certainly set up septic bronchitis and abscess of the lung. Should the direct method be unavailable, tracheotomy had better be performed, as this operation has been proved to have a favourable influence on the mortality rate. Not infrequently the foreign body is coughed out through the tracheotomy wound.

Occasionally children are brought to the hospital who are said to have swallowed some foreign body, usually a coin, and radiography reveals its presence in the oesophagus. There may be no symptoms, as the oesophagus is a very tolerant structure. As a rule, the body is impacted at the entrance to the oesophagus, in the post-cricoid region.

The instrument known as the coin-catcher may be used in removal, or, better still, the more modern and scientific method of oesophagoscopy. It is a much easier proceeding than bronchoscopy.

Laryngeal Diseases in Children.

In conclusion, I wish to direct attention to a few practical points regarding diseases of the larynx in small children. These diseases are difficult to diagnose, and are often a source of much anxiety not only to the parents but to the medical attendant.

The child's larynx is a smaller structure than might be supposed, and its cartilages are very soft. Hence stenosis and suffocation are more liable to occur in children than in adults. Laryngoscopy is more difficult, though in the ordinary routine examination of the throat with a tongue-depressor one often sees the epiglottis in small patients. I have had to allay the fears of more than one anxious mother who thought her child's epiglottis was something pathological. The inferior turbinal bone in the nose is a similar offender, and on three occasions in my experience it has been diagnosed as polypus. Nasal polypus is very rare in childhood.

You may be called out one night to see a child who has suddenly developed a "croupy" cough, accompanied by choking and shortness of breath of a very alarming nature. I need not enlarge on this condition, which is so fully described in textbooks under the various names of "laryngitis stridulosa," "croup," or "spasmodic laryngitis."

The nervous spasm occurring in rickety infants, and known as laryngismus stridulus, is quite a different disorder. The spasm and cyanosis are quite transient, and attacks may come on at any time during the day or night. Treatment should be directed towards the underlying condition.

In both of those diseases remember that adenoids are frequently an important factor in the etiology.

Another laryngeal affection of infancy is congenital laryngeal stridor. It commences at birth or shortly after birth, and consists of a crowing or croaking sound accompanying each respiration. The sound varies in intensity and diminishes during sleep. Thanks to direct laryngoscopy, we now know that the larynx in those cases is backward in its development. The epiglottis is sharply folded upon itself and the arytenoids are closely approximated so that the upper aperture of the larynx is narrowed. No treatment is required, as the condition tends to disappear during the second year of life.

Lastly, I shall merely mention papilloma of the larynx, which must be borne in mind as a possible cause of laryngeal obstruction in children. Its diagnosis is beset with difficulty, tracheotomy is often necessary, and the growths are very liable to recur after removal.

MR. W. B. SMITH, Federal chemist, Kansas, recently reported that court plaster which is being sold throughout the State is full of tetanus bacilli. This report led to the arrest of five Germans. Samples of the plaster are being examined by the United States Department of Justice.

A SOCIETY for American fellowship in French universities has been formed for the purpose of bringing to the notice of American students the extensive facilities offered by French institutions and to induce them to seek there the opportunities for further study which they have hitherto been led to believe were to be found only in Germany. Ten or more graduate fellowships for American students are to be established in French universities to be awarded as the result of competition and to be held for two years. The society has published a book entitled *Science and Learning in France*.

COMBINED VACCINATION WITH MULTIPLE VACCINES (QUADRUPLE, QUINTUPLE, AND SEXTUPLE).

BY

ALDO CASTELLANI, M.D., M.R.C.P.,
LIEUT.-COLONEL ROYAL ITALIAN MEDICAL SERVICE (NAVY),
MEMBER INTERALLIED SANITARY COMMISSION;

AND

FRANK TAYLOR, M.D., M.R.C.P., F.R.C.S., D.P.H.,
LECTURER ON BACTERIOLOGY, UNIVERSITY OF LONDON,
KING'S COLLEGE; PATHOLOGIST, ROYAL WESTMINSTER
OPHTHALMIC HOSPITAL.

