A report on localised tuberculosis in swine / by A. Eastwood, M.D. and F. Griffith, M.B.

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A Report on Localised Tuberculosis in Swine, by A. Eastwood, M.D., and F. Griffith, M.B.

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A Report on Localised Tuberculosis in Swine; by A. Eastwood, M.D., and F. Griffith, M.B.

ARTHUR NEWSHOLME,
Medical Officer,
9th February, 1914.

Part I.

TUBERCULOSIS IN PIGS OBTAINED FROM THE SLAUGHTER HOUSE.

Part II.

EXPERIMENTS ON THE PRODUCTION OF LOCALISED TUBERCULOSIS IN PIGS BY FEEDING WITH MAMMALIAN TUBERCLE BACILLI.

General Results of the Enquiry.

PLATES I—III.

No. 91.

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Part I.

TUBERCULOSIS IN PIGS OBTAINED FROM THE SLAUGHTER-HOUSE.

Introduction.

This report comprises the results of an investigation undertaken in the Board's laboratory during the period January, 1911, to August, 1913, for the purpose of throwing light on the question of the dissemination of tubercle bacilli in the tissues of tuberculous pigs in which, as a result of naked-eye examination, the disease was apparently confined to the lymphatic glands in relation to the alimentary tract.

Arrangements were made with Mr. Cuckney, Superintendent at the Brighton Borough Abattoir, to send for examination the following material from every pig in which, in the course of routine inspection, no disease beyond the glands in direct relation to the alimentary tract was discovered:—the lymphatic glands of the submaxillary region, the entire thoracic organs and diaphragm, the liver and portal glands, the spleen, the mesenteric glands, the inguinal glands, and a few pounds of muscle. As the tissues were required for bacteriological research, Mr. Cuckney was asked to make no more incisions into them than were necessary to enable him to form a preliminary opinion as to the nature of the case; his opportunities for searching for disseminated lesions were therefore restricted. The tissues were chilled after removal from the body and were then packed in a tin box containing an ice-bag, the specimens being separated from each other by wrapping in impervious material. The tin box was packed within a wooden box, and the parcel was then sent to the Board's laboratory. The specimens were accompanied by a letter declaring that the entire carcase had been inspected without the discovery of any tuberculosis except in the parts sent; in most cases the statements was also made that the carcase had been examined after it had been sawn through. Mr. Cuckney was also asked to send, for the purpose of comparison with the apparently localised cases, a few cases where he had found slight dissemination.

Shortly after the commencement of the work, Dr. Robertson, Medical Officer of Health for Birmingham, kindly aided the enquiry by arranging that his inspectors should send cases of localised tuberculosis, the arrangements as to the examination of the entire carcase and the selection of the material being similar to those made with Mr. Cuckney, except that no muscle was asked for. In order to prevent risk of mistakes where many pigs were slaughtered on the same day, the viscera and the carcase from which they were removed were at once identified by a system of duplicate labelling.

From February 15th, 1911, to January 16th, 1913, 66 cases were received from Brighton and 34 from Birmingham. The proportion of pigs complying with the requirements laid down to the total pigs examined by the inspector was ascertained at Brighton, and the figures are given on pp. 126 and 130.

Acknowledgment must be made of the marked care and skill with which Mr. Cuckney selected his material and collected his statistics, of the excellence of Dr. Robertson's arrangements in Birmingham, and of the skill of his inspectors in discovering suitable cases.

During the latter part of the enquiry the investigation of the material obtained from the slaughter-house was in most cases confined to the description of the lesions and identification of the

type of tubercle bacillus responsible for them. Experience had shown that the tissues on arrival were often unfit for inoculation in considerable quantities, and the anatomical characters of the lesions sometimes afforded no decisive indication as to whether the tubercle bacillus concerned was of avian or of mammalian type. An attempt was therefore made to produce the particular degree of tuberculosis of which this enquiry is the subject by feeding pigs experimentally with tested strains of mammalian tubercle bacilli. The results of these experiments supplement those obtained with the apparently normal tissues of the slaughter-house pigs and are recorded in Part II of this report.

Our thanks are due to Professor Sims Woodhead, who kindly provided us with facilities for keeping the pigs and making the post mortem examinations on them at the Cambridge University Field Laboratories.

