basal congestion and of patchy pneumonic consolidation; the consolidated areas are usually localised, varying from an area corresponding in size to a marble to that of an orange. Around the airless patches a margin of crepitant and deeply-coloured lung tissue is to be found. The pleural surfaces are usually dotted with petechiae, and occasionally with fair-sized subpleural hæmorrhages. The linings throughout the respiratory tract are reddened, injected, and show here and there hæmorrhages in the submucous tissue; a frothy blood-tinged mucus is commonly found occupying the passages.

The changes in the other viscera of the body are similar to those met with in bubonic plague; but there are no buboes, nor are enlarged glands, as a rule, met with anywhere in the body.

Septicæmic Plague.

The glands, in septicæmic plague, over the whole body are congested and swollen, in most instances to only a small extent, but in one group and frequently in one gland of the group adenitis has advanced considerably. There are no buboes, but a gland may be seen as big as a hazel nut here and there. When cut into the glands are pink in colour and of a firm rather tough consistence, but, in some of the larger sized, localised areas of softening occur. The visceral engorgement and congestion with petechiae and subendothelial and submucous hæmorrhages are features in septicæmic plague in common with all other varieties of the disease.

NOTES ON THE INTRODUCTION OF A CASE OF PLAGUE INTO THE NEIGHBOURHOOD OF CARDIFF.

By E. WALFORD, M.D., D.P.H.,

Medical Officer of Health for the Borough and Port of Cardiff.

THE danger of this country becoming infected by plague occurring on board vessels during a comparatively long voyage is one which cannot be ignored in view of the recent importation into the neighbourhood of Cardiff of an undoubted and tolerably well-defined example of the bubonic variety of the disease. The main facts connected with this particular case have been recorded, so that it will be unnecessary to add to any extent to the information already given. That the cases of illness which occurred amongst the firemen during the voyage of the *South Garth* from Rosario to King's Lynn were cases of plague is an assumption based almost entirely upon the light of subsequent events. If cases of pestis minor can be easily overlooked by medical practitioners, it is tolerably certain that they will not receive much attention at the hands of the ordinary master of a vessel, who does not as a rule exercise a very close medical supervision over his crew. The *South Garth* left Rosario about August 20th, and calling at Buenos Aires shipped in place of an old hand, who deserted, a new one—an Austrian—who acted as third engineer. When the steamer arrived at King's Lynn in September this man, who was seriously ill, was sent ashore to a hospital, but the nature of his illness, although a matter of great interest, has not yet transpired. The other members of the crew taken ill during the voyage were firemen shipped at Barry or Cardiff on the outward voyage to South America. The point of interest in the etiology is the determination of the method by which the disease was conveyed from Rosario and the infected ports in the River Plate to South Shields during a voyage of about thirty-three days. Apart from personal infection in connection with these doubtful or suspicious cases, there is the possibility of the cargo having become in some way infected, of some infected articles having been taken on board, and of the disease having been conveyed by means of rats. With respect to the cargo, it is to be remarked that this was discharged at King's Lynn between September 12th and 21st.

The man attacked with plague (W. G., the donkeyman) was found on his arrival at his house in Llandaff on Sept. 26th to be very ill, and had presumably been ill for some days. On admission to the Borough Hospital of Cardiff on October 2nd he had the appearance of a man in the second or third week of a severe attack of typhoid fever. The incubation would thus probably date from some time within the period of discharging the cargo of maize, and the origin may have been due to

the disturbance of this cargo. Rats were plentiful on board, and at various times several dead ones were noticed; possibly some of these rodents may have introduced the infection into the maize, and others may have become infected from it. There is no evidence that the patient was bitten or had touched any rat, and the method of infection in this, as in many other cases, remains obscure.

The chief precautionary measures devolved of course upon the rural sanitary authority in whose district the case occurred, and these consisted in the immediate isolation of the patient in the hospital of the adjoining urban sanitary district of Cardiff, in the medical examination of all persons who were in contact with the plague case, and the keeping under observation of "suspects" during the necessary period, and in disinfection or destruction of articles likely to be infected.