THE advantage of using the method of combined vaccinations, introduced by one of us (C.) long ago, is at the present time recognized. The triple vaccine—typhoid + paratyphoid A + paratyphoid B—for instance, prepared and used by one of us since 1905, has recently been adopted in all the allied armies, thanks especially to the work of Dreyer, Walker, Gibson, Bassett-Smith, Cumming and Cummins, Widal, Chantemesse, Vincent, Sergeant, Nègre, Rho, Conte, Porcelli, and others. There are, however, other combined vaccines which will be found useful, and it is on these vaccines—containing, some of them, four, five, and six species of germs—we desire to make some remarks based on a certain amount of experimental work we have carried out.

TETRAVACCINE No. 1 (T.A.B.C.).

Technique of Preparation.—The growth of twenty-four hours typhoid agar cultures is washed off with sterile 0.85 per cent. salt solution to which 0.5 per cent. carbolic acid has been added; the emulsion so obtained is stored at room temperature for twenty-four hours and then standardized.

In some rare cases, when the emulsion is very thick, twenty-four hours may not be sufficient for the small amount of carbolic present to sterilize it completely; the germs, however, will be non-motile, easily counted, and the addition of carbolic salt solution necessary to standardize the vaccine will quickly kill the germs. To standardize the emulsion the bacilli are counted by using a Thoma-Zeiss apparatus, and sufficient carbolic salt solution is added to reduce the number of germs to 2,000 million per cubic centimetre. The standardized emulsion is tested some hours later for sterility. The same procedure is carried out with twenty-four hours old agar cultures of paratyphoid A and paratyphoid B, these two emulsions being standardized to contain 1,000 million organisms per cubic centimetre. The above procedure is also carried out with cholera cultures, the emulsion of which, however, is standardized to contain 8,000 million germs per cubic centimetre. The four standardized emulsions (when found sterile) are mixed together in equal proportions, and the vaccine will therefore contain per cubic centimetre:

Typhoid	...	...	...	500 million
Paratyphoid A	...	...	...	250 "
Paratyphoid B	...	...	...	250 "
Cholera	...	...	...	2,000 "

This mixture, which must be tested for sterility, is the combined vaccine. Of this mixture $\frac{1}{2}$ c.cm. is given under the skin of the arm the first time, and the same, or double the amount, a week later.

Blood Examination of Rabbits Inoculated with Tetravaccine No. 1 (T.A.B.C.).

With the assistance of Mendelson, Porcelli, and others we have carried out experiments on seven rabbits, each of which had received two injections of the tetravaccine, at a week's interval.

The doses given varied between 0.2 c.cm. and 1 c.cm.; the production of agglutinins was investigated in all the seven rabbits, and bacteriolysins in three. The amount of antibodies produced did not seem to be in proportion to the amount of vaccine inoculated; this confirmed the old observation made by one of us, that when immunization is obtained by one injection the production of antibodies is not in proportion to the amount of vaccine injected. Provided a sufficient minimum quantity be given, the same amount of agglutinins, bacteriolysins, etc., will be produced whether one, five, or ten times that minimum dose be given.

The four curves show the agglutinins induced by the injection of tetravaccine in rabbits. They are practically identical with the curves obtained in control rabbits injected with monovaccines.

Agglutination curve for *B. typhosus* in rabbits inoculated twice (at a week's interval) with tetravaccine (T.A.B.C.).

Agglutination curve for *B. paratyphosus* A in rabbits inoculated twice (at a week's interval) with tetravaccine (T.A.B.C.).

Agglutination curve for *B. paratyphosus* B in rabbits inoculated twice (at a week's interval) with tetravaccine (T.A.B.C.).

Agglutination curve for *V. cholerae* in rabbits inoculated twice (at a week's interval) with tetravaccine (T.A.B.C.).

As regards bacteriolysins, in the three rabbits examined they were present for the four species of microbes, and did not seem to be present in smaller amount than in control rabbits inoculated with monovaccines.

Blood Examination of Individuals Inoculated with the Tetravaccine (T.A.B.C.).

The production of agglutinins for typhoid is large, for paratyphoid A and paratyphoid B satisfactory, for

cholera small. The agglutinins present for paratyphoid B are generally in larger amount than for paratyphoid A. The production of agglutinins is not inferior to that found in control individuals inoculated with monovaccines. In fact, not rarely have we noticed that during the first two or three weeks the agglutinins, especially for typhoid and cholera, are in higher amount than in individuals inoculated with monovaccines.