Method of Procedure in the Laboratory.

On their arrival in the laboratory the tissues sent from the slaughter-house were first submitted to minute examination with the naked eye, supplemented by microscopical search of smear preparations obtained from lesions of a suspicious nature, and also in certain cases, by inoculation of these lesions into guinea-pigs.

It was considered an essential part of the investigation in each case to determine the type of tubercle bacillus causing the infection. Direct cultures from the tuberculous submaxillary or mesenteric glands were always attempted, and in most cases with success. In some instances, where the material contained an admixture of extraneous organisms, pure cultures were raised after preliminary treatment with antiformin. It was also the routine practice to inoculate guinea-pigs with material from the same tuberculous glands, and to make cultures from these animals, the post-mortem examination of which gave some indications as to the nature of the bacillus.

In dealing with the tissues other than the local lesions the procedure adopted in the earlier part of the enquiry was as follows :— If after free incision the portal, bronchial, and inguinal glands were found to be normal and the surfaces of the lungs, liver, and spleen showed on close scrutiny no evidence of tuberculosis, portions of the three last mentioned organs were removed with sterile precautions, after cauterisation of the surface. The examination of these organs was then completed after cutting them into thin slices. If this scrutiny revealed no tuberculosis, the reserved portions in certain cases were used for ascertaining if, by animal inoculation, tubercle bacilli not associated with visible lesions could be found. But if tuberculous foci were visible in the lungs, liver, or spleen, or in the glands associated therewith, any further tests for the presence of tubercle bacilli were usually limited to the muscle.

In the investigation of apparently normal tissues it was realised that the significance of any results obtained must be interpreted in the light of the actual amounts of tissue used. The dosage, therefore, was always recorded, together with the total weight of the organ in the case of liver, spleen, or lung. After the tissue had been weighed on a chemical balance it was transferred to a mortar and there reduced to a fine emulsion, with the addition of normal saline solution. At first the emulsions were filtered through muslin, but as this method resulted in a proportion of the tissue being left in the muslin, particularly in the case of muscle, filtration was subsequently abandoned. To exclude grosser particles, the emulsion was drawn up by a pipette, with a diameter at the tip of 1 mm., the pieces of

fibrous tissue which obstructed the inlet being constantly removed with the aid of forceps. For the first few minutes the removal of these obstructions required considerable patience and progress was slow; but after the greater portion of the obstructive particles had been moved aside the tissue was withdrawn much more readily and ultimately nothing was left remaining in the mortar but shreds of fibrous tissue. This method was found particularly valuable in obtaining an inoculable emulsion of muscle with the minimum loss of material. The inoculations were made intraperitoneally into guinea-pigs either with a platinum needle of about the same diameter as the inlet of the pipette, or with a glass pipette of the same calibre as the one used for withdrawing the emulsion from the mortar.

Owing partly to the length of time which necessarily elapsed between the slaughter of the pig and the receipt of the tissues in the laboratory, but more especially owing to microbic infection of the tissues during operations immediately subsequent to slaughter, considerable difficulty was sometimes experienced from the presence of extraneous organisms which rapidly proved fatal to the guinea-pigs. This was especially the case with the lungs; the same disadvantage was also experienced in some instances with the liver and spleen. This difficulty was in several instances, where the material was manifestly not in perfect condition, obviated by preliminary treatment of the emulsified tissue with a small percentage of antiformin, though this procedure was less satisfactory than the inoculation of perfectly fresh and untreated tissues.

Anatomical and Specific Characters of the Lesions found in one hundred Pigs.

Pig I.

Received from Brighton on February 15th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—The glands from one side of the neck were normal.

On the other side there was a nodule the size of a small hen's egg (probably two glands fused together); on section it was found to contain soft yellow caseous, slightly foul, gritty material surrounded by a wall consisting in parts of firm grey tissue and beset with necrotic, gritty streaks and patches. A smear preparation showed one doubtful acid-fast bacillus. From a guinea-pig in which the material produced general tuberculosis a culture yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Beneath the capsule were seven or eight yellowish, irregular necrotic patches, each about 2 mm. in diameter; in a smear from one of these no acid-fast bacilli were seen. In the substance of the liver there was one grey, slightly gritty tubercle, the size of a rape seed; in a smear from this no acid-fast bacilli were seen.

