Certain other experiments deserve mention, which were carried out in an infected flea-infested godown. The animals exposed in this case were divided into three groups: four animals were allowed to run about the floor; four, in cages, were suspended two inches above the ground; and four, in cages, were hung two feet above the ground. Fleas readily reached the animals of the first two groups, but not those of the third group. All the animals in the first two groups died of plague, but none in the third group.

On several occasions monkeys were placed in separate cages in an infected godown, two at a time. Both animals were protected from soil infection and were equally exposed to aerial infection if this occurred. One animal, however, was protected from fleas, either by a broad strip of sticky paper over which fleas could not hop or by a fine metallic gauze curtain which prevented their passage. Fleas had ready access to the other animal. The animals were left in the godown for forty-eight hours. Eleven animals protected from fleas all escaped infection, while six out of thirteen monkeys exposed to the attack of fleas contracted plague.

We are justified in assuming that close and continuous contact with plague-infected animals, if fleas are excluded, does not give rise to an epizootic among the healthy animals; that when fleas are present an epizootic may develop which varies in severity and rate of progress according to the season of the year and the number of fleas present; that an epizootic may be started without contact with infected animals if infected fleas are available; that, in fact, fleas and fleas alone are the transmitting agents of infection.

Mechanism of Transmission of Plague by Fleas.

Early in my work on fleas I made serial sections of fleas, and found that some of them, which had fed on a plague-infected rat, showed numerous plague-like bacilli in the oesophagus and in a valvular organ which is sometimes called "the gizzard," situated immediately in front of the stomach. I referred to these sections in a paper read before the Bombay Natural History Society in 1903, but the subject was also mentioned by Elkington in a paper on the propagation of plague published in the *Australian Medical Gazette* of August 20th, 1903. Elkington was a co-worker with me in the laboratory at Parel, and he refers to my sections as follows:

"These sections were stained and mounted in the usual manner, and it was found that the bacilli after a meal of infected blood were for the greater part retained in a curious gizzard-like structure between the oesophagus and the stomach, the blood corpuscles, after being broken up, passing on into the latter organ through a valve resembling a fish trap which prevents regurgitation. Check specimens fed upon healthy rats show no bacilli in 'the straining organ,' as it may be called, whereas in fleas fed upon plague-stricken rats large numbers of bacilli resembling the plague organism were seen microscopically. These bacilli appear to remain in the straining organ after the blood had been digested in the stomach and were found up to eighty-four hours after a meal."

But it remained for Martin and Bacot to prove the full significance of the appearances noted in these sections. They showed that while it was possible to infect animals by smearing the surface of the skin, which had been punctured by fleas, with the dejecta of infected fleas, as had been done by the Plague Research Commission, the number of successful transmissions by this method was low. By observing infected fleas feeding upon a healthy animal through a magnifying lens they succeeded in showing that infection could be brought about by the bites alone without the deposition of infected material on the punctured surface. The proportion of infections by this method was higher than by the former method. During the course of these experiments they noted that whereas certain fleas sucked energetically and persistently, yet no blood entered their stomachs, but the oesophagus became unusually distinct. On dissecting these fleas a curious condition was discovered—their gizzards or proventriculi were blocked with what proved to be a solid culture of plague.

They obtained a still higher percentage of successful transmissions by using "blocked" fleas. They explain that "although with the proventriculus obstructed in this manner blood cannot find its way into the stomach, this

does not prevent the insect sucking, but it only succeeds in distending the oesophagus. The blood in the distended oesophagus may flow out again on the cessation of the sucking act." They have seen drops of blood escape from the mouth parts of "blocked" fleas when the insect withdrew its proboscis. This appears to be the common way in which infection is transmitted by fleas, but the rubbing of infected dejecta on the punctured skin may perhaps also sometimes be a method of infection. I wish, however, to emphasize that the anatomical construction of the proventriculus, which allows of the pathological development of the "blocked" condition in plague-infected fleas, distinguishes these insects from other common blood-sucking insects such as bugs, lice, or mosquitos, and is one of the reasons why fleas are the instruments by which plague infection is transferred from animal to animal, as opposed to the other blood-sucking insects I have mentioned.

Summary.

The modern study of bubonic plague, then, has shown that the disease is essentially one of rodents; that men become infected from these animals by living in proximity to them; that the plague bacilli, which are the cause of the disease, are transmitted from rodents to men by the instrumentality of fleas, which, on account of their anatomical structure, are liable to develop a peculiar pathological condition which allows the injection of the bacillus under the skin when certain species of rodent fleas feed upon men in exceptional circumstances.

THE SCHICK TEST AND TOXIN-ANTITOXIN INJECTIONS FOR DIPHTHERIA.

BY

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OWING to the difficulty of stamping out an epidemic of diphtheria in the King Edward VII Hospital for Crippled Children, Sheffield, it was thought advisable to determine which of the patients and staff were susceptible to the disease by their reaction to the Schick test. An endeavour was then made to immunize those who had been shown to be susceptible by injecting toxin-antitoxin. After the third dose of toxin-antitoxin the cutaneous test was again made to ascertain whether the patients had really been rendered immune.

The Schick test was carried out by intracutaneous injection into the left arm of 0.2 c.cm. of diluted diphtheria toxin (representing one-fiftieth of the minimum lethal dose for a guinea-pig). The same amount of diluted toxin, previously heated, was injected into the skin of the right arm as a control. Children under 5 years old were not tested, as it was concluded that they would all give positive results (Report of Medical Research Council).

Initial Schick Test.

Of 89 children between 6 and 15 years of age 58 gave negative and 31 positive reactions. Of 14 members of the nursing staff 13 gave a negative reaction and 1 a positive. Of the 71 negative cases, 10 showed the negative and pseudo reactions; only one of these was an adult; of the 32 positive cases, 2 showed the positive and pseudo reactions, one being in an adult. In a few cases it was rather difficult to decide between the "negative and pseudo" and the "positive and pseudo" reactions in twenty-four hours; but in forty-eight hours there were hardly any doubtful cases, and these could be definitely settled by observing the subsequent progress of the reaction.

Toxin-Antitoxin Injections.

Three doses of toxin-antitoxin of 1 c.cm. each were given at intervals of one week to 28 patients who had given positive reactions to the Schick test, and also to 10 children under 5 years of age who were assumed to be susceptible on account of their age. Permission was obtained from the parents before making the injections. This was not refused in any instance. Three of the 31 patients who had

been proved susceptible but were not injected had to be discharged before it was possible to finish the investigation.

After the first dose only 2 patients of the 38 showed any marked reaction, either local or general. One was a boy, aged 8, who had an inflamed and painful arm for three days, but showed no general symptoms. This boy had no reaction after the two subsequent injections. The second was a girl, aged 7, who also had no general symptoms, but a well marked local reaction; she had both local and general reactions after the second dose.

After the second dose 5 patients had severe local reactions. The girl just mentioned above was kept awake all night with the pain in her arm, and had a temperature of about 100°; it became normal in twelve hours. Another girl also cried for some hours during the night with a painful arm, and six hours after the injection fainted in bed, although she had been kept recumbent all the time. Her temperature then rose to 100.8° (pulse 130, respirations 34), and ten hours after the injection was 102.2° (pulse 130, respirations 36). After this the temperature, pulse, and respirations gradually became normal, and by the next day the child seemed perfectly well. Two of the remaining five patients with local reactions had temperatures just under 100° for a few hours, but no other symptoms.

After the third dose none of the patients had any local or general reaction worth mentioning.

Second Schick Reactions.

The 38 patients who had been immunized with toxin-antitoxin were then tried with the Schick test again. Two of these still gave a definitely positive result, although the reaction was less marked than previously; 8 gave negative and pseudo reactions, 4 of these being in children under 5 years of age. The remaining 28 did not react at all, and were therefore presumably immune.

Summary.

Of 103 persons 32 were apparently susceptible to diphtheria. An endeavour was made to immunize 38 patients, including 10 patients under 5 years of age: 36 of these patients failed to respond to the Schick test, and probably therefore had been rendered immune.

ACUTE PUERPERAL COMPLETE INVERSION OF THE UTERUS: REPLACEMENT: RECOVERY.

BY

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ACUTE complete inversion of the uterus is an accident happily seen only rarely in modern obstetrical practice. According to Beckmann¹ not a single case occurred in the course of 250,000 labours in the St. Petersburg lying-in hospital, only one case was reported among 190,833 deliveries in Dublin, while Thorn² collected only 641 cases from the literature of the entire world. The average incidence, however, of this condition is no doubt underestimated by a study of the statistics collected from large obstetrical clinics in which all possible precautions are taken, and it is probably more common in private practice, in patients cared for in their own homes, and by accoucheurs less skilled in the practice of obstetrics. The following case came under my observation when I was assistant resident medical officer to the Brownlow Hill Infirmary, Liverpool.

A multipara, aged 30 years, was delivered by forceps in her own home at 10.15 a.m. on March 21st. The labour was not remarkable; the placenta was presumably expressed by Credé's method. The midwife in attendance reported that there had been no excessive haemorrhage, although the patient subsequently stated that she had bled profusely and had passed large clots all that afternoon. In the evening there was considerable abdominal pain, which kept the patient awake all night. In her own words, "there was also a sense of something slipping down inside, which felt like the head of another baby coming through." At about 6 o'clock the following evening the patient suddenly collapsed; a doctor was called, and ordered her immediate removal to hospital.

On admission the patient was in an extremely collapsed condition, and obviously suffering from profound shock. She was

quite unconscious, blanched, pulseless at both wrists, not restless, and her respirations very shallow. Completely outside the vulva was a mass about the size of a small coco-nut, in appearance exactly like a placenta with its uterine surface presenting. The usual means of combating shock were immediately taken: the foot of the bed was raised, the lower extremities were bandaged, and hot-water bottles utilized. In addition, strychnine was administered hypodermically, followed by ether intramuscularly. The pulse then became just palpable, and one pint of saline was transfused intravenously through the basilic vein. The pulse gradually improved, and consciousness was restored, but the patient still looked exsanguinated, in spite of the fact that there was no visible bleeding. At 10 p.m. more strychnine was administered hypodermically, and the uterus was then examined. Abdominally the hypogastrium was soft, and instead of the protuberance of the usually hard uterus a depression was noted. The "placental" mass outside the vulva was found to be distinctly pyriform in shape, with its broad end outside the vulva, and its apex firmly embraced by the cervix, whose collar-like circumference was easily palpable. The fundus could not be felt either anteriorly or posteriorly, and the walls of the vagina were normal. Reposition was easily effected manually without an anaesthetic by gently compressing the narrow end and pushing it through the cervical os. Digital dilatation of the os was found necessary before the fundus could be replaced. The fundus was then palpable by the hand on the abdomen; a hot douche was ordered and the vagina packed. At this stage the pulse was 160, temperature 97°, and respirations 28. The patient passed a fairly comfortable night, and appeared much better in the morning, but as the lochia were offensive 30 c.cm. of antistreptococcal serum was given. The temperature remained 101°-99.6° for two days, and on the third day the patient was anaesthetized and a tube was inserted into the uterus by Mr. Leyland Robinson. Eusol douches were given through this tube night and morning. Recovery was now uneventful.

The interesting features of this case are, to my mind: (1) the extreme gravity of shock; (2) the immediate good results of transfusion; (3) the ease with which the uterus could be replaced.

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Memoranda: MEDICAL, SURGICAL, OBSTETRICAL.

PERINEAL PROSTATECTOMY.

A METHOD I have used for some time now in removing a prostate by the perineal route, and which I have found very satisfactory, is the following:

The bladder is washed out with warm boracic lotion several times, and an ounce or two left in. The patient is then placed in the lithotomy position and a curved prostatic staff is inserted into the bladder. The scrotum being kept out of the way and the staff held in place, the prostate is reached by the usual perineal dissection—namely, exposure and retraction forward of the transversus perinei muscles, deeper dissection posteriorly bringing into view the lower part of the prostate and the recto-urethralis muscle, which is divided transversely, the necessary care being taken to avoid injury to the anal canal and lower part of the rectum, which is gently separated from the posterior aspect of the prostate. A good light is necessary, and a head-lamp is sometimes useful.

The point of one blade of a pair of scissors is now thrust into the groove in the staff through the membranous urethra at its junction with the prostate, and a cut made directly through the substance of the prostate and the capsular sheath on its postero-inferior aspect for about half an inch, the rectum being kept well out of the way.

A Teale's gouget is now gently but firmly pushed along the staff into the bladder and the staff withdrawn. There is here an escape of the remaining fluid in the bladder. The gouget, which tends to split the prostate, is now withdrawn, and the forefinger inserted in its place. The gland can now in most cases be easily shelled out in two or more pieces through the opening in the posterior and lower part of its capsular sheath which had been previously divided. The more "obstinate" portions may be twisted out with a stout pair of forceps.

The end of a six-inch by half-inch rubber tube with a lateral "eye" is inserted into the bladder, and the other end brought out through the wound, which is now closed interruptedly and the tube anchored by a stitch or two of silk worm gut. This end is clamped and the patient put back to bed, where the clamp is removed and a long rubber drainage tube is connected to it and led over the side of the bed into a basin or bucket.

The bladder is washed out two or three times a day, and the tube withdrawn on the third day and the patient allowed out of bed, the wound and perineum being well supported with