Innocuity of the Tetravaccine (T.A.B.C.).

In Ceylon several thousands of individuals were inoculated in 1913 and 1914, and in Serbia more than 120,000 men were inoculated in 1915 with the tetravaccine by Castellani and Mendelson, Lurie, Mitchell, Shattock, Colonel Randon Head of the French Mission, and others, without any untoward result. It was adopted by the American Red Cross Commission, at the head of which were Drs. R. Strong and T. Jackson. No really serious reaction was ever observed, and the inoculated persons were generally able to attend to their duties in from twenty-four to forty-eight hours after injection. The opinion of the medical men in charge of the troops and of the Serbian authorities was very favourable; so much so that the vaccine has recently been adopted officially for the whole of the Serbian army. As regards results, owing to the unfortunate condition of the country elaborate statistics are unobtainable, but the four diseases have been practically absent from the portion of the Serbian army which was inoculated with this vaccine.

TETRAVACCINE No. 2 (T.A.B.M.).

This vaccine consists of an emulsion in carbolyzed saline solution (carbolic acid 0.5 per cent., salt solution 0.85 per cent.) of *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, and *M. melitensis*. In the preparation of the vaccine care should be taken to use a strain of *M. melitensis* rich in antigen, otherwise antibodies for this germ may not develop. The technique is the same as that described in the preparation of the Tetravaccine No. 1 (T.A.B.C.), but agar cultures of *M. melitensis* forty-eight hours old should be used. The technique of preparation is the same as that described above. The growth of the typhoid agar cultures is washed off with 0.85 salt solution containing 0.5 per cent. carbolic acid, is stored at room temperature for eighteen to twenty-four hours, and then standardized in such a way that 1 c.cm. will contain approximately 2,000 million typhoid bacilli. The same technique is used to prepare the paratyphoid A and B vaccines, each of these being standardized to contain 1,000 million. The same technique is used to prepare the Malta fever vaccine, but this vaccine is standardized in such a way as to contain 8,000 million per cubic centimetre.

After standardizing the four different vaccines and testing their sterility they are mixed together in equal parts. The vaccine will contain per cubic centimetre:

Typhoid	...	...	...	500 million
Paratyphoid A	...	...	...	250 "
Paratyphoid B	...	...	...	250 "
Malta fever	...	...	...	2,000 "

Of this vaccine 0.5 c.cm. is injected subcutaneously in the arm, and a week later the same or double the amount is given.

This vaccine has been used in a fairly large number of persons (over 600). The reaction was hardly higher than after the simple typhoid or mixed paratyphoid A and paratyphoid B vaccines. The blood of all inoculated persons examined (24) developed a large amount of agglutinins for typhoid, paratyphoid A and paratyphoid B, and a certain amount for Malta fever, which, however, in several cases, was very small. The amount of agglutinins produced for each germ was apparently not distinctly less than in control individuals inoculated with simple "one disease" vaccines.

PENTAVACCINE No. 1 (T.A.B.C.P.).

This combined "five diseases" vaccine consists of a carbolyzed saline emulsion of typhoid, paratyphoid A, and paratyphoid B bacilli, cholera vibrios, and plague bacilli.

Agar cultures twenty-four hours old are used in the case of typhoid, paratyphoid A, paratyphoid B, and cholera; agar cultures three days old are used in the case of plague, as this germ grows slowly. The technique of preparation

is the same as that already described. The vaccine is standardized to contain per cubic centimetre:

<i>B. typhosus</i> ...	...	...	500 million
<i>B. paratyphosus</i> A ...	...	...	250 "
<i>B. paratyphosus</i> B ...	...	...	250 "
<i>V. cholerae</i> ...	...	...	2,000 "
<i>B. pestis</i> ...	...	...	500 "

Half a cubic centimetre is given the first time and double the amount a week later.

Method of Vaccination.