Spleen.—Normal.

Inguinal glands.—Normal. (Left not received.)

Summary.

Disease apparently limited to submaxillary lymphatic glands, with the exception of one minute tubercle in the liver, and found due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig II.

Received from Brighton on February 17th, 1911, as a case of apparently localised tuberculosis. Aged 4 months.

Submaxillary lymphatic glands.—The glands from one side of the neck were normal.

On the other side there was a gland containing about six yellow, caseous foci scattered about the cortex. Cultures were made but remained sterile. No guinea-pigs were inoculated.

Anterior mesenteric glands.—One gland near the head of the pancreas contained three irregular, caseous foci.

Lungs.—On the surface of the left lung beneath the pleura were two caseating nodules, measuring up to 2·5 mm. in diameter; there were also one or two tubercles in the margin. In the right lung just beneath the pleura were four caseous tubercles, up to a millet seed in diameter, which were not appreciably gritty. On section of the lungs no further nodules were found. A culture from one nodule remained sterile.

Bronchial glands.—Three glands, situated anteriorly to the left bronchus, were tuberculous; the largest, measuring 4·2 cm. by 2·1 cm., was beset with caseo-calcareous patches and small nodules; the two others showed caseous, gritty patches. Two right bronchial glands were a little firm and showed similar caseous, gritty patches.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis; type of bacillus not ascertained.

Pig III.

Received from Brighton on February 18th, 1911, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—There were three nodules ranging in size from a millet seed to a small pea. Each consisted of soft, chalky substance enclosed in a capsule of grey translucent tissue. Smear preparations showed no acid-fast bacilli, and inoculation of a guinea-pig failed to produce tuberculosis.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

Pig IV.

Received from Brighton on February 18th, 1911, as a case of apparently localised tuberculosis. Aged six months.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Just beneath the surface were about 30 yellowish nodules varying in size up to a millet seed or a little larger. They consisted of grey, translucent tissue with a central core of soft, gritty or chalky material which in some cases was dry and in others moist. On section of the liver other similar nodules were seen throughout the substance. Smears from the nodules showed no acid-fast bacilli; cultures remained sterile, and inoculation of a guinea-pig failed to produce tuberculosis.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

PIG V.

Received from Brighton on February 24th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—There were from 20 to 30 nodules varying in size up to a small pea. Some consisted of yellowish white, chalky substance contained in capsules of grey translucent tissue. A few were translucent throughout. The majority consisted of greyish, slightly congested tissue, apparently necrotic liver tissue, which was usually separated from the surrounding liver substance by a thin, fibrous capsule. Smears from these nodules and inoculations of guinea-pigs failed to reveal the presence of tubercle bacilli.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

PIG VI.

Received from Brighton on March 2nd, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not received.

Lungs.—On the surface were two grey translucent nodules, each about a hemp seed in size; on section they were soft and not fibrous, resembling parasitic nodules. Inoculation of one into a guinea-pig failed to produce tuberculosis.

Bronchial glands.—Normal.

Liver.—On the surface and also in the substance were areas of necrosis beset with hæmorrhagic spots. There were also two or three grey nodules between a hemp seed and a millet seed in size and a small pea-sized grey nodule with a yellow, caseous central mass. A guinea-pig inoculated with this last nodule died prematurely.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

Pig VII.

Received from Brighton on March 4th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Six glands, which were not obviously enlarged, contained each one or two yellow caseous gritty nodules ranging up to 6 mm. in diameter. The nodules shelled out readily from the gland substance, leaving smooth walls. Cultures from these lesions remained sterile; one guinea-pig inoculated with an emulsion of the lesions remained healthy but showed a few acid-fast bacilli in a smear-preparation from its omentum. These bacilli were probably dead as they had produced no disease in the guinea-pig and failed to grow in culture.

Lungs.—In the left lung were three nodules on the surface, each slightly larger than a millet seed and composed of soft, grey, translucent tissue. In the right lung were two similar nodules. They resembled the parasitic nodules of frequent occurrence in pigs' lungs On section no lesions were found in either lung. A nodule inoculated into a guinea-pig did not produce tuberculosis.

