side.

Normally, the upper lobe expands to fill the whole hemithorax within the first day or two after operation, according to physical signs, x rays, and post-mortem observations. This case, I think, illustrates that with a paralysed diaphragm one has removed the principal factor in expanding the lung,

and there is extreme risk of the patient dying from an infection of the pleural cavity.

Case 2.—A girl, aged 19, was admitted to St. Bartholomew's Hospital on September 21st, 1933, under Dr. F. G. Chandler. At the age of 3 she had had double pneumonia, and since then had had cough and sputum. In 1929 lipiodol demonstrated a bronchiectasis in the left lower lobe. She then had several ounces of offensive sputum daily. An artificial pneumothorax was therefore induced, and maintained with monthly refills of 500 c.cm. There was at no time any pleural effusion. The pneumothorax succeeded in reducing her sputum to a few drachms of inoffensive sputum daily, but by 1932 this had started to increase again. The lung was almost completely collapsed, except for a small part situated behind the heart shadow. Lipiodol demonstrated dilated bronchi in the collapsed portion of the lung. By September, 1933, she was producing one ounce of sputum in the twenty-four hours. A lobectomy was therefore advised, and was performed on October 17th. On opening the chest I found that the whole pleural cavity was lined by a thick white membrane, which completely obscured the anatomical landmarks. This was stripped off the lower lobe and a left lower lobe lobectomy performed, but with some difficulty owing to adhesions in the interlobar fissure. After removing the lobe I attempted to decorticate the white membrane off the upper lobe. This, however, was only partially successful, as it was firmly adherent in one place. At the end of the operation the chest was drained with a closed waterlocked drainage. This patient now (December, 1933) has a complete empyema on the left side, and there is practically no expansion in the remaining upper lobe. I fear that we will therefore have substituted a large chronic empyema for a left basal bronchiectasis.

In an artificial pneumothorax of more than a year's duration, even in those cases where there is no pleural effusion, the lung is likely to be encased in a white membrane and expansion of the remaining lobe therefore severely hampered. In future, before performing a lobectomy in a case of artificial pneumothorax, I shall inspect the pleural cavity with a thoracoscope.

DISCUSSION

After a *phrenic evulsion* for a basal bronchiectasis there may be a temporary improvement, but subsequently, when the diaphragm has completely atrophied, the patients return to the same, or a worse, condition. In cases of dry bronchiectasis, suffering from haemoptysis only, I have seen a definite improvement in symptoms following paralysis of the diaphragm. It is, however, advisable first to try a temporary paralysis, by crushing the nerve, to see if this is going to be effective in controlling the bleeding.

Artificial pneumothorax frequently fails owing to extensive pleural adhesions, but when a complete collapse is obtained the symptoms may disappear, as in those cases quoted by Dr. F. G. Chandler and referred to by Dr. Beaumont in the correspondence in the *British Medical Journal* of October, 1933. The collapse must, however, be maintained by refills for the rest of the patient's life, and, should oblitative pleurisy develop, with subsequent expansion of the lower lobe, one has probably burnt one's boats as far as lobectomy is concerned.

Thoracoplasty for basal bronchiectasis has, on the whole, given extremely bad results, and involves the sacrifice of a whole lung for a basal lesion, which is obviously wrong. But this operation still has a place in the treatment of unilateral bronchiectasis, when all the lobes are grossly affected and there is a large quantity of sputum. By means of a very extensive resection it is possible in these cases to reduce the sputum from, say, 20 ounces to one or two ounces; occasionally, they may even be sputum-free, but in the majority it recurs again—although never, of course, to the same extent as before operation.

Thus the choice of therapy in basal bronchiectasis seems to me to rest between (a) posture and bronchoscopy, and