The inoculation is made subcutaneously in the arm in the same manner as when using simple typhoid vaccine. In strong male adults we give 0.5 c.cm. the first time and 1 c.cm. a week later; in adults who do not appear to be very strong and also in women half doses are given with apparently the same satisfactory results. Children between 10 and 16 years of age receive about one-third of the adult dose; children below 10 years of age we have not yet inoculated. The inoculation of the vaccine is followed in a few hours by a local reaction (redness and some infiltration) and general reaction (fever, malaise, rheumatic pains), which generally do not incapacitate for work more than twenty-four to forty-eight hours. The reaction may be said to be, as a rule, much more severe than after the inoculation of simple typhoid, or the mixed typhoid, paratyphoid A, paratyphoid B vaccine, or the tetravaccine T.A.B.C., but certainly somewhat less severe, in our experience, than after using Haffkine's monovaccine. It is to be noted that occasionally one comes across individuals who show practically no reaction.

Innocuity of the Pentavaccine No. 1 (T.A.B.C.P.).

In Ceylon four coolies who volunteered were inoculated nine times each at a week's interval. They remained in good general health, though two had somewhat severe general and local reactions. All the individuals inoculated in the Balkanic and Adriatic zones (more than 400), apart from a rather severe reaction, remained in perfect health; they had each two injections—0.5 c.cm. the first time, 1 c.cm. a week later.

Blood Examination of Rabbits inoculated with Pentavaccine No. 1 (T.A.B.C.P.).

It is interesting to note that we have had much better results in rabbits inoculated in this country than in the tropics. Very often, in Ceylon, rabbits which were inoculated with more than four species of germs produced antibodies only for three or four species and not for all. In Ceylon rabbits are generally smaller than in Europe, and big healthy rabbits in this country seem to respond to inoculation much better. The results as regards agglutinins in two rabbits are collected in Table I.

TABLE I.—Pentavaccine (T.A.B.C.P.).

Rabbits inoculated.	Blood tested against	Limits of Agglutination. Weeks after First Inoculation.					
		1	2	3	4	5	6
No. B—III	<i>B. typhosus</i> ...	1/160	1/1280	—	1/320	—	1/160
	<i>B. paratyphosus</i> A	1/20	1/320	—	1/80	—	1/40
	<i>B. paratyphosus</i> B	1/160	1/640	—	1/160	—	1/160
	<i>V. cholerae</i> ...	1/160	1/640	—	1/160	—	1/160
	<i>B. pestis</i> ...	1/20	1/160	—	1/80	—	1/20
No. A—4	<i>B. typhosus</i> ...	1/160	1/1280	1/640	1/640	1/320	1/160
	<i>B. paratyphosus</i> A	1/20	1/160	1/80	1/40	1/20	1/20
	<i>B. paratyphosus</i> B	1/80	1/640	1/320	1/80	1/80	1/40
	<i>V. cholerae</i> ...	1/80	1/1280	1/320	1/80	1/80	1/80
	<i>B. pestis</i> ...	0	1/140	1/20	1/20	1/20	1/20

Porcelli observed that rabbits inoculated with the pentavaccine T.A.B.C.P., prepared by one of us, showed complete protection against the subcutaneous injection of virulent plague bacillus.

Blood Examination of Individuals Inoculated with Pentavaccine No. 1.

Lack of time has prevented the study of the amount of all protective substances produced in inoculated individuals. The investigation, therefore, has been limited to studying

the amount of agglutinins produced in comparison with individuals inoculated with simple "one disease" vaccines, the results being practically identical.

PENTAVACCINE No. 2 (T.A.B.C.M.).

This combined vaccine is prepared according to the technique already described. It is so standardized that each cubic centimetre contains:

Typhoid	...	...	...	500 million.
Paratyphoid A	...	...	...	250 "
Paratyphoid B	...	...	...	250 "
Cholera	...	...	...	2,000 "
Malta fever	...	...	...	2,000 "

In man $\frac{1}{2}$ c.cm. is given at the first injection, and the same or double the dose a week later.

Inoculation of Rabbits.—Three rabbits have been inoculated, with the results as regards agglutinins shown in Table II.

TABLE II.—Pentavaccine No. 2 (T.A.B.C.M.).