Bronchial glands.—Normal.

Liver.—Just beneath the surface was one spherical, grey nodule, the size of a hemp seed; a culture from this remained sterile. A second grey, translucent miliary nodule was also found. Otherwise the liver appeared normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculous lesions of the mesenteric glands, in which the bacilli present were probably dead.

Pig VIII.

Received from Brighton on March 4th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—They were not obviously enlarged, but about 16 contained yellow, caseous, slightly gritty nodules, easily shelling out of the gland substance. Their size varied from a pin's head up to 6 or 7 mm. in diameter; they were all opaque and, in the majority of cases, irregular in outline. The material was not in fresh condition, and guinea-pigs inoculated with lesions died prematurely.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—On the surface beneath the capsule were five minute opaque tubercles with grey margins, one distinctly calcareous, also two miliary translucent nodules. On section of the liver several more caseous tubercles were seen in the substance. Smears from the calcareous tubercle and one of the opaque tubercles showed tubercle bacilli.

Spleen.—Normal

Inguinal glands.—Normal.

Summary.

Tuberculosis of mesenteric glands and liver; type of bacillus not identified.

Pig IX.

Received from Brighton on March 6th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not obviously enlarged, but four contained tuberculous lesions; in one, these were discrete, miliary, calcareous nodules; in the others, they were caseous, gritty nodules, easily shelling out and measuring between 6 and 9 mm. in diameter. The lesions contained numerous acid-fast bacilli, which proved, on direct culture, to be tubercle bacilli of the avian type.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Two translucent miliary nodules were seen, and also one minute tubercle, which showed no acid-fast bacilli in a smear preparation.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the mesenteric glands due to tubercle bacilli of avian type, virulent for a fowl. One suspicious focus in the liver.

Pig X.

Received from Birmingham on March 9th, 1911, as a case of apparently localised tuberculosis. Aged 9–10 months.

Submaxillary lymphatic glands.—These, four in number, were somewhat enlarged and studded with softening, caseous, slightly gritty nodules, some of which were discrete and about the size of a hemp seed, whilst others replaced nearly the whole of the cortex. A guinea-pig inoculated with these nodules remained healthy and direct cultures yielded tubercle bacilli of the avian type.

Mesenteric glands.—Not received.

Lungs.—On the surface of the right lung beneath the pleura were two translucent miliary nodules of doubtful nature. The left lung was normal.

Bronchial glands.—In one left bronchial gland were four minute yellowish, caseous foci. A smear from one of these showed tubercle bacilli. The other bronchial glands were normal. A culture from the affected gland remained sterile.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for a fowl. Evidence of dissemination in the bronchial glands.

Pig XI.

Received from Brighton on March 13th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—The glands from one side of the neck appeared normal.

From the other side, one gland was the size of a thrush's egg, and another the size of a sparrow's; both were more than half replaced

by caseous, slightly gritty tissue. The lesions produced general tuberculosis in a guinea-pig, from which a culture of mammalian type was obtained.

Mesenteric glands.—Four glands contained caseous, gritty nodules. The lesions produced general tuberculosis in a guinea-pig, from which a culture of mammalian type was obtained.

Lungs.—Parasitic nodules were found, but no tubercles.

Bronchial glands.—Normal.

Liver.—Just beneath the capsule were five grey, miliary nodules with caseous centres, but not appreciably gritty ; a smear from one of these showed a tubercle bacillus. On section half-a-dozen more nodules were seen, two of which were gritty. One was nearly the size of a hemp seed, and consisted of a thick, grey, translucent capsule with opaque, slightly yellowish, soft contents ; a smear from this showed no tubercle bacilli. An emulsion of two nodules produced general tuberculosis in a guinea-pig, from which a culture of tubercle bacilli was grown.

Portal glands.—One gland contained a few caseous, gritty nodules.

Spleen.—Just beneath the capsule was a single nodule the size of a rape seed with an opaque, caseous streak in the centre. On section was a grey nodule the size of a hemp seed with a softening and slightly yellowish centre ; a smear from this showed no tubercle bacilli. One of the nodules produced general tuberculosis in a guinea-pig.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XII.

