Agglutination.

The explanation of the agglutination reaction as an adsorption phenomenon has been the thesis of many contributions to the literature of immunity. Bordet (1899) considered that agglutinin is adsorbed by the bacilli as dye is adsorbed by filter paper. The aggregation of the bacilli is then brought about by changes in the molecular attraction between the bacilli and the surrounding medium. The question of agglutination was very thoroughly studied from the adsorption standpoint by Craw (1905). Craw showed that the rate of addition of bacillary suspensions to agglutinating serum is a factor determining the amount of agglutinin fixed by the bacilli. By adding a suspension of bacteria in parts to the antiserum, Craw was able to show that more agglutinin was removed than is the case when the whole amount of bacillary suspension is added at once.

The process of agglutination is probably brought about by an interaction between the antiserum and antigen which has passed out from the bacillus into the medium which immediately surrounds it. The result of this interaction is the aggregation of the particles of the globulin of the antiserum on the surface of the bacillus. In other words, the proteins of the antiserum are adsorbed by the bacillus. For the production of agglutination the presence of precipitable protein is essential. If to a mixture of bacillary emulsion and diluted antiserum there be added a third ingredient—normal serum—the agglutination of the bacteria is rendered more complete. This reinforcement of the proteins of the antiserum by those of a normal serum has been called conglutination. This phenomenon was described independently in 1906 by Muir and Browning and by Bordet and Gay.

The substance present in normal serum which is able to aid the agglutination of red cells or bacteria by the homologous antiserum appears to be the englobulin (Dean, 1911).

That in such a reaction the englobulin is actually precipitated may be shown by experiment.

In discussing the merits of rival theories of the mechanism of the serum reactions it has been frequently observed that Ehrlich's hypothesis alone provides an explanation of the problem of specificity. The value of the side-chain theory as an explanation of specificity may, however, be doubted. To say that antigen unites with antibody as a key fits a lock is no explanation at all. It is merely a diagrammatic representation of the supposed facts. Of the nature of the fundamental reaction between antigen and antibody we have, at the present time, no knowledge. But in all the serum reactions which have been above considered the immediate consequence is an aggregation of globulin particles around the antigen. The degree to which the aggregation or precipitation proceeds depends entirely on the experimental conditions, on the relative proportions of antigen and antibody in the mixture, on the nature of the antigen-containing substance, red corpuscle, bacillus, or normal serum; on the presence of some third factor, a normal serum containing complement or conglutinin. In other words, the various serum reactions are various methods of observing and measuring one single reaction. The simplest of these reactions is the precipitation reaction, for in it the formation of the precipitate is directly observed. In the other reactions the aggregation of particles may be less complete, and the change is measured by indirect methods. The main phenomena are most readily accounted for by Bordet's adsorption theory, and no useful purpose would seem to be served by postulating the existence of a separate kind of antibody for each of these reactions. The reactions are no doubt of a very complex nature, as all reactions which occur in a mixture of colloids must be, and it is to be anticipated that great difficulties must be encountered before any entirely satisfactory explanation is arrived at. Similar difficulties have been met with in the past whenever the attempt has been made to explain physiological phenomena in the light of the laws of chemistry and physics. These difficulties will be met, and with a more perfect knowledge of the mechanism of the serum reactions there will be attained a more perfect knowledge of the laws which govern both natural and acquired immunity.

BIBLIOGRAPHY.

- Amako (1910): *Zeit. f. Immunitätsforschung*, Bd. 8, S. 168.
 Bang and Forssman (1906): *Beiträge z. chem. Phys. u. Path.*, Bd. 8, S. 238.
 Bordet (1899): *Ann. de l'Institut Pasteur*, T. 13.