Rabbits inoculated.	Blood tested against	Limits of Agglutination. Weeks after First Inoculation.					
		1	2	3	4	5	6
No. B—1	<i>B. typhosus</i> ...	1/160	1/1280	—	1/160	—	1/80
	<i>B. paratyphosus</i> A	1/20	1/160	—	1/40	—	1/20
	<i>B. paratyphosus</i> B	1/40	1/320	—	1/160	—	1/40
	<i>V. cholerae</i> ...	1/40	1/640	—	1/80	—	1/40
	<i>M. melitensis</i> ...	1/20	1/320	—	1/160	—	1/80
No. B—2	<i>B. typhosus</i> ...	1/40	1/1280	—	1/160	—	1/40
	<i>B. paratyphosus</i> A	0	1/80	—	1/20	—	1/20
	<i>B. paratyphosus</i> B	0	1/160	—	1/40	—	1/20
	<i>V. cholerae</i> ...	0	1/640	—	1/320	—	1/40
	<i>M. melitensis</i> ...	1/20	1/320	—	1/80	—	1/40
No. A—19	<i>B. typhosus</i> ...	1/20	1/1280	1/1280	1/320	1/160	1/160
	<i>B. paratyphosus</i> A	0	1/640	1/640	1/160	1/80	1/80
	<i>B. paratyphosus</i> B	0	1/640	1/640	1/320	1/80	1/80
	<i>V. cholerae</i> ...	0	1/1280	1/640	1/320	1/160	1/80
	<i>M. melitensis</i> ...	0	1/320	1/640	1/320	1/80	1/40

Inoculation in Man.

In man 0.5 c.cm. is given subcutaneously in the arm, and a week later another injection of the same or double the dose. The reaction, according to observations made by one of us in Ceylon, and by Lurie in Serbia, is not severe, and the inoculated individuals are able to resume their ordinary avocations in twenty-four to forty-eight hours. The inoculated persons develop agglutinins in large amount for typhoid, in fairly large amount for paratyphoid A and paratyphoid B, in small amount for cholera and Malta fever; the amount of agglutinins produced does not seem to be much smaller than in control individuals inoculated with monovaccines.*

HEXAVACCINE (T.A.B.C.P.M.).

This vaccine consists of an emulsion in carbolized salt solution (carbolic acid 0.5 per cent., salt solution 0.85 per cent.) of *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *V. cholerae*, *B. pestis*, and *M. melitensis*. The technique of preparation is the same as that for the other multiple vaccines described above. The combined vaccine is standardized so as to contain per cubic centimetre:

<i>B. typhosus</i> ...	...	...	...	500 million.
<i>B. paratyphosus</i> A	...	...	...	250 "
<i>B. paratyphosus</i> B	...	...	...	250 "
<i>V. cholerae</i> ...	...	...	...	2,000 "
<i>B. pestis</i> ...	...	...	...	500 "
<i>M. melitensis</i> ...	...	...	...	2,000 "

In man 0.5 c.cm. is given the first time and the same or double the amount a week later.

Inoculation of Rabbits.—Rabbits have been inoculated in Ceylon and in this country, the doses varying between 0.1 and 0.5 c.cm. The rabbits in Ceylon did not respond very well to the inoculation as a rule; agglutinins in a number of cases did not develop for all the germs. In this country we have had much more satisfactory results. These are collected, as regards agglutinins, in Table III.

* For details supporting this statement the reader is referred to Dr. Lurie's paper, "Observations on Castellani's Tetravaccine and Pentavaccine," BRITISH MEDICAL JOURNAL, January 8th, 1916, p. 45.

TABLE III.—Hexavaccine (T.A.B.C.P.M.), Two Inoculations.

Rabbits Inoculated.	Blood tested against	Limits of Agglutination. Weeks after First Inoculation.					
		1	2	3	4	5	6
No. B-3	<i>B. typhosus</i> ...	1/320	1/1280	—	1/320	—	1/40
	<i>B. paratyphosus A</i> ...	1/40	1/160	—	1/40	—	1/20
	<i>B. paratyphosus B</i> ...	1/80	1/640	—	1/160	—	1/40
	<i>V. cholerae</i> ...	1/320	1/640	—	1/160	—	1/40
	<i>B. pestis</i> ...	1/20	1/80	—	1/20	—	1/20
	<i>M. melitensis</i> ...	1/160	1/320	—	1/160	—	1/40
No. A-21	<i>B. typhosus</i> ...	1/80	1/1280	1/1280	1/320	1/80	1/80
	<i>B. paratyphosus A</i> ...	0	1/320	1/160	1/80	1/20	1/20
	<i>B. paratyphosus B</i> ...	1/20	1/1280	1/640	1/160	1/80	1/80
	<i>V. cholerae</i> ...	1/20	1/640	1/320	1/320	1/80	1/80
	<i>B. pestis</i> ...	0	1/20	1/40	1/20	1/20	1/20
	<i>M. melitensis</i> ...	1/20	1/80	1/160	1/160	1/80	1/80