Received from Brighton on March 17th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Normal.

Lungs.—Scattered throughout the lungs but mainly on the surface just beneath the pleura were numerous sharply circumscribed, grey, translucent nodules varying up to 2 mm. in diameter. The nodules were composed of soft (not fibroid) tissue, though they felt hard and were very distinctly palpable. In a few there was a very minute, opaque central point. A smear from one of these showed no acid-fast bacilli. Cultures from the nodules remained sterile and inoculations in 3 guinea-pigs failed to produce tuberculosis. At the time of the post mortem examination the lesions were considered to be probably parasitic in nature. Histological sections revealed the presence of worms in the consolidated areas.

Bronchial glands.—Normal.

Liver.—There were two nodules each about 3 mm. in diameter and composed of translucent tissue with caseous, gritty substance in the centre ; no tubercle bacilli were seen. Inoculation with one of these nodules failed to produce tuberculosis in a guinea-pig. There were also seen a few irregular, opaque foci which occasionally showed a slightly congested periphery.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

PIG XIII.

Received from Brighton on March 18th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—The majority were enlarged and composed of firm, grey, translucent tissue, closely beset with small, irregular, yellow, caseous patches and streaks, which were rarely gritty and were not easily separated from the surrounding tissue. A smear preparation showed numerous acid-fast bacilli, and in histological sections bacilli were found in groups, suggestive of avian infection, in the caseous areas. Cultures remained sterile and inoculations into three guinea-pigs failed to produce tuberculosis. A few acid-fast bacilli were demonstrated in the omentums of two of the guinea-pigs and an attempt was made to raise a culture, but no growth occurred.

Lungs.—With the exception of two soft, grey, translucent nodules showing no tubercle bacilli, the lungs were normal. Inoculation failed to produce tuberculosis in a guinea-pig.

Bronchial glands.—Normal.

Liver.—The substance was peppered with minute grey points consisting of soft, translucent tissue and showing in smear preparations no acid-fast bacilli. Inoculations failed to produce tuberculosis in guinea-pigs. Histological examination showed abundant small tubercles containing giant cells and fibroblasts and an infiltration of leucocytes and lymphocytes. In one tubercle two tubercle bacilli were seen.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculous lesions of the mesenteric glands, in which the bacilli present were probably dead.

PIG XIV.

Received from Birmingham on March 18th, 1911, as a case of apparently localised tuberculosis. Aged one year.

Submaxillary lymphatic glands.—On one side there was a mass about the size of a goose's egg, adherent to which was a number of smaller nodules. On section the mass and the small nodules were composed of caseo-necrotic tissue, softening but not broken down and enclosed within a firm fibrous capsule.

On the other side were two slightly enlarged glands which on section were firmer than normal and contained a few discrete, caseous tubercles. Two guinea-pigs, inoculated with the lesions and killed 42 days later, had local tuberculosis only. Cultures obtained direct and through one of the guinea-pigs were of mammalian type.

Mesenteric glands.—Not received.

Lungs.—There were several grey, translucent nodules in the margins and three others on the surface. No tubercle bacilli were seen in them, and they were without doubt due to parasites. There was also a patch of grey tissue containing caseous, gritty substance; a smear showed no tubercle bacilli.

Bronchial glands.—Normal.

Liver.—The liver substance was beset with minute, irregular, yellowish grey, necrotic foci ; a smear showed no tubercle bacilli.

Spleen.—Just beneath the capsule were two nodules composed of soft, grey, translucent tissue ; one was larger than a millet seed, the other the size of a rape seed. A smear from each showed no tubercle bacilli. Three guinea-pigs inoculated with an emulsion of the spleen tissue remained healthy.

Inguinal glands.—Normal.

Summary

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for a rabbit.

PIG XV.

Received from Birmingham on March 23rd, 1911, as a case of apparently localised tuberculosis. Aged 14 months.

Submaxillary lymphatic glands.—On either side they were slightly enlarged and contained firm caseo-calcareous nodules ranging up to 6 mm. in diameter. A smear showed a few tubercle bacilli. Culture yielded tubercle bacilli of the avian type. Two guinea-pigs, inoculated with an emulsion of the nodules, developed slight local tuberculosis only ; an avian culture was obtained from one.

