GUNSHOT WOUNDS OF THE THORAX: THEIR LATER STAGES.

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SOME of the men who receive gunshot wounds of the thorax die on the field of battle, some in hospitals abroad; others filter through these hospitals and reach the hospitals at home. Those who come home include the less serious cases. The following table and notes deal with 50 of these cases—that is, with the later or terminal stages. On an average the cases were admitted 18 days after being wounded. Wounds of entrance: chest 19, back 12, shoulders 8, sides 7, neck 4.

No.	Non-pene- trating.	Pene- trating.	Through- and- through.	Hæmo- thorax.	Aspirated.	Resected.	Metal removed.	Metal still in.	Pneu- monia.	Dis- charged to duty.	Empley- ments III.	Medical boarded.	Died.
1	—	1	—	1	—	—	—	1	—	—	—	1	—
2	—	1	—	1	—	1	—	—	—	—	—	1	—
3	—	1	1	1	—	1	—	—	—	—	—	1	—
4	—	1	—	—	—	—	—	—	1	—	—	—	1
5	—	1	—	—	—	—	—	—	—	1	—	—	—
6	—	1	1	1	—	—	—	—	—	—	1	—	—
7	—	1	1	1	—	1	—	—	1	—	—	—	—
8	—	1	1	1	—	—	—	—	—	1	—	—	—
9	—	1	—	1	—	—	—	—	1	—	—	—	—
10	—	1	—	1	—	—	—	—	—	1	—	—	—
11	—	1	1	1	—	1	—	—	—	—	—	—	—
12	—	1	—	1	—	1	—	—	—	—	—	1	—
13	—	1	1	1	—	—	—	—	—	1	—	—	—
14	—	1	—	1	—	1	—	—	—	—	—	1	—
15	1	—	—	—	—	—	—	1	—	1	—	—	—
16	—	1	—	1	—	—	—	1	—	1	—	—	—
17	—	1	—	—	1	—	—	—	—	1	—	—	—
18	—	1	—	—	—	—	—	1	—	1	—	—	—
19	—	1	1	—	—	—	—	—	—	1	—	—	—
20	1	—	—	1	—	—	—	—	—	1	—	—	—
21	1	—	—	1	—	—	—	—	—	1	—	—	—
22	1	—	—	1	—	—	—	—	—	1	—	—	—
23	—	1	1	1	—	—	—	—	—	1	—	—	—
24	—	1	1	—	—	—	—	—	—	1	—	—	—
25	—	1	1	1	—	—	—	—	—	1	—	—	—
26	—	1	1	1	—	—	—	—	—	1	—	—	—
27	—	1	1	1	—	—	—	—	—	1	—	—	—
28	—	1	—	—	—	—	1	—	—	1	—	—	—
29	—	1	—	1	—	—	—	—	—	1	—	—	—
30	—	1	—	1	—	1	—	—	1	—	—	—	1
31	—	1	—	—	1	—	—	—	—	1	—	—	—
32	—	1	—	—	1	1	—	—	—	—	—	1	—
33	1	—	—	—	—	—	1	—	1	—	—	1	—
34	—	1	—	1	—	1	—	—	—	—	—	1	—
35	—	1	1	1	—	1	—	—	—	—	1	—	—
36	—	1	—	1	—	1	—	—	—	1	—	—	—
37	—	1	—	1	—	—	1	—	—	—	—	1	—
38	1	—	—	—	—	—	—	—	1	—	1	—	—
39	—	1	—	1	—	—	—	1	—	1	—	—	—
40	—	1	—	1	—	1	—	—	—	—	1	—	—
41	—	1	—	1	—	1	—	1	—	—	—	1	—
42	—	1	1	1	—	—	—	—	—	—	—	1	—
43	—	1	1	1	—	—	—	—	—	—	—	1	—
44	—	1	—	1	—	—	—	1	—	—	—	1	—
45	—	1	—	1	—	1	—	1	—	—	1	—	—
46	—	1	—	1	—	1	1	—	—	—	—	1	—
47	—	1	—	1	—	1	1	—	—	—	—	1	—
48	—	1	1	1	—	—	—	—	—	1	—	—	—
49	—	1	—	1	—	—	1	—	—	—	—	—	—
50	1	—	—	1	—	—	—	—	—	1	—	—	—

Non-penetrating.—Seven cases of wounds of thoracic wall did not penetrate pleura. Two of these had hæmoptysis, 4 had hæmothorax; of latter 2 manifested pleuritic friction. One had a small swelling over ribs due to incarceration of piece of cloth; here also pleuritic friction was heard over adjacent area. This came on late in course of illness, probably due to extension of inflammation. One developed pneumonia and another a persistent form of basal congestion or broncho-pneumonia. Thus, concussion may cause hæmoptysis, hæmothorax, or pneumonia.

Penetrating wounds.—Most of these had hæmoptysis, some for several days after they were wounded. Several state quite definitely that they did not spit blood and yet they presented physical signs of effusion. In 8 cases ribs were broken, in 4 scapula, in 2 humerus (1 requiring amputation at shoulder), in 1 clavicle. In 1 vertebrae were damaged; in 1 œsophagus was slightly damaged. In 3 pleura had been sewn up, in 1 diaphragm. In 16 cases the wounds were through-and-through; some of these had only short tracks through lungs. Several did not present any physical signs of hæmothorax. In 13 cases resection of rib was done for empyema. Several had physical signs of contralateral disease of lung or pleura, conditions very well described by Sir J. R. Bradford.¹

Several cases with the physical signs of effusion were not aspirated, as there were no indications of sepsis; physical signs gradually disappeared. Pleuritic friction was frequently heard in the later stages.

Twenty-eight, or more than half, returned to duty in from 2 to 4 months; 6 were discharged to Employments III. and 14 from the Army by medical boards, 6 in consequence of empyema, 4 in consequence of still having metal in lungs, and 4 because of disabilities due to other injuries. One man had a sinus two inches deep between lower ribs, left by some operative procedure, and into this iodoform and bismuth paste was injected; immediately coughing was provoked, and within a few seconds he coughed up pieces of paste size of pea. Sinus healed in a few days. Two patients died from septic pneumonia.

1. Came in with small wound above left clavicle. X rays revealed ragged piece of metal deep in neck, probably in apex of lung.

2. Gunshot wound in back, caused by piece of metal striking glancing blow near inferior angle of scapula. When admitted—four weeks later—right lung was dull and crepitant. Sputum blood-stained. Died three weeks after admission from double septic pneumonia.

Both these cases had septic flesh wounds other than those over the lungs. This association is suggestive of danger.

The operations required at this hospital were performed by Major G. Sichel, now in France, but then senior surgeon.

ABSTRACT OF A PAPER ON CAPSULATE MUCOID FORMS OF PARATYPHOID AND DYSENTERY BACILLI.

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(From the Laboratory of the University War Hospital, Southampton.)

DURING routine examination of excreta of two chronic paratyphoid carriers I have met with some curious capsulate bacilli which form large mucoid colonies on Endo's fuchsin-sulphite-agar, totally unlike those of *B. paratyphosus* B, but which proved to be a variety of that organism. I have also encountered similar organisms in a case of infection with *B. aertryck*, and in convalescents from dysentery of the mannite-fermenting group.

I have not found them in typhoid, paratyphoid A, or in dysentery of Shiga type. Such cases have been few in number, and possibly they may yet be found; indeed, Professor Tanner Hewlett has suggested to me that all the members of the coli group may have this Proteus-like power of disguising themselves, and he has drawn my attention to a paper by Cecil Revis.¹

Revis found that when a sample of soil contaminated with human faeces was first sterilised and then inoculated with a certain culture of *B. coli* "very large, jelly-like, clear colonies," quite unlike ordinary *B. coli*, developed at the end of four months. These colonies gave the usual fermentations of *B. coli*, and "on microscopical examination the bacteria were seen to be embedded in a cementing substance." When they were subcultured it was found that "the typical form and the new type seem to be quite dynamic, passing readily from one to the other."

I have had no opportunity of conducting experiments on animals, but I am publishing this account without waiting to do so, because it is important they should be recognised. In addition to Professor Hewlett, I am indebted to Lieutenant-Colonel D. Harvey, Major F. W. Andrewes, and Captain A. C. Inman for examining several of the cultures, to Dr. Doris MacKinnon and Miss Gertrude Long for drawings and charts, and to Dr. Alex. Hill for allowing me to make photographs at the Southampton University College. I shall be most happy to supply other workers with subcultures.

Paratyphoid Mucoids.

In the spring of 1917 the faeces were examined daily of a number of soldiers from whom paratyphoid bacilli had been isolated during convalescence, to determine if the place of the pathogenic bacilli is taken by any special organism, or group of organisms. I hoped that, if the paratyphoid bacilli were crowded out during convalescence, such an organism might be of benefit in treating carriers; a forlorn hope, one must admit.

Pte. S., a chronic paratyphoid carrier, was taken ill at end of August, 1916. His excreta were examined many times. When an emulsion was plated direct on to Endo's fuchsin-sulphite-agar from

¹ Brit. Med. Jour., August 4th, 1917.

¹ Centralblatt für Bakteriologie, 1910, 26

57 to 100 per cent. of colonies were paratyphoid. 116 samples of faeces had been examined; the 116th sample gave 100 per cent. of paratyphoid colonies. In the 117th percentage dropped to 10; a new type of colony appeared, consisting of large, slimy, white, mucilaginous colonies which I have named "Mucoids." During the next 11 days the faeces were examined seven times; average percentage of paratyphoid colonies only 11; mucoids were present in large numbers on each occasion. On twelfth day no mucoids found on plate; percentage of paratyphoid colonies rose once more to 50. (See Chart.) The mucoids

Chart showing percentage of ordinary paratyphoid colonies present on Endo plate and the fall in percentage when mucoids were present. The proportion of mucoids is given for those days on which it was recorded.

were not found again in seven subsequent examinations, and the paratyphoid colonies were as numerous as ever. The sum percentage of mucoids and paratyphoids is approximately equal to percentage of paratyphoid colonies usually seen when no mucoid organisms are present.

Subcultures were made and usual media inoculated. The organism reacted in same fashion as *B. paratyphosus B*. When first isolated the organism was not agglutinated by a paratyphoid serum, but it did absorb the agglutinins from it. When this strain of mucoids was re-tested eight months later it agglutinated slowly and imperfectly in low dilutions.

One day, when I had wished to prepare a fresh culture from a single mucoid colony, I plated out some peptone-water inoculated five days before. The result was a mixture of mucoids with ordinary paratyphoid colonies. I thought I was working with a contaminated culture. Further investigation proved that the paratyphoid colonies had originated from the mucoid form. If a culture of the mucoid be inoculated into peptone-water and plated every day there will be a few ordinary paratyphoid colonies on plate made on third day; on fifth day they will be in majority. The mucoid colonies give rise to ordinary paratyphoid bacilli.

[Experiments undertaken to test purity were here described.]

with them, like ground glass. If the latter be subcultured several times they will give rise to the luxuriant large mucoids once more.

I have never yet succeeded in obtaining mucoids from the ordinary form. Cecil Revis, it will be remembered, found that his "jelly-like" *coli* colonies passed readily from one form to the other.

In mucoid colonies 24 hours old many of the bacilli measure from 1.5 to 2.5 μ ; there is a large number of small coccoid forms 0.75 to 1 μ in diameter. The general appearance of a film made from one of the paratyphoid colonies derived from the mucoids is very different. These derived bacilli are, for the most part, larger; the small coccoid bacilli, so numerous in mucoid films, are rare; very long "involution forms," from 12 to 45 and even 100 μ in length, are the most striking feature.

When a culture of the mucoid form in peptone water is examined by the dark-ground method the number of small coccoid bacilli at once catches the eye, and the rapidity with which these coccoid forms travel is very striking.

When films of the mucoids and of the derived colonies are stained by Benians' "relief stain,"² the two can be distinguished at a glance. The picture is quite different from that given by ordinary staining methods; there the bacilli in mucoid cultures are smaller than those in the derived; here, on the contrary, the silhouettes of the mucoid organisms are much the larger. The explanation of this is that they have capsules, while the paratyphoid bacilli in the derived colonies have none.

In films made from the mucoids the faint outlines of the bacilli can be distinguished lying within thick capsules, and there are many round, coccoid forms about 3 μ in diameter. The capsules cannot be stained by ordinary means, such as Welch's method, and it is possible that they are not firm envelopes, but are derived from the mucoid matrix in which the bacilli are embedded and envelop them as drops of dew envelop particles of dust.

There is yet another point of difference between films made from mucoids and those from the derived paratyphoid colonies. In the latter the background of Congo-red is homogeneous, but in mucoid films it is traversed in all directions by an irregular reticulum composed of a deposit of small granules, which appears to be derived from mucilaginous matrix. This deposit is not shown in Fig. 2.

The evidence in favour of classifying these mucoids as a form of *B. paratyphosus B* is overwhelming.

The mucoid organisms disappeared from the excreta of Pte. S. on June 11th, 1917, and shortly afterwards he was transferred to another hospital.

From that time until Oct. 6th only six carriers of paratyphoid bacilli were admitted to this hospital; none a chronic carrier; no mucoids found in excreta. On Oct. 6th Pte. C., a chronic carrier of *B. paratyphosus B*, was sent here from France.

He had been taken ill on Sept. 1st, 1917; severe attack with high fever and hæmorrhage from bowels. He had received two injections, by T.A.B. 2 method, 1½ years before illness.

In first plate, prepared from faeces, a large number of mucoids was present. The mucoids did not disappear; in 59 examinations made while he was here they were found 47 times. Ordinary *B. para-*

Illustrations of Mucoid Forms of Paratyphoid Bacilli.

FIG. 1.—Sketch of five-day peptone culture of mucoid isolated from faeces of Pte. S., plated on Endo's medium. The large colonies represent the mucoids, the small colonies (to which the arrows are directed) consist of paratyphoid organisms derived from them.

FIG. 2.—Drawing of silhouettes of mucoid organisms in case of Pte. S. (Benians' stain.) $\times 2000$.

FIG. 3.—Drawing of silhouettes of paratyphoid bacilli derived from mucoids. (Benians' stain.) $\times 2000$.

The only way in which these paratyphoid organisms derived from mucoids differ from typical paratyphoid bacilli is: (a) the colonies on solid media are, as a rule, more granular; (b) more long "involution forms" are present than usual. Subcultures from these derived colonies behave in every other respect like ordinary paratyphoid organisms.

The mucoid colonies have about twice diameter of ordinary paratyphoid colony, and after repeated subculture on successive days they may attain a diameter of more than 1 cm. in 24 hours. They are dome-shaped, circular in outline, with a regular margin, and a mucoid appearance absolutely unlike a paratyphoid colony. By transmitted light they are very translucent and are somewhat like frosted glass.

A fresh culture on an agar slope is thick and slimy-like mucus. In a few days the sliminess disappears, except near top of tube, and on re-plating some ordinary paratyphoid organisms derived from the mucoids are found. If a culture on agar be left for several weeks and then plated the resulting growth will consist almost entirely of non-mucoid paratyphoid colonies and a few minute ghostly colonies mingled

with them, like ground glass. If the latter be subcultured several times they will give rise to the luxuriant large mucoids once more.

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² T. H. C. Benians: Brit. Med. Jour., Nov. 25th, 1916.

Aertryck Mucoids.

These mucoid organisms were isolated from another patient.

Pte. W. suffered from acute infection with *B. aertryck* of "Mutton" type, ascribed to infected pork-pie. Typical *Aertryck* bacilli were isolated five times from faeces, once from urine.

Mucoid bacilli were recovered from faeces once only, at beginning of third week. This mucoid organism is motile, Gram-negative, does not liquify gelatin or produce indol. It turns milk acid in 12 hours and alkaline after four days. Its fermentation reactions in lactose, saccharose, glucose, maltose, mannite, dextrin, and dulcitol are identical with those of *B. aertryck*.

When first isolated emulsions of mucoid organisms were not agglutinated by an *Aertryck* serum, nor did they absorb the specific agglutinins from it. When a culture in peptone-water, which has been growing for a few days, is plated on Endo's medium there are colonies of ordinary *Aertryck* bacilli mingled with mucoid colonies. The bacilli in colonies derived from mucoids behave in every way like typical *B. aertryck* of Mutton type.

One must conclude, therefore, that there is a mucoid form of *B. aertryck* as well as a mucoid form of *B. paratyphosus* B.

Organisms of the Mucoid Type in Dysentery.

Mucoid colonies have been found in four carriers of *B. dysenteriae* (mannite-fermenting) and in one convalescent from dysentery, but from whose excreta dysentery bacilli were never isolated.

These mucoids differ in many respects from those found in paratyphoid infections. On an Endo plate spread with emulsion of faeces and incubated for 24 hours the mucoid colonies are about twice the size of usual dysentery colony. On plates made from subcultures they are smaller and reduced to little yellow droplets, which in 24-hour culture adhere to platinum loop and can be removed bodily from surface of medium without leaving a trace behind. In older cultures they become very adherent. Subcultures on agar slopes are hard, rough, and tenacious, with a yellowish colour.

After subculture of these mucoids in peptone-water, bacilli which resemble ordinary dysentery bacilli appear amongst the mucoids. These bacilli are derived from the mucoids.

These derived bacilli are agglutinated by immune sera of Flexner-Y type, but they do not absorb the specific agglutinins for homologous cultures or for typical dysentery bacilli isolated from same patients.

Neither the mucoids isolated from these dysentery convalescents nor the non-mucoid strains derived from them have been shown to be true dysentery bacilli.

ON A METHOD OF PREPARING MEDIUM FOR THE CULTURE OF PFEIFFER'S INFLUENZA BACILLUS THAT GIVES PROFUSE GROWTH AND IS TO A MARKED DEGREE SELECTIVE FOR THIS ORGANISM.

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IN view of the prevailing pandemic of influenza it seems a fitting time to publish a short account of this peculiarly valuable medium, though it has been in contemplation to publish a more complete paper with detailed experiments and illustrations. The medium, however, is so favourable for the culture of influenza bacilli that it is deemed inadvisable to delay in making it available for general use.

The method consists in the use of blood digested by trypsin, the preparation of which is as follows:—

Quantities of 0.25 c.cm. of Allen and Hanburys trypsin compound are added to tubes containing 4.75 c.cm. of sterile broth. The mixture is then incubated for 24 hours and any contaminated tubes discarded. 1 c.cm. of blood from a venipuncture is then introduced into each tube, and the mixture of trypsin, blood, broth is incubated for three or four days. The product is then ready for use and is mixed with agar, as if making ordinary blood agar, in the proportion of 5 c.cm. of trypsin-blood mixture to about 30 c.cm. of agar. The trypsinised blood can be used in larger proportions than indicated, with advantage, if large quantities of emulsion be required. My colleague, Captain A. F. Hayden, obtained extraordinarily thick growths by using trypsinised sedimented corpuscles.

The advantage of the proportions indicated, however, is that they are just those quantities arrived at when making diagnostic blood cultures by the method of Douglas and Colebrook.¹ Thus any blood cultures that may prove

sterile form ideal material for the medium in question, instead of being a waste product. Indeed, it was by the use of such material that the value of the method was discovered.

It may here be noted that Captain S. R. Douglas suggested the use of trypsinised medium about the date of the paper referred to, but the experiment failed at that time for the reason that the digestion process was not carried far enough.

The incubation of the trypsin-blood mixture should not be prolonged for more than a week. The product retains its properties for six months at laboratory temperature, but after that tends to deteriorate. Possibly it would keep indefinitely in the ice-chest.

The agar used is preferably Douglas's tryptagar,² and should be faintly but definitely alkaline to litmus paper. Whole blood may be digested by adding trypsin in the proportion of 1-4 of blood, but the product is not so handy for intermittent use as when made in a series of tubes, one of which may be used as required.

The blood used need not be fresh, but may well be citrated blood that has been kept in an ice-chest. Indeed, there is some advantage in using citrated blood, as the trypsinisation seems to proceed more rapidly when citrate is present than when fresh blood is used.

The medium grows influenza freely from the first culture, and it is to a marked extent selective. Thus, it inhibits pneumococci entirely and in a large measure streptococci and other Gram-positive organisms, but apparently favours staphylococci.

It grows the Gram-negative cocci of the catarrhalis group, together with bacilli of the coliform group, freely, but does not favour them in the way it favours influenza bacilli.

The colonies of these bacilli on initial cultures attain a large size, being frequently 3 mm. broad; they are at first hemispherical, and later tend to be flat, and are translucent, with a brownish tinge and a regularly circular outline. The colonies of the catarrhalis group are usually more opaque, more convex, and more deeply tinted; staphylococcal colonies are white. Subcultures usually give quite confluent growths, frequently of the profusion of a typhoid culture, with a similar greasy appearance, but of brownish tinge.

As a rule the bacilli are typical, but not infrequently they are replaced by enormously long filaments. To some extent this filamentous condition depends on variations in the medium, but occasionally the characteristic persists through several subcultures on the special medium, the growth at all times being typical when subcultures are made on ordinary blood-agar. These strains do not emulsify so readily as the typical ones, and subcultures are apt to show only a few discrete colonies, possibly on account of the matting due to the filamentous forms of the organism.

It may not be out of place to record that during the present epidemic I have investigated about a dozen typical cases of the disease presenting these features—sudden onset, fever of 103-104°, prostration and malaise, usually with no symptoms of catarrh, and followed by rapid and usually complete recovery, though in some the malaise has tended to continue.

In every case I have recovered, frequently in profuse and practically pure culture, Pfeiffer's bacillus when making use of West's post-nasal swab, which method I almost invariably use, planting the swabs direct on to plates of trypsinised blood-agar. In the cases where catarrh has been present I have found the bacillus in bronchial and nasal mucus, together with varying quantities of pneumococci and streptococci, as shown by ordinary blood-plates. One case of nasal catarrh gave a pure culture from the nose as well as from the post-nasal space. No single organism, with the exception of Pfeiffer's bacillus, has been invariably—or perhaps frequently—present.

I feel confident, therefore, that if this medium be used, and especially if the post-nasal space be explored, Pfeiffer's bacillus will be found universally associated with the epidemic.

Wimpole-street, W.

¹ THE LANCET, July 29th, 1916.

² THE LANCET, Oct. 10th, 1914.