Porcelli, carrying out experiments in the South of Europe with a hexavaccine prepared by one of us, found that bacteriolysins were produced in very satisfactory amount for all the germs. He observed also that the inoculated rabbits showed complete protection to the subcutaneous injection of virulent *B. pestis*.

Inoculation of the Hexavaccine in Man.

Six persons were inoculated in the tropics in 1913, and recently twenty persons in the Adriatic-Balkan zone. The reaction, as is the case with all vaccines containing plague, is severe; somewhat less severe, however, than after inoculating with Haffkine's plague monovaccine. The blood of two of the inoculated individuals was examined regularly during five weeks for agglutinins; they developed for typhoid in large amount; for paratyphoid A and paratyphoid B in a fairly satisfactory quantity; for cholera and Malta fever in small amount; and only a trace for plague. On the whole the production of agglutinins was similar to that observed in control individuals with monovaccines; but further researches on a much larger number of inoculated individuals will be necessary before coming to a definite general conclusion.

CONCLUSIONS.

1. The inoculation of the combined vaccines mentioned in this paper is harmless. The reaction is not severe with the exception of those containing *B. pestis*, but even simple plague monovaccines, whatever their method of preparation, give a severe reaction.
2. The mixed vaccines should be prepared by using emulsions in carbolized normal saline solution (carbolic acid 0.5 per cent., salt solution 0.85 per cent.) without heating. These emulsions give much less local reaction than broth cultures killed by heat. The presence of 0.5 per cent. carbolic acid is sufficient to kill the micro-organisms.
3. It is essential to use in the preparation of the vaccines selected strains of the various micro-organisms which have been found by experience to be rich in antigen. This is especially the case as regards *B. paratyphosus A* and *M. melitensis*, some strains of which are very poor in antigen, and when injected give rise to only a small production of antibodies.
4. Combined vaccines are of practical advantage, especially in the case of troops, rendering possible a contemporaneous immunization for several different maladies; this saves a great deal of time, and the men do not suffer the discomfort of a large number of inoculations. To protect the troops against typhoid, paratyphoid A, paratyphoid B, and cholera with the old method of ordinary monovaccines in succession, eight inoculations at least were necessary, spread over a period of two months; with the tetravaccine T.A.B.C. two inoculations only are sufficient, spread over a period of a week.
5. The triple vaccine, typhoid + paratyphoid A + paratyphoid B (T.A.B.), prepared and used by one of us since 1905, has been adopted in practically all the armies. We consider that the tetravaccine (T.A.B.C.) is also past the experimental stage, and should be adopted in the routine inoculation of troops going east. The pentavaccines (T.A.B.C.P. and T.A.B.C.M.) have given encouraging results, and can, in our opinion, be used without any risk. The hexavaccine (T.A.B.C.P.M.) is still in the experimental stage, and we propose to continue our experiments

on it, as we consider that this vaccine, if it be found efficient, would constitute the ideal vaccine for use in the tropics.

BIBLIOGRAPHY.