Mesenteric glands.—Not received.

Lungs.—Just beneath the pleura was a single translucent, miliary tubercle ; microscopically no tubercle bacilli were seen. Otherwise the lungs were normal.

Bronchial glands.—In one there was a calcareous grain the size of a rape seed ; a smear showed no tubercle bacilli.

Liver.—Normal.

Spleen.—One slightly enlarged Malpighian body, showing no tubercle bacilli ; otherwise normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for a fowl. Slight evidence of possible dissemination in a bronchial gland.

PIG XVI.

Received from Brighton on March, 25th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On one side the glands were moderately enlarged ; one consisted throughout of pinkish, necrotic tissue, beset with caseous, gritty streaks, with a margin of caseous, gritty tissue just beneath the capsule of the gland ; other glands contained discrete, yellow, caseous, gritty nodules.

On the other side one gland contained a few discrete, yellow, caseo-calcareous tubercles and a single nodule, 1 cm. by 6 cm. composed of caseo-necrotic substance. In a smear tubercle bacilli were moderately numerous : they were fairly thick and showed one or more darkly staining granules. A guinea-pig was inoculated and developed general tuberculosis. Cultures, obtained direct and through the guinea-pig, yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Not received.

Lungs.—Throughout the lungs was sparsely scattered, yellow caseous, gritty tubercles with grey translucent capsules. The tubercles varied in size up to a millet seed, but the majority were the size of a rape seed. No tubercle bacilli could be seen in a smear.

Bronchial glands.—The majority of the glands, which were not appreciably enlarged, were beset with discrete, yellow, caseo-calcareous, miliary tubercles; there were also a few larger nodules up to a pea in size. A smear showed tubercle bacilli, and an emulsion produced general tuberculosis in 2 guinea-pigs, from one of which a culture of tubercle bacilli was grown.

Liver.—Just beneath the capsule were three minute, yellow, gritty tubercles and one caseous nodule, with a grey capsule, slightly larger than a millet seed. Smears showed no tubercle bacilli and an emulsion of the larger nodule failed to produce tuberculosis in a guinea-pig.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and rabbits.

Pig XVII.

Received from Brighton on March 31st, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—About 14 contained nodules consisting of slightly gritty, pinkish, caseo-necrotic tissue, easily shelling out and leaving smooth-walled cavities in the gland substance. The glands were only slightly enlarged. The nodules varied in size, some of the smaller glands being half replaced by them. A smear showed moderately numerous tubercle bacilli. Two guinea-pigs inoculated with a thick emulsion of the nodules developed local tuberculosis only. Cultures obtained direct and through the two guinea-pigs yielded tubercle bacilli of avian type.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—There were about five very small grey nodules with minute opaque centres. Two were rather less than a rape seed in size. No tubercle bacilli were found in smears.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the mesenteric glands due to tubercle bacilli of avian type, but of relatively low virulence for fowls. Slight evidence of possible dissemination in the liver.

Pig XVIII.

Received from Brighton on April 24th, 1911 as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Three showed a caseous, gritty network in the gland substance; only one of these glands was perhaps a little enlarged. In two others discrete, minute, caseous tubercles were

seen. A smear showed a few tubercle bacilli. Two guinea-pigs were inoculated and developed local tuberculosis only. Cultures obtained direct and through the two guinea-pigs yielded tubercle bacilli of avian type.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—The tissue was beset with numerous minute, translucent tubercles, the majority smaller than a rape seed and none larger. They contained minute opaque centres, in one of which slight grittiness was detected. In smears one or two short acid-fast bacilli were found. Histologically the tubercles showed early fibroid change and tendency to giant cell formation. Cultures made from the liver substance yielded tubercle bacilli of avian type.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the mesenteric glands due to tubercle bacilli of avian type, virulent for a fowl. Evidence of dissemination in the liver.

Pig XIX.