As regards the urban and port districts of Cardiff special precautionary measures have been adopted since the first introduction of the disease into Europe. Assistant medical officers and additional inspectors have been appointed to enable the authority to maintain an inspection of vessels from infected and suspected ports. Careful medical inspection of sailors' lodging houses is being carried out; inspection and cleansing of courts and dirty houses; circulars to medical practitioners relating to the notification of the disease. An infectious disease hospital has been provided with nearly 200 beds, and with separate buildings for the isolation of any such special cases, and furnished with a separate administrative department and staff. The destruction of rats on board vessels and in the neighbourhood of the docks has been carried out extensively during the past two months; about 2,000 of these animals have been caught and burned. The Port Sanitary Authority has, besides a hospital on the Flat Holm Island (about three miles from the shore), a very complete crematorium with mortuary and *post-mortem* room attached. The remains of the deceased, who died two days after admission into hospital, were on this occasion cremated in this apparatus, which was constructed by Messrs. Goddard and Massey, and, on the first occasion of its use, worked admirably, the entire remains being reduced to ashes in less than two hours.

The Port Sanitary Authority has compulsory powers under a local Act of Parliament for the cremation of persons dying from cholera, yellow fever and plague, but in this instance the full consent of the relatives was obtained.

As these remarks are only intended as an 'introduction' to the clinical and bacteriological notes which are of chief interest in this case, I have only to add that on this, as on many other occasions, the bacteriological laboratory, maintained jointly by the Glamorgan County Council and the Cardiff Corporation, was of extreme value, and the positive evidence of the presence of Kitasato's bacillus, given by Dr. Savage, our bacteriologist, at the earliest possible date, was completely confirmed by him by cultural and inoculation experiments, and by the subsequent investigation of Dr. Klein.

A CASE OF PLAGUE FROM A CLINICAL AND PATHOLOGICAL POINT OF VIEW.

BY

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THE rarity of plague in this country, and the completeness with which we were enabled to investigate the following case, is our excuse for giving the notes of it somewhat in detail. The vast majority of cases recorded and the bulk of work done in connection with this disease has been carried out abroad, and few cases are available for comparison between the disease as met with in tropical and in more temperate climates. This case agrees in the main with the classical descriptions derived from cases studied in the tropics.

CLINICAL REPORT.

History.

W. G., aged 38, donkeyman on board ss. *South Garth*, left

Fig. 3.—Haffkine's vaccine, showing stalactites.

Fig. 4.—*B. pestis* showing polar staining.

Fig. 5.—*B. pestis* showing chain and polar staining.

Fig. 1.—Cervical bubo.

Fig. 2.—Inguinal buboes.

Fig. 6.—*B. pestis* from primary bubo.

Fig. 8. Cultivation.

Fig. 7.—*B. pestis* in blood.

Fig. 9.—Involution forms $\times 1200$.

Fig. 10.—*B. pestis* in sputum.

Fig. 11.—Spleen showing *B. pestis*.

CLINICAL SIGNS AND BACTERIOLOGY OF PLAGUE.

DESCRIPTION OF SPECIAL PLATE.

- Fig. 1.—Photograph of case of plague, showing left cervical bubo and comatose condition with half-closed eyes. (From the Report to the Bengal Government on the Plague in Bombay in 1897, by Major Dyson, I.M.S., Sanitary Commissioner, Bengal, and Captain Calvert, I.M.S.)
- Fig. 2.—Photograph showing inguinal bubo in a male patient (Hindu) suffering from plague; taken on the ninth day of illness. The patient died on the following day. (After the lithograph in the Report of the Commission sent to Bombay by the Imperial Academy of Sciences in Vienna, *Über die Beulenpest in Bombay im Jahre, 1897.*)
- Fig. 3.—A culture of bacillus pestis in a flask (Soyka's) of broth; the surface of the fluid in the flask is shown, but the upper part of the flask has been shaded from view by a black screen. Several "stalactites" are seen growing near the side where they come into focus (natural size). From a photograph by Dr. Balfour Stewart (*The Thompson-Yates Laboratories Reports*, vol. iii, Part I).
- Figs. 4 and 5. Cover-slip preparations made by Professor Sheridan Delépine from cultures on agar-agar. Some bacilli show "polar staining." These cultures were made from the spleen pulp of a guinea-pig inoculated with a culture of the plague bacillus made by Dr. Calmette from a case of plague in Oporto. This culture, and the subcultures made from it by Professor Delépine during the last six months, have retained their virulence almost unimpaired. They have been kept at the ordinary temperature of the laboratory (about 18° C. to 20° C., except during the hottest days of summer, when the thermometer was above 22° C.). From photomicrographs by Dr. Sidebotham.
- Fig. 6.—Cover-slip preparation from the juice of a primary bubo, showing the enormous number of plague bacilli in a primary bubo, and their polymorphism (Hom. Imm. A. Zeiss, Comp. Ocul. 6), after a lithograph in the Report to the Academy of Sciences in Vienna.
- Fig. 7.—Cover-slip preparation from the blood showing the great number of plague bacilli shortly before death. (Same magnification as Fig. 6.) After a lithograph in the same report.
- Fig. 8.—Photograph of growth of the plague bacillus on agar-agar made by Dr. W. G. Savage from the case at Cardiff (natural size).
- Fig. 9.—Involution forms of the plague bacillus from a 4-days old culture on agar-agar (X 1200). From the *Bombay Plague, being a History of the Progress of the Plague in the Bombay Presidency from September, 1896, to June, 1899*, compiled by Captain J. K. Condon.

Fig. 10.—Cover-slip preparation from the sputum of a case of primary plague pneumonia, showing polar staining of bacilli and chains. (Same magnification as Fig. 6.) After a lithograph in the report of the Academy of Sciences in Vienna.

Fig. 11.—Section of the spleen, showing numerous plague bacilli in the tissues. (Same magnification as Fig. 6.) After a lithograph in the same report.

GEOGRAPHICAL DISTRIBUTION OF PLAGUE AT THE PRESENT TIME.

EXPLANATION OF MAP.

PLAGUE is apparently endemic in Upper India (Kumaon), Southern China (Yunnan and Pakhoi), Manchuria (North China), probably in Mesopotamia, Persia, and Turkestan. Plague has occurred on many occasions in the Levant since the pandemic of 1665, so that it may perhaps be considered endemic there. Dr. Clemow considers it more or less endemic in the neighbourhood of Samarkand. Koch reported it as endemic in an area east of Victoria Nyanza. The accompanying map of the world shows the places where plague has occurred since January, 1899. The names of areas where plague is endemic are twice underlined; the ports where plague has been limited to cases occurring on ships from infected places are marked by a single underline, and include London, Plymouth, Capetown, Trieste, Hamburg, St. Petersburg, and New York. Arrows are placed to show the probable diffusion of infection from various centres. China probably infected India in the first place, though Mohammedan pilgrims to Nadje on the Euphrates, where plague has appeared as lately as 1878, may have brought it back with them, or possibly it may have spread from Kumaon in the Himalayas, where it is endemic. With endemic areas in Manchuria, Russo-Mongolia, the Himalayas, and the Euphrates, it is quite possible for plague to be diffused by inland routes of pilgrimage or trade as well as by seaports. China has traffic with Australia, Oceania, Japan, and San Francisco, where Chinese quarters exist. India is connected by trade with Natal, Delagoa Bay, Madagascar, and the Mauritius, many Indian coolies migrating in these directions. India is probably responsible also for the outbreaks in the Red Sea and the Mediterranean, at the ports of London and Plymouth. It is not clear how South America was infected, but in its turn it has spread the disease from Rosario to both Capetown and Cardiff, though in neither case has a local outbreak followed. Possibly South America may be responsible for the outbreak at Oporto. The very limited outbreak at Vienna entered in the map was due to laboratory infection.

Rosario (La Plate) about August 20th. After a voyage of thirty-three days another member of the crew was landed at King's Lynn suffering from "enteric fever." Two days subsequently (September 23rd) W. G. left the boat at South Shields in consequence of not feeling well. He travelled from there to his home in Cardiff, reaching his destination on September 27th. He was medically attended from September 28th to October 2nd, when, suspicious symptoms developing, he was on that date transferred to the Cardiff Isolation Hospital as a possible case of plague.

According to his wife's statement his illness began on September 21st (on the very day the other member of the crew was landed at King's Lynn) with pains all over the body, lassitude, weakness, and severe headache. Six days subsequently (the day he reached home) he took to his bed with pains in the groins and back, faintness, constipation, and fever.

Symptoms and Physical Signs.