- Bassett-Smith: *Proceedings Roy. Soc. of Med.*, 1915; *Trans. Soc. of Trop. Med.*, 1915.
 Castellani: Ceylon Medical Reports, 1904 and 1905; Transactions of the Bombay Medical Congress, 1908; *Centr. f. Bakt.*, 1909, Bd. 52, Heft I, and 1914, Bd. 72; *Lancet*, 1912; *Journal of the Ceylon Branch, British Medical Association*, October, 1913, June, 1914; *BRITISH MEDICAL JOURNAL*, 1913 (vol. ii, p. 1577), 1914 (p. 814), 1915 (May 1st, p. 446); *Indian Medical Gazette*, November, 1915; *Sperimentale*, 1915; *Trans. Soc. of Trop. Med.*, December, 1915, general account of investigations carried out on various combined vaccines; *Policlinico*, 1916.
 Castellani and Mendelson: *BRITISH MEDICAL JOURNAL*, November 13th, 1915.
 Conte: *Annali Med. Navale*, July-August, 1915.
 Cummins and Cumming: *Journ. R.A.M.C.*, 1914.
 Dreyer: *Proceedings Roy. Soc. of Med.*, 1915.
 Dreyer, Walker, and Gibson: *Lancet*, February 13th, 1915.
 Kabeshima: *Centr. f. Bakt.*, 1914, Bd. 74.
 Lurie: *BRITISH MEDICAL JOURNAL*, January 8th, 1916, p. 45.
 Porcelli-Tittoni: *Riforma Medica*, 1915, No. 15, and communications by letter.
 Rho: *Resoc. Accad. Med. Roma*, 1916.
 Sergeant and Nègre: *Bull. Acad. de Méd.*, October 26th, 1915.
 Widai: *Bull. Acad. de Méd.*, August, 1915.

RUPTURE OF LEFT BRONCHUS FROM TRACHEA.

BY

JOHN PATRICK, M.A., M.B.GLAS., F.R.C.S.EDIN.,

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

SURGICAL SPECIALIST, — CASUALTY CLEARING STATION, SALONICA.

WHILE there is no limit to the variety of possible injuries which the body may suffer, and while the record of them may tend to be equally limitless, occasionally a case is met with whose vagaries are so peculiar as to merit notice. I have had many opportunities of examining the bodies of persons who have died as the result of violence, but I cannot recall any injury quite like that of the following case:

Gunner J. S., aged 34, was admitted to the casualty clearing station, Salonica, with the story that he had on the previous day fallen from an empty general service limber, whose wheel had passed over his chest.

On admission he was suffering great respiratory distress, with orthopnoea. The complexion was livid, face swollen, eyes apparently bulging and lower eyelids very full. There was a great collar-like emphysematous swelling from the edges of the lower jaw to the clavicles, extending backwards across the posterior triangles. The left side of the chest was flattened, owing to fracture of several ribs. There was limited emphysema of the left side of the chest in the axillary line. The sternum was broken at the junction of the manubrium and gladiolus. There was no bruising or other evidence of injury on the skin of the chest wall. The temperature was 103.4°, pulse 110, respirations 44. No mitigation of the patient's distress and agony resulted from treatment. It was thought that his condition was due to acute pulmonary congestion with pneumo-haemothorax; he was so ill, however, that clinical examination was very imperfect. The temperature varied from 99.6° to 102°; the pulse very quickly reached from 128 to 140, and was often uncountable; the respiratory rate ranged from 40 to 52. His condition became rapidly worse, and he died seventy-two hours after injury. *Post-mortem* examination revealed the following:

1. Fracture of third to seventh left ribs at the anterior axillary line, the fifth penetrating the parietal pleura.
2. Fracture (incomplete) of the sternum at the junction of manubrium and gladiolus.
3. The left lung was collapsed to about one-fourth its ordinary size; the lower lobe was intensely haemorrhagic, with a blood cavity within it 2 in. in diameter; on section the lung appeared to be one mass of blood clot; the visceral pleura was covered by very thick shreddy exudation; there was no gross visible laceration of lung; the left pleural cavity was half full of blood.
4. Acute generalized pericarditis, exudation exceedingly loose, of buttered bread appearance; in the pericardial cavity were 1½ drachms of thin pus; heart otherwise normal.
5. Separation of the left bronchus from trachea, the tear being through the anterior portion to the extent of two-thirds of the circumference; acute inflammatory reddening of the mucous membrane of both bronchi; inflammatory infiltration of cellular tissue of middle mediastinum; the cartilaginous rings of trachea and bronchi normally flexible and tough.

The most striking primary features of the *post-mortem* examination were the profound degree of collapse of the left lung, its acute haemorrhagic state, evidence of the severity of the crushing blow, and the acuteness of the pericardial inflammation. This last was difficult to account for, and it was not till closer search was made that the rupture of the left bronchus from the trachea was found. There was no discoverable tear in the posterior pericardium,