- Bordet and Gengou (1901): *Ann. de l'Institut Pasteur*, T. 15, p. 289.
 Bordet and Gay (1906): *Ann. de l'Institut Pasteur*, T. 20, p. 467.
 Brand (1907): *Berl. klin. Woch.*, Bd. 44, S. 1075.
 Chapman (1910): *Proc. Roy. Soc.*, B, vol. lxxxii, p. 398.
 Craw (1905): *Journ. of Hygiene*, vol. v, No. 1, p. 495.
 Dean (1911): *Proc. Roy. Soc. Med.*, vol. v (Path. Sect.), p. 62. *Proc. Roy. Soc.*, B, vol. lxxxi, p. 416. (1912): *Journ. of Hygiene*, vol. xii, p. 259.
 Ferrata (1907): *Berl. klin. Woch.*, Bd. 44, S. 366.
 Gay (1905): *Ann. de l'Institut Pasteur*, T. 19, p. 593. *Centralb. f. Bakt.*, Abt. I, Orig., Bd. 39, S. 603.
 Gengou (1911): *Zeit. f. Immunitätsforschung*, Bd. 11, S. 143.
 Henderson Smith (1910): *BRITISH MEDICAL JOURNAL*, vol. ii, p. 1433.
 Ledingham (1907): *Journ. of Hygiene*, vol. vii, p. 65.
 Liefmann (1909): *Muench. med. Woch.*, vol. lvi, S. 2097.
 Moreschi (1906): *Centralb. f. Bakt.*, Abt. I, Ref., Bd. 38, Beiheft, p. 96. *Berl. klin. Woch.*, Bd. 43, S. 100.
 Muir and Martin (1906): *Journ. of Hygiene*, vol. vi, p. 265.
 Muir and Browning (1906): *Journ. of Hygiene*, vol. vi, p. 20.
 Neisser and Wechsberg (1901): *Muench. med. Woch.*, Bd. 48, S. 697.
 Neisser and Sachs (1906): *Berl. klin. Woch.*, Bd. 43, p. 67.
 Pick (1902): *Beiträge z. Chem. Physiol. u. Path.* (Hofmeister).
 Ritchie and Milne (1913): *Journ. of Path. and Bact.*, vol. xvii, p. 429.
 Sachs and Altmann (1909): *Handb. d. Technik u. Methodik d. Immunitätsforschung* (Kraus u. Levaditi), vol. ii, S. 969.
 Sachs and Bolkowska (1910): *Zeit. f. Immunitätsforschung*, Bd. 7, S. 778.
 Skwirsky (1910): *Zeit. f. Immunitätsforschung*, Bd. v, S. 538.
 Welsh and Chapman (1907): *Proc. Roy. Soc.*, B, vol. lxxviii, p. 297.

FIVE CASES OF LABOUR OBSTRUCTED BY A CONTRACTION RING.

By CLIFFORD WHITE, F.R.C.S.ENG.,

SURGEON TO THE SAMARITAN AND METROPOLITAN HOSPITALS;
 OBSTETRICIAN TO IN-PATIENTS, QUEEN CHARLOTTE'S HOSPITAL.

THE importance of a localized contraction of the uterus as a cause of obstruction in labour has been recognized more and more during the last few years. In the *BRITISH MEDICAL JOURNAL* of October 14th, 1916, Mr. H. T. Hicks attempts to describe the type of patient in whom it occurs, and discusses the means of diagnosis and treatment. He states that "in all these cases" the condition is associated with (a) primiparity; (b) some degree of pelvic contraction; (c) thinning of the lower uterine segment; (d) a movable presenting part above the brim, with the fundus continuing to contract, but later passing into a state of "tetany."

In five cases under my observation in which labour has been obstructed by a ring, and therefore probably closely related to his cases, most of the above conditions have been absent. There was not contraction of the pelvis, and tetany of the fundus did not supervene. These five patients had been pregnant 2, 5, 5, 0, and 14 times respectively.

It would appear, therefore, that the condition is one that covers a wider clinical area than Mr. Hicks's account would indicate. My interest in this condition of the uterus was aroused by the detailed examination of a specimen removed during labour by hysterectomy. This specimen showed that the contraction ring formed over a depression in the child's body, and that the part below the ring was not pathologically thinned. Thus, the ring has no connexion with the ring of Bandl, commonly called a retraction ring. It is usually termed a contraction ring, in distinction to the former, and the majority of American writers use this term. In 1912, when describing this specimen, I gave details of three cases, and gave

Left. Right.

Diagram to illustrate, on left, uterus with contraction ring. The lower uterine segment is not thinned, the fundus is frequently relaxed, and the ring forms over a depression in the outline of the fetus. On the right, uterus with retraction ring (of Bandl). The lower segment is thinned, the fundus is contracted, and the ring forms at the junction of the thickened upper and thinned lower uterine segments. It is possible that combinations of these two primary conditions may exist simultaneously.

references to the literature.¹ Since then two more cases have come under my care, and details of other cases under the care of my colleagues seem to indicate that localized spasm of the uterine muscle is a difficult subject, and one which is, at present, very imperfectly understood. Eden, in the 1915 edition of his *Midwifery*, recognizes: (1) Excessive retraction, with the formation of a retraction ring due to the violent efforts which the uterus makes to overcome some mechanical obstruction; (2) general tonic contraction from unsuccessful efforts of a strong uterus to overcome obstruction, or from irritation by drugs or manipulations; (3) local tonic contraction leading to a contraction ring.

The details of the two cases at present unrecorded are as follows:

CASE IV.

Primipara, aged 30, sent into Queen Charlotte's Hospital on August 2nd, 1913, by a doctor who had attempted to hasten delivery by manual dilatation of the cervix and high forceps, which failed. She had been in labour for forty-eight hours.

On admission: Pelvis $9\frac{1}{2}$, $10\frac{1}{2}$, $7\frac{1}{2}$ in. Child in L.O.P. position, dead. Head in cavity of pelvis. The resident medical officer's notes say: "No pains. It was decided to wait for pains and then perforate." When the fundus occasionally contracted the head was perforated, and with great difficulty he pulled it outside the vulva with the cranioclast, but all efforts to deliver the shoulders failed even after cleidotomy, and the fundus of the uterus now became "irritable."

When I saw her an hour later she was suffering from severe shock, so a 7 lb. weight was tied to the cranioclast, and she was left for transfusion, hot bottles, etc., for $1\frac{1}{2}$ hours. It was then very easy to deliver by bringing the arms down over the head and making light traction, whereas previously the strongest traction had failed to move the fetus at all. The fundus was now "flaccid," and the placenta temporarily retained, so it was removed manually and an intrauterine douche was given. There was no obvious ring obstructing the exit of the placenta, the delay being due to other causes.

The child weighed $8\frac{1}{2}$ lb. The mother recovered, but there was considerable sloughing of the vagina, resulting in the formation of a urethro-vaginal and uretero-vaginal fistula during the second week of the puerperium.

CASE V.

Patient aged 41. Fourteen previous pregnancies without difficulty. Admitted on August 26th, 1915, after being in labour twenty hours. Child dead and an offensive discharge coming from uterus. Previous repeated attempts at delivery had been made, and it was thought to be a case of locked twins, as a foot and hand could be felt high up, but nothing could be brought down below the brim.

I found a very tight contraction ring round the thigh of the child, which did not yield to continuous pressure. The mother being obviously infected, I did not risk a simple Caesarean section but excised the whole gravid uterus. As the vagina was cut through the child fell out, and so a detailed description of the specimen is useless. The mother made an uninterrupted recovery.

RETRACTION AND CONTRACTION RINGS.

It is obvious that these cases have no connexion with the retraction and thinning that occur, for instance, in a case of labour obstructed by a hydrocephalic head, where a retraction ring may form late in labour.

The conclusions arrived at from a study of the numerous recorded cases in 1912 may be summarized as follows:

DIFFERENTIAL DIAGNOSIS.

Contraction Ring.

1. A localized thickening of the wall of the uterus due to the contraction of the circular fibres over a point of slight resistance, most frequently over a depression in the child's outline or below the presenting part.

2. The uterine wall at the site of the contraction ring will therefore be thicker than it is either above or below.

3. The wall below is neither thinned nor over-distended.

4. The presenting part is not forcibly driven into the pelvis.

5. The child may be wholly or mainly above the contraction ring.

6. The body of the uterus above a contraction ring is usually relaxed and not tender.

7. Round ligaments are not tense.

Retraction Ring.

1. The junction of the thinned lower uterine segment with the thick retracted upper uterine segment.

2. The uterine wall above the retraction ring is much thicker than it is below it.

3. The wall below a retraction ring is both thinned and over-distended.

4. The presenting part is or has been jammed into the pelvis.

5. Part of the child must be below the retraction ring.

6. The body above a retraction ring is tonically contracted and hard.

7. Round ligaments stand out.

Contraction Ring.

8. A contraction ring may occur in the first, second or third stage of labour.

9. A contraction ring does not vary in position as labour goes on.

10. A contraction ring is rarely felt on abdominal examination.

11. The patient's general condition is good.

12. Causation.—Premature rupture of the membranes. Intrauterine manipulations.

Retraction Ring.

8. A retraction ring practically always occurs late in the second stage of labour.

9. A retraction ring gradually rises as retraction of the upper uterine segment proceeds.

10. A retraction ring may frequently be felt per abdomen (?).

11. The patient's general condition is bad.

12. Causation.—Obstructed labour.

The position of the ring is, roughly speaking, round the neck in 45 per cent.; below the whole of the child in 21 per cent.; round the arm in 15 per cent.; round the thorax in 9 per cent.; and round the after-coming head in 9 per cent. of recorded cases.

The difference between the condition of the lower uterine segments was well seen recently when attempting to excise a grossly infected tonically contracted gravid uterus without opening it. The tense thinned lower segment would not come up, and on attempting to put on curved clamps, in order to retain the infected fetus within the uterus, the lower segment cracked and ruptured. Whereas in the two cases where similar excision of infected contraction ring cases has been necessary, no such difficulty was met with.

In Dickinson's series of 90 cases, multiparae and primiparae were equally affected; in those that I collected it was twice as common in multiparae. Excluding laparotomy cases the maternal and fetal mortalities were 58 and 63 per cent.

TREATMENT.

Expectant treatment usually fails in a severe case. [Budin waited thirty-six hours, but no relaxation occurred.] Anaesthetics, morphine, and, in fact, all drugs are useless.

Dilatation.—In a slight case manual dilatation has succeeded. In severe cases the method of continuous weight traction advocated by Willett has been successful in several recorded cases. In my fourth case a fistula resulted, but she had had prolonged and repeated efforts made to deliver her before weight traction was used.

Forceps are useless. If the head is suspended by a ring round the neck, they usually slip off. If they do not fall off, intermittent traction merely pulls the child and uterus down together. Embryotomy is always particularly difficult, partly owing to the high position of the child; it is attended by a high maternal mortality and often fails altogether. Cleidotomy, as well as craniotomy, is necessary if the ring is round the neck, but often fails. Attempts to cut the ring from inside have been made, but are obviously futile. In a severe case, if manual dilatation and weight traction fail, laparotomy will be necessary. Laparotomy, in the cases collected in 1912, gave a maternal mortality of 7 out of 19. Now, including Hicks's three cases and my own last, it would be 9 out of 23, but in most of the old cases Caesarean section was not tried till all else had failed. If performed early, there is no reason why its death-rate should be higher than when performed for contracted pelvis.

REFERENCE.

¹ *Proceedings of the Royal Society of Medicine, Obstetrical and Gynaecological Sections, January, 1913.*

ON THE LIFE-HISTORY OF ASCARIS LUMBRICOIDES.

BY CAPTAIN F. H. STEWART, D.Sc.,
INDIAN MEDICAL SERVICE.

In papers published in the *BRITISH MEDICAL JOURNAL* on July 1st and October 7th, 1916, the life-history of *Ascaris lumbricoides* was traced from the hatching of the eggs in the alimentary canal of rats and mice to the arrival of the larvae in the mouth of these animals. It has been shown that the larvae reach the mouth on the eighth day after infection and are still present in abundance in the lungs and trachea on that day.

Guided by later experiments, it is now possible to trace the course of the parasite through a further stage. Larvae have been found to persist in the lungs and trachea of