On the fifth day afterwards he was seen by one of us at his home. He was then obviously very ill, with high temperature, rapid pulse and respirations. In the right inguinal region was an enlarged gland about the size of a small walnut. This showed no signs of inflammation or tenderness; it was not hard, but showed no signs of breaking down.

At 6.15 on the same evening he was admitted to hospital in a state of collapse, his face cyanosed and terribly drawn, the lower jaw dropped, the tongue covered to the edge with a slimy grey deposit one-eighth of an inch thick. A similar but slighter deposit covered the pharynx and the soft and hard palate. His injected eyes stared with a fixed frightened look. The pupils were dilated, but reacted well to light. He was quite conscious, heard everything that was said, answered questions, but only monosyllabically from sheer weakness, and swallowed with great difficulty. The surface of his body was clean, but much pigmented from exposure. His trunk and extremities were covered with a dusky red macular rash disappearing on pressure, with spots varying in size from a hemp seed to a wheat grain, best marked over the abdomen and thighs. No information as to when it first appeared could be elicited. The appearance of this rash was somewhat suggestive of typhus. Slight movement or manipulation of the body caused intense pain. Three right inguinal and two right femoral and one left femoral gland were enlarged and very slightly tender. The central right inguinal gland was about the size of a small walnut, and not very hard; the others were smaller and harder. There was no inflammation of the skin over them, and they were freely movable; in fact the right chain of glands was suggestive of a syphilitic cause, but the history, absence of an abrasion or scar of any kind on the genitalia, negated the idea. The abdomen was moderately distended, the spleen considerably enlarged, and the liver just to be felt below the ribs. The skin was hot and dry, the pulse small and hard, the heart sounds pure but faint. The chest was hyper-resonant all over; vocal fremitus diminished; the air entered well, but moist, medium-sized rales were present, especially at the back, in both lungs. The pulse and respirations were very rapid, and the temperature 104.6° F. (see chart).

October 3rd, 9 A.M. The patient had slept little, being restless and at times unconscious during the night. He had a slight harassing cough but no expectoration; he seemed too weak to get it up. The rash was purple, and a few spots were petechial. A bright-red, slightly-raised patch, the size of a crown (3.8 cm.) had developed on the centre of the right shin. The bowels and bladder acted unconsciously. The patient still maintained the dorsal decubitus, making no effort to move. His eyes were open, with an apprehensive stare. He looked weaker, and respiration was more laboured. At 2 P.M. his condition was much the same; the patch on the right shin had become vesicular, and some semi-purulent fluid was taken from it. At 11 P.M. the patch on the shin was more inflamed and angry-looking, and a smaller one had appeared on the corresponding part of the left shin, but more towards its outer aspect. There was diarrhoea of a yellow offensive character; the urine was copious and passed involuntarily; specific gravity 1018, acid; no albumen.

October 4th, 9 A.M. He had passed a very restless night in great agony, and was delirious at times. The skin over the right shin had given way, discharging a necrotic mass and a

little purulent fluid, leaving exposed an irregular unhealthy surface, discharging sanious pus. That on the left leg had still further developed, and a small one had appeared on the left buttock. The rash had faded. There was very slight crepitus at the base of the lungs. The pulse was weak, and the patient was unable to answer questions. At 2 P.M. he was much weaker. The mouth was quite open, the tongue and the floor of the mouth rose and fell with respiration. The terrified look still persisted. The edges of the ulcer on the leg were thin and undermined; its surface dry and red. His extremities were very cold. He perspired a good deal, and the surface of the body was cold and clammy. His respirations and pulse gradually became weaker and intermittent, and he sank and died at 3.15 P.M.

CLINICAL DIAGNOSIS.

In such a well-marked case diagnosis, at any rate in the later stages, was not difficult. Perhaps the two diseases which were most nearly simulated were typhoid and typhus fevers. The differential diagnosis in this case was readily made by considering the expression of his face, the characters of the tongue, the enlargement in the groins, the rash and its time of appearance, and the necrotic areas on the shins (so-called carbuncles). On the other hand, the absence of abdominal symptoms such as tympanites, tenderness, and gurgling in the iliac fossa, and of typhoid spots, was against typhoid fever. Besides the positive symptoms of plague, the absence of the well-marked symptoms of typhus such as sudden onset, early drowsiness, stupor, and delirium, negated the idea of typhus fever.

PATHOLOGICAL REPORT.

Bacteriological Diagnosis.

At 4 P.M. on October 2nd the patient was first seen by one of us. He then presented a well-marked glandular swelling in the right groin. The skin over the bubo was sterilised by

in 500 corrosive sublimate, and all traces of antiseptic were removed by prolonged washing in alcohol. The needle of a hypodermic syringe (the whole, of course, previously sterilised) was inserted into the bubo, but only one or two drops of fluid could be withdrawn into the barrel of the syringe, though the needle was turned in several directions. These few drops were injected into an agar slope tube. A little blood exuded from the wound; this was inoculated by a sterilised platinum loop into a broth tube.

The finger was sterilised in the same way, pricked, and from the blood a blood serum and a broth tube were inoculated. Cover-glass preparations were also made from the blood, and some of the blood was collected into sterile pipettes.

The cultures were taken back to the laboratory, and incubated at 37° C. By 10.30 A.M. the next morning it was possible to give a diagnosis pointing strongly to the case being one of plague. This was founded upon examination of the films from the blood and from the cultures. Both coverslip preparations made from the blood showed bacilli in considerable numbers, quite indistinguishable from *B. pestis* (Fig. A). Of the cultures, the only one which showed any growth was the agar slope made from the bubo fluid. This showed minute translucent colonies, which when examined microscopically showed short, rather stout, bacilli, with rounded ends, very many of which were in pairs end to end. Stained by carbol fuchsin, and partially decolorised by very weak acid, they showed fairly well-marked polar staining. They were not stained by Gram's method, and examined in hanging drop they showed marked oscillatory movement, but no true motility. The agar culture was a quite pure one.

To complete the bacteriological diagnosis the growth on the agar slope, after twenty-four hours, was scraped off with a sterile platinum loop, made into an emulsion with sterile broth, and 2 c.cm. of this was injected subcutaneously into the neighbourhood of the left knee-joint of a young guinea-pig. The inoculation was made on October 3rd at 5 P.M.

October 3rd, 4 fresh cover-slip preparations were made from the blood; they all showed *B. pestis*. Cultivations were also made on agar slope.

All the cultivations made from the blood remained quite sterile. The broth culture from the bubo, however, after two days, showed the broth quite clear, but a considerable amount of powdery growth at the bottom of the tube. Films from this broth culture showed the bacilli in short chains (no chains longer than 11 bacilli were seen), the individual elements showing well-marked polar staining.

Fig. A.—Cover-slip preparation from the blood of the patient who died at Cardiff showing plague bacilli collected and examined October 3rd.

The symptoms of the case were originally very similar to those of typhoid fever, so with blood obtained on October 3rd it was thought advisable to perform Widal's test. No signs of any reaction were obtained in two hours with dilutions 1 in 30 and 1 per cent. The inoculated guinea-pig showed no symptoms until the evening of October 5th, when it became very quiet. On October 6th it was still very quiet, remaining in one place. It died at 1 P.M. that day—that is, nearly three days after the inoculation. Great swelling and hæmorrhagic exudation were found in the left groin. The individual glands could not be separated. Films from this exudation, stained by carbol fuchsin, showed numerous bacilli. The glands on the left side of the body, noticeably the gland near where the iliac artery divides, and the one in the neighbourhood of the

kidney, were markedly enlarged, and films from them showed on staining enormous numbers of bacilli, particularly in the latter gland. Bacilli just as numerous were found in the enlarged spleen (Fig. B). *B. pestis* in pure culture was obtained from the spleen, left lymphatic glands, liver, kidneys, and heart blood. No bacilli were found in the peritoneal fluid, and the glands on the right side of the body were not enlarged. The provisional bacteriological diagnosis was in this way completely confirmed.

Fig. B.—Cover-slip preparation direct from the spleen of an inoculated guinea-pig. It shows the enormous number of the bacilli in the spleen, and is almost like a preparation from a pure culture.

Necropsy.

The *post-mortem* examination of the patient W. G. was made at the mortuary attached to the crematorium on the Flat Holm Island of the Port Sanitary Authority of Cardiff twenty-four hours after death. Owing to unavoidable conditions a more complete examination could not be made. Thus the brain and cord were not examined, nor were the different viscera weighed.

External Appearances.—The body was that of a well-nourished, powerfully-built man. Rigor mortis had passed off. Hypostatic congestion was well marked. All traces of rash had disappeared. There was diffuse ecchymosis over the face, neck, and shoulders down to the level of the third rib. A sanious froth oozed freely from the mouth. The glands in the right groin were visibly enlarged; these were removed *en masse*, and subsequently it was a matter of great difficulty to separate the individual glands owing to the great infiltration around them; in some places this was hæmorrhagic. The larger glands when cut across were of a pinkish-red colour. The glands in the left groin, though not visible, could be easily felt. These were similarly removed and dissected out. There was no enlargement of the cervical or axillary sets. A superficial undermined ulcer was present on the right shin, and a small one on the left shin.

Thorax.—No fluid in the pericardium; heart collapsed, flabby, and empty; heart muscle pale and very much softened. No excess of fluid in pleural cavity, but several old-standing pleuritic adhesions. Both lungs were greatly congested, emphysematous in patches, and on section were nearly black and dripped blood. No consolidation patches were found. The bronchial glands were not specially examined.

Abdomen.—There was no distension of or fluid in the abdominal cavity, and no signs of peritonitis. The stomach and intestines were moderately distended with gas. The spleen was of a dull purple colour, and very considerably enlarged, its under surface hyperæmic and bloodstained, its veins engorged and substance softened. The liver, though smooth on both surfaces, was deeply stained in places, apparently a *post-mortem* occurrence. It was apparently somewhat but not markedly enlarged. The entire surface was studded with a number of whitish, irregularly-shaped bodies, varying in size from a pea to a bean, which on section showed a soft, friable, caseous pinkish-white material. They were present throughout the whole organ. These areas were sharply marked off from the surrounding liver substance, and no signs of inflammation visible to the naked eye were seen around them. The liver substance was apparently normal, but softer than usual. The kidneys were slightly congested, the glomeruli stood out prominently, and the capsule stripped easily; no macroscopic hæmorrhages were seen either in the liver, spleen, kidney, or other organ; nor were the peculiar areas described in the

liver found in any other organ. The lower 6 feet of ileum and cæcum were removed, cut open, and washed; great congestion was detected in three places in the small intestine, the most marked being at the junction of the small intestine with the cæcum; each patch was irregularly-shaped, about 2 inches in width, and embraced the entire circumference of the bowel. There was no inflammation of Peyer's patches or ulceration of the small intestine; no enlargement of the mesenteric glands.

Gland.—Sections of one of the enlarged right inguinal glands stained by eosin and hæmatoxylin showed great vascular engorgement with numerous blood extravasation, both in the gland and especially in the periglandular tissues. Throughout the gland, but especially in patches, there was well-marked infiltration of the tissue proper with small cells, apparently leucocytes, with deeply-staining nuclei. Sections of the enlarged left glands showed only some congestion and slight engorgement of vessels.

Heart.—Sections of the heart wall showed degenerative changes in the muscle fibres.

Liver.—The well-defined whitish areas found throughout the liver were further examined in sections. They showed microscopically a varying amount of degenerated liver substance, present for the most part as isolated strands of a few cells, while between were very numerous small cells, apparently leucocytes and pus cells. While sharply cut off to the naked eye, these areas microscopically, though fairly well defined, were seen not to be abruptly distinct from the liver substance, but numbers of the small cells extended between the liver cells for a considerable distance. Also in these areas were a number of small, more deeply staining masses, which examined with a high magnification, could be seen to consist almost entirely of *B. pestis*. But few bacilli could be found in the liver except in those areas and in those more especially in the small patches described. The rest of the liver showed cloudy swelling. To demonstrate the changes described some sections were stained by hæmatoxylin and eosin, and others by methylene blue, aniline oil being used as the decolorising and dehydrating agent.

Distribution of the Plague Bacilli in the Cadaver.

The distribution of the plague bacilli in the patient at the time of the necropsy is of some interest.

In the enlarged glands of the right groin coverslip preparations showed a few bacilli but they were by no means numerous. A few of the glands showed more marked signs of breaking down, and films from them showed many more bacilli. Cultures from one of the largest glands showed a mixed growth of *B. pestis* and other organisms. Cultures and cover-slip preparations from the left inguinal and femoral glands showed no bacilli.