Received from Birmingham on April 25th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—From each side of the neck was a nodule about the size of a bantam's egg. On section each of these was about half replaced by caseous, gritty tissue, which in one case was softening. In the remaining halves of the glands were numerous irregular, discrete, caseous tubercles. In culture there was a growth of tubercle bacilli of mammalian type.

Cervical glands.—Two of these each contained a few caseous foci.

Mesenteric glands.—Not received.

Lungs.—There were five grey tubercles with caseous centres, two the size of millet seeds, the rest smaller. In a smear from one, three tubercle bacilli were seen. There were also two translucent miliary nodules.

Bronchial glands.—In one was a small patch of soft, yellowish, caseous material. A smear showed no tubercle bacilli.

Liver.—Not received.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Supramammary glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XX.

Received from Brighton on May 6th, 1911, as a case of apparently localised tuberculosis. Aged 2 years.

Submaxillary lymphatic glands.—Several glands were normal, but in five, two from one side and three from the other, there were nodules consisting of a putty-like, firm, necrotic tissue, with a yellowish, gritty margin, enclosed in firm, translucent tissue, which

was almost cartilaginous. The necrotic tissue shelled out cleanly from the capsule. The largest gland was about the size of a pigeon's egg, and was wholly replaced by necrotic tissue. In a smear no tubercle bacilli were found, but a few large, blue staining bacilli. Two guinea-pigs inoculated remained healthy. Cultures from the necrotic tissue remained sterile.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Just beneath the capsule were three nodules consisting of a softening, caseous, gritty substance, enclosed in a translucent capsule. The largest was a wedge-shaped nodule contained in the margin and extending into the substance for about half an inch ; of the other two the larger was the size of a hemp seed. On section several irregular nodules similarly constituted were observed. Smear preparations showed no tubercle bacilli ; guinea-pigs failed to develop tuberculosis.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

Pig XXI.

Received from Brighton on May 20th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not received.

Lungs.—On the surface beneath the pleura were eight nodules from 1 to 3 mm. in diameter ; they consisted of opaque, grey, non-caseous, homogeneous material, and were surrounded by a zone of congested tissue. No acid-fast bacilli were found in three smears. In the substance of the lung no nodules were found.

Bronchial glands.—Normal.

Liver.—On the surface, just beneath the capsule, were 55 yellowish grey nodules from 2 to 5 mm. in diameter ; similar nodules were sparsely scattered throughout the substance. The nodules shelled out easily and consisted of tough, semi-fibrous tissue without any peripheral zone. No acid-fast bacilli were found in four smears, but cultures from the nodules yielded tubercle bacilli of mammalian type, and two inoculated guinea-pigs developed general tuberculosis.

Spleen.—On the surface, beneath the capsule, were three nodules, each about 2 mm. in diameter and of the same character as those in the liver. There was also one in the substance, about 4 mm. in diameter. Smears (from two nodules) showed no acid-fast bacilli.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XXII.

Received from Brighton on May 31st, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On one side normal. On the other one gland contained a fibro-caseous gritty nodule, 1 cm. in

diameter ; the rest were normal. In the affected gland a few tubercle bacilli were found, and an emulsion produced general tuberculosis in a guinea-pig.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—On the convex surface, near the margin, was one opaque nodule, 1·5 mm. in diameter ; the centre was calcareous and shelled out easily ; no tubercle bacilli were found in it ; otherwise the liver was normal.

Portal glands.—Externally these appeared normal, but on section four showed caseo-calcareous foci, not more than ·5 mm. in diameter, varying from 3 to 12 in number and in places confluent. Smears showed a moderate number of tubercle bacilli.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the mesenteric glands with evidence of dissemination in the portal glands ; the bacilli were not obtained in culture, but general tuberculosis was produced in a guinea-pig.

Pig XXIII.

Received from Brighton on June 9th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—There was very little enlargement, but the majority were affected and contained nodules which easily shelled out of the gland substance and were composed of caseous, gritty tissue, sometimes softening. In many cases practically all the gland substance was replaced ; in a few the gland tissue was firm and beset with discrete caseous tubercles. Smears showed moderately numerous, fairly thick and long tubercle bacilli, which on culture proved to be of avian type. Two guinea-pigs developed slight omental disease only.

Lungs.—On the surface beneath the pleura were scattered grey tubercles with caseous centres, the majority minute and the largest but little greater than a rape seed. On section only a few grey tubercles were seen. Three smears showed no tubercle bacilli, and emulsions failed to produce tuberculosis in guinea-pigs.

Bronchial glands.—Normal.

Liver.—Just beneath the surface were five submiliary, opaque, caseous tubercles. On section three more were seen, about the size of rape seed ; they consisted each of a grey capsule with a soft, yellowish centre. Smears showed no tubercle bacilli, and emulsions failed to produce tuberculosis in guinea-pigs.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the mesenteric glands due to tubercle bacilli of avian type, virulent for a fowl. Evidence of possible dissemination in the lungs and liver.

Pig XXIV.

Received from Brighton on June 17th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—One side was normal.

On the other side there was a gland, the size of a pigeon's egg, which was closely beset with softening, yellow, caseous, gritty patches and tubercles; the substance of the gland was firm and translucent. In two smaller glands there were discrete tubercles. In a smear one tubercle bacillus was seen. Cultures yielded tubercle bacilli of mammalian type. Two guinea-pigs inoculated with the caseous substance died of general tuberculosis.

Mesenteric glands.—Five glands were affected. Two were slightly enlarged and were almost replaced by softening, caseous, gritty masses. In the other three were discrete caseous nodules.

Lungs.—Scattered throughout but mainly just beneath the pleura was a moderate number of grey tubercles with calcareous centres up to a millet seed in size. No tubercle bacilli were seen in a smear, but emulsions produced general tuberculosis in a guinea-pig.

Bronchial glands.—They were not appreciably enlarged but all contained discrete, yellow, caseous patches and tubercles, which were softening and gritty.

Liver.—The surface of the liver beneath the capsule showed numerous irregular nodules up to 4 or 5 mm. in diameter. They consisted of grey, translucent tissue beset with opaque, yellow foci. They are most numerous on the surface beneath the capsule, but were seen also on section through the substance of the liver. In a smear no tubercle bacilli were seen, but two guinea-pigs inoculated developed general tuberculosis.

Spleen.—Five scattered nodules were found, varying up to 3·5 mm in diameter. They consisted of grey, translucent tissue with soft, yellow, caseous centres, some of which were gritty. In a smear no tubercle bacilli were seen.

Summary.

Disseminated tuberculosis due to tubercle baccilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XXV.

Received from Brighton on June 28th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—Normal.

Mesenteric glands.—Not received.

Lungs.—In the parenchyma were sparsely scattered discrete, caseous, miliary tubercles.

Bronchial glands.—These were enlarged, firm, and extensively caseated. Tubercle bacilli were found in a smear and a culture of mammalian type was obtained.

Liver.—Two caseous nodules were found.

Portal glands.—These were firm, and infiltrated with caseous gritty material which replaced more than half of the glandular tissue. A culture of mammalian tubercle bacilli was obtained.

Spleen.—There were six grey nodules with caseous foci and patches, some of them softening. The largest nodule measured 1·2 cm. by 1 cm. In a smear no tubercle bacilli were seen, but a culture of tubercle bacilli was grown.

Inguinal glands.—One contained a caseous patch in which tubercle bacilli were found.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for a rabbit.

Pig XXVI.

Received from Birmingham on July 19th, 1911, as a case of apparently localised tuberculosis. Aged 9 or 10 months.

Submaxillary lymphatic glands.—On each side they were enlarged, the largest being the size of a pheasant's egg. They were very hard, and, on section, were found to be to a great extent replaced by fibro-caseous, calcified substance. A smear showed a few tubercle bacilli and cultures yielded tubercle bacilli of mammalian type. Two guinea-pigs inoculated with the lesions developed general tuberculosis.

Mesenteric glands.—Not received.

Lungs.—In the left lung there was one minute caseous focus; a smear from this showed no tubercle bacilli. Otherwise the lungs were normal.

Bronchial glands.—On the left side were two glands, not enlarged, which contained a few discrete, caseous foci. A smear showed no tubercle bacilli but an emulsion produced general tuberculosis in a guinea-pig.

Liver.—The surface was normal. On section there were three nodules, the largest the size of a pea, consisting of softening, caