examined the blood of four of the inoculated persons. I have collected the results in the following table:

Tetravaccine.						
Individuals Inoculated.	Blood tested against	Limits of Agglutination. Weeks after First Injection.				
		1	2	3	4	5
No. 1.	<i>B. typhosus</i> ...	1/40	1/1200	1/500	—	1/200
	<i>B. paratyphosus</i> A ...	1/20	1/400	1/200	—	1/100
	<i>B. paratyphosus</i> B ...	1/20	1/300	1/200	—	1/100
	<i>V. cholerae</i> ...	1/20	1/100	1/80	—	1/60
No. 2.	<i>B. typhosus</i> ...	1/20	1/1200	1/400	1/300	1/200
	<i>B. paratyphosus</i> A ...	1/20	1/200	1/150	1/150	1/100
	<i>B. paratyphosus</i> B ...	1/20	1/200	1/200	1/150	1/100
	<i>V. cholerae</i> ...	1/20	1/60	1/40	1/40	1/40
No. 3.	<i>B. typhosus</i> ...	1/40	1/600	1/600	1/300	1/200
	<i>B. paratyphosus</i> A ...	1/20	1/500	1/400	1/200	1/150
	<i>B. paratyphosus</i> B ...	1/20	1/500	1/400	1/150	1/150
	<i>V. cholerae</i> ...	1/10	1/60	1/100	1/40	1/40

Comparing the results collected in the above table with the results obtained in control individuals inoculated with monovaccines by Dr. Castellani and Dr. Mendelson, I find that the amount of agglutinins present is not distinctly smaller.

Pentavaccine.

The pentavaccine I used was the typhoid + paratyphoid A + paratyphoid B + cholera + Malta fever. I obtained it from Dr. Castellani. As regards the technical preparation of this vaccine I refer the reader to Dr. Castellani's own publications. I inoculated with this vaccine 2,000 individuals, mostly at the inoculating department attached to the Uskub American Clinic, with no untoward accident of any kind. The injections were given ($\frac{1}{2}$ c.cm. each) at an interval of five to eight days, with the usual technique. The reaction, local and general, was not more severe than in individuals inoculated with the tetravaccine. The blood of two of the inoculated persons was examined with the kind assistance of Mr. D. de Silva.

The results are given in the following table.

Pentavaccine.						
Individuals Inoculated.	Blood tested against	Limits of Agglutination. Weeks after First Injection.				
		1	2	3	4	5
No. 1.	<i>B. typhosus</i> ...	1/40	1/800	1/500	1/300	1/150
	<i>B. paratyphosus</i> A ...	1/20	1/400	1/300	1/200	1/150
	<i>B. paratyphosus</i> B ...	1/20	1/400	1/400	1/200	1/200
	<i>V. cholerae</i> ...	1/10	1/60	1/40	1/40	1/40
	<i>M. melitensis</i> ...	—	1/40	1/80	1/80	1/20
No. 2.	<i>B. typhosus</i> ...	1/20	1/1200	1/400	1/250	1/200
	<i>B. paratyphosus</i> A ...	1/20	1/500	1/400	1/300	1/200
	<i>B. paratyphosus</i> B ...	1/20	1/500	1/300	1/300	1/150
	<i>V. cholerae</i> ...	1/20	1/100	1/80	1/40	1/40
	<i>M. melitensis</i> ...	1/10	1/40	1/200	1/150	1/80

CONCLUSIONS.

The use of Castellani's tetravaccine, typhoid + paratyphoid A + paratyphoid B + cholera, is harmless, and the inoculated persons develop protective substances for the four diseases. My results are therefore identical to those obtained by Castellani, Mendelson, and Randon, who have used that vaccine on a very large scale.

The use of the pentavaccine, typhoid + paratyphoid A + paratyphoid B + cholera + Malta fever, is also harmless, and, according to my experiments, the inoculated persons develop protective bodies for the five diseases. In my opinion, these mixed vaccines should be used as a matter of routine in all countries where such diseases exist already or may be easily imported.

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Castellani and Mendelson: *BRITISH MEDICAL JOURNAL*, November 13th, 1915.

DR. HENRY MACDONALD CHURCH, Demonstrator of Anatomy in the University of Edinburgh, left personal estate in the United Kingdom valued at £17,400.

REPORT OF A CASE OF SEVERE TETANUS SUCCESSFULLY TREATED BY ANTITOXIN.

BY

T. P. KILNER, CAPTAIN R.A.M.C.(T.F.).

THOUGH the following report was written in the earlier months of the war, when tetanus was much more commonly seen than it is now, it still may be justified in its publication in that it may give some little guidance to those who are called upon to treat the cases of a similar type which still occasionally appear.

At the time of writing much discussion was in progress around the whole subject of tetanus and its treatment, but the views and suggestions put forward were so numerous and so extremely varied that it was quite obvious that no very definite "best" line of treatment had been found.

Up to the commencement of the war reported cases in England were comparatively few, and even in America, where statistics of antitoxin treatment are particularly abundant, detailed reports are scarce, so that one is unable to get clear ideas of the severity of a particular case, the doses of antitoxin required, and the precise nature of the effects of the treatment on the patient.

It would seem, however, that insufficient patience and perseverance are exercised in many cases, and that one settles down too easily to the conclusion that all cases with a short incubation period are hopeless from the onset—a statement certainly borne out by a report in the *BRITISH MEDICAL JOURNAL* about the time of writing, which said: "The result (death) seems to agree with what was already fairly generally recognized—namely, that if the disease has an incubation period of less than twelve days it is fatal in spite of treatment, whether by antitoxin or other means."

A private, aged 31 years, was admitted to the Manchester Royal Infirmary in the early morning of October 31st, 1914. He gave a history of having been wounded at Ypres at 8 a.m. on October 27th by the explosion of a shrapnel shell, and on examination was found to have a large suppurating crateriform wound, extremely foul-smelling, occupying a position on the inner side of the right leg immediately below the knee-joint. A small punctured wound was also present on the anterior aspect of the joint, but the two had apparently no connexion, and the joint itself was not opened.

He stated that after receiving his wounds he had to drag himself, his leg trailing along the ground, for a distance of about fifty yards before reaching cover, and that it was not until 8 p.m. that the wound received its first dressing. He had lost large quantities of blood, and was very anaemic and toxæmic looking when he arrived in hospital, four days after the injury. The wound was dressed with boracic fomentations every four hours, and irrigated frequently with hydrogen peroxide solution. The cavity involved the upper end of the tibia, and from time to time fragments of necrosed cancellous bone were removed.

The wound cleared up somewhat, but the question of amputation was under consideration on account of the bad general condition of the patient and the obvious impossibility of preserving a useful limb, when at 9.30 on the morning of November 5th, nine days after the injury, rigidity of the masseters was first noticed, the patient complaining of a sore throat and being found unable to open his mouth for inspection.

Previous to this, one had been on the outlook for signs of tetanus, for the patient had shown those profuse sweats which are apparently frequently the precursors of the condition, and which had been particularly marked on the previous evening.

The trismus increased rapidly and spread to the muscles of the neck and abdomen. Perspiration was profuse, so that the bed linen was soaked. At noon of the same day the leg was amputated at the middle of the thigh, partly with a view to removing the focus of infection and partly because hopes of preserving the leg were obviously small. At the time of operation about 1,000 units of antitoxin were injected into the spinal theca, and a further 2,000 units given subcutaneously. At 6 p.m. the patient had recovered from the anaesthetic, but was still very rigid about the head and neck.

The abdominal muscles were also tightly contracted, and there had been some clonic contraction of the arm muscles associated with stertorous breathing. A second anaesthetic was administered, and 4,500 units of antitoxin were injected spinally and 9,000 units given subcutaneously in the abdominal wall. Two teeth were extracted at the same time in order to facilitate the anticipated difficulty in feeding. The foot of the bed was raised and the room kept as quiet as possible.

At 1 a.m. of the following day 6 oz. of chloretone in olive oil were administered by the rectum for the continued clonic contractions of the arm muscles. Potassium bromide and chloral (aa gr. xx) were then given by the mouth at intervals of four hours. At 4 p.m. a further 15,000 units of antitoxin was given subcutaneously.

Active treatment was now temporarily suspended. The patient was fed on fluids, of which he managed to take large quantities without resort to tube feeding being necessary. His condition gradually improved, but the inability to open the mouth persisted until November 15th. A little previous to this it had been noted that the spasm relaxed slightly during sleep. On November 16th the patient took solid food for the first time. On November 17th he was given a further 15,000 units of anti-toxin, 4,500 being administered spinally, 10,500 subcutaneously.

It should be noted that on each occasion when serum was given the patient's condition became temporarily much worse, there being marked increase in rapidity of the pulse and considerable rise of temperature. During the last spinal injection it is interesting to note that the patient experienced painful numbness and tingling in the amputation stump which by this time was practically healed.

Gradually the patient resumed the normal state of health—there was no return of muscular spasm, and we were able to transfer him to a convalescent hospital very shortly; there, according to later reports, he made an excellent recovery.

The points to which I would draw particular attention are:

1. Recovery in spite of well-marked symptoms and a short incubation period (nine days).
2. The large doses of serum administered, 46,500 units in all.
3. The very slow and gradual relaxation of spasm.

I am indebted to Captain E. D. Telford, F.R.C.S., R.A.M.C.(T.), in whose wards the patient was treated, and to whom I was acting as house-surgeon at the time, for permission to publish these notes.

SEROLOGICAL TESTS IN DYSENTERY CONVALESCENTS.

BY

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AND

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In a previous paper¹ we have explained that the subacute cases of dysentery which have been admitted here have all been due to infection by *B. dysenteriae* Shiga, this organism having been recovered from the dysenteric dejecta. Since that paper was published three further subacute cases have been found to be due to *B. dysenteriae* Shiga and two to *B. dysenteriae* Flexner. Only in one case so far has *E. histolytica* been present in the active form. As already mentioned, a large number of convalescent cases were admitted from whose faeces (for the most part not of dysenteric type) no organisms of the typhoid-dysentery group were recovered. There were probably 150 to 200 of these. In a certain proportion of these flagellates were found to be present in the stools, but owing to pressure of work it was impossible to analyse these cases more exhaustively. Recently, however, a fresh batch of these convalescents arrived, and the opportunity was taken to ascertain by agglutination tests with the serums of the cases what proportion of them had suffered from bacillary dysentery. The necessity for this investigation was rendered the more urgent as conflicting evidence had reached us with regard to the relative proportion of bacillary and amoebic dysentery in the Near East. The history given by these convalescents did not point invariably to dysentery, but might have been construed in some cases as typhoid infections. We have now examined the serums of over 100 of these cases, the stools in all (except one) being negative as to *B. dysenteriae*, *E. histolytica*, and typhoid organisms. The technique was that described in the previous paper. Time limit twenty-four hours.

Determination of the Upper Limit of Agglutination of *B. dysenteriae* Shiga by the Serum of Normal Persons.

It has been generally held that agglutination of *B. dysenteriae* Shiga in a dilution of 1 in 50 is significant of infection, and the statement is probably in the main true, but such statements are unfortunately not accompanied by specifications of the time limit, the method employed, and the degree of agglutination at this dilution. We therefore decided to obtain the upper normal limit in a series of serums of normal persons (generally orderlies) who had never been out of the country, and had never

suffered from dysentery. Twenty-three such have been examined under the prescribed conditions, with the following result:

- 14 gave no agglutination whatever at 1 in 50.
- 3 gave a trace of agglutination at 1 in 50.
- 3 gave agglutination amounting only to one + at 1 in 50, but no agglutination at 1 in 100.
- 3 gave agglutination amounting to one + at 1 in 50, and a mere trace of agglutination at 1 in 100.

In no case was complete agglutination at 1 in 50 with normal serum obtained.

It was decided therefore to treat all reactions above "50 (+) 100 (trace)" as significant.

Results in 103 Convalescents, the Great Majority of whom gave a History of Dysentery.

- 24 gave no agglutination in 1 in 50.
- 12 gave a trace of agglutination in 1 in 50.
- 11 gave agglutination (+) in 1 in 50, but no agglutination at 1 in 100.
- 7 gave agglutination (+) in 1 in 50, and a trace of agglutination at 1 in 100.

The above (54) fell within normal limits. Of the remaining 49 cases—

- 15 gave agglutination with end point between 100 and 200. (Illustrative reaction, 50 (+++) 100 (+) 200 (0).)
- 19 gave agglutination with end point between 200 and 400. (Illustrative reaction, 50 (++++) 100 (+++) 200 (+++) 400 (0).)
- 15 gave agglutination with end point beyond 400. (Illustrative reaction, 50 (++++) 100 (++++) 200 (++++) 400 (+++), 800 (+).)

We conclude, therefore, that 49 or 47.5 of the convalescents have suffered from bacillary dysentery (type Shiga).

Dr. Woodcock, parasitologist to the hospital, found 41 per cent. of these cases showed in the faeces either one or more of the following protozoa—namely, *Lamblia intestinalis*, *Trichomonas*, or *Entamoeba coli*. The positive Shiga agglutination cases were not found to be more liable to harbour the above protozoa than the negative Shiga cases.

REFERENCE.

¹ Ledingham, Penfold, and Woodcock, Recent Bacteriological Experiences with Typhoid Disease and Dysentery, *BRITISH MEDICAL JOURNAL*, November 13th, 1915.

METASTATIC ENDOPHTHALMITIS IN A CASE OF CEREBRO-SPINAL MENINGITIS.

BY

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I THINK the following case worthy of record for two reasons—(1) the way the threatened panophthalmitis was aborted, and the quick resolution of the inflammation, possibly due to the antimeningococcus serum; (2) the cultivation of a pure growth of meningococcus from the interior of the eye.

Private H., aged 19, had pneumonia on the transport during the voyage from Australia. He arrived in Egypt on September 28th, and was sent to a convalescent hospital.

He was well until October 9th, when he had severe headache, diarrhoea, and vomiting, with rise of temperature. On October 10th the headache was worse, he became unconscious, and was admitted to hospital. He then had all the signs of meningitis: head retracted, vomiting frequently, restless, and groaning; temperature 103°. Extensor response present, and also Kernig's sign. The eyes were apparently normal, except that the right pupil was noticed larger than the left; both pupils acted to light; there was no deviation.

On October 11th, lumbar puncture showed cerebro-spinal fluid under pressure, turbid, and clotting rapidly.

Bacteriological Report.—"Fluid frankly purulent, stained films show preponderance of polymorpho-neutrophils with numerous endothelial cells and a small intracellular Gram-negative diplococcus. Culture on Buchanan's medium shows a pure culture of a Gram-negative diplococcus, morphologically indistinguishable from the meningococcus of Weichselbaum."

October 12th. The left eye was noticed to be inflamed, and when I saw the case the same morning the lids were slightly swollen, there was slight ptosis, general injection of conjunctiva, episcleral oedema, cornea hazy. Descemet's membrane covered with thin yellowish film; anterior chamber deep, turbid, and iris covered with thick grey-yellow exudate; pupil contracted, inactive to light, and completely filled with exudate; no fundus reflex obtained; globe tender; tension slightly subnormal; vision bare perception of light. There was no proptosis, and ocular movements were full in all directions. There was no discharge from the conjunctiva, and no dacryocystitis. There was partial left-sided facial paralysis.

I diagnosed metastatic infection, and, deciding that there was