Cultures from the spleen and kidneys showed a mixed growth of *B. pestis* and other bacilli; from the liver a pure culture of *B. pestis* (Fig. C), and from the heart blood and

it was an anaërobic organism. They were also present in the enlarged glands of the right groin.

REMARKS.

Some of the chief points of interest in the above case are:

1. *The Enlarged Glands.*—The absence of any pain, tenderness, or signs of inflammation in or around the enlarged glands, during the whole time he was under observation.

2. *Bacilli in the Blood.*—The bacilli were present in the blood in sufficient numbers to be readily detected by simple microscopic examination. They agreed morphologically with *B. pestis*, and almost certainly were that organism, but cultures from the blood (four in all) remained sterile. Possibly this may be ascribed to a small amount of the antiseptics used clinging about the fingers. Every effort was made to prevent it, and cultivations were made from the blood on two distinct occasions.

3. *Necrosis in the Liver.*—The presence of whitish areas scattered through the liver. They were only found in the liver, and appear to be, as Professor Childe reports, commencing necrotic areas caused by the plague bacillus (and its toxins). They are mentioned by Professor Childe¹ in his report to the Plague Research Committee as occurring in a case of plague septicæmia, and are also apparently described by Dr. Arnott² in a case in Bombay.

4. *The "Carbuncles."*—The red and subsequently necrotic patches on the shins, the so-called carbuncles, appear to be one of the characteristic features of plague, but their frequency seems to be a matter of dispute. According to the article on Plague in *Allbutt's System of Medicine* they have sometimes been attributed to direct introduction of the virus of plague into the skin. Here we were able to watch their development, as none were present when the patient was first examined. By far the best marked was the area on the right shin (that is, on the same side as the bubo). On October 3rd the skin was distinctly raised from the surface by sero-purulent fluid. Two cover-slip preparations were made from this on that day. They show numerous bacilli morphologically identical with *B. pestis*. Many show polar staining. Unfortunately cultures were not made, so that it is impossible to say definitely if they were *B. pestis* or not. Microscopically they were identical, and associated as they were with the absence of pus cocci and most other organisms (the skin had not ruptured when preparations were made) it is not improbable that they were the true *B. pestis*. If this be so, the gangrenous breaking down must be ascribed to local action of the bacilli and their toxins. If this be the case we have a very obvious source of infection of his surroundings by the patient.

REFERENCES.

- ¹ Abstract in the BRITISH MEDICAL JOURNAL, September 24th, 1898.
- ² *Scottish Medico-Chirurgical Journal*, February, 1898. Quoted in the above number of the BRITISH MEDICAL JOURNAL. We have not read the original paper.

THE BACTERIOLOGY OF PLAGUE.

(With Illustrations on Special Plate.)

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HISTORY.

VIRCHOW, in 1879, reasoning from analogy, predicted that as plague never arises spontaneously in a locality where it has not previously existed the disease would prove to be one of microbic origin. In the same year Hirsch and Sommerbrodt observed in the blood of patients suffering from plague elongated refractile granules, usually arranged in pairs. These bodies may or may not have been plague bacilli; at any rate, these observers failed to attach any importance to them from the etiological standpoint. With the outbreak of plague in Hong-Kong in 1894 independent Commissions were sent by the Japanese and French Governments respectively to investigate the disease. The former was under the direction of Kitasato and Aoyama, and the latter under the direction of Yersin. Kitasato almost at once succeeded in determining the constant presence of a characteristic bacillus in the buboes, blood, and organs of patients suffering from the disease. His colleague confirmed the discovery. Subsequently Yersin, working independently, found the organism, and although the cultural characters and staining affinities which he described for his bacillus did not agree with those published by Kitasato, there is no doubt that they were both

Fig. C.—Cover-slip preparation from a two days' old broth culture made direct from the liver of the same patient. It shows the shortened bacilli in chains; the so-called strepto-bacilli.

lungs a well-marked growth of foreign organisms but no plague bacilli. Cover-slip preparations from the liver, kidneys, and spleen showed scarcely any plague bacilli, but numerous large bacilli in threads with square ends, very similar to *B. anthracis*, were found. They were apparently a *post-mortem* invasion, and from the fact that attempts to cultivate this organism on ordinary media failed, it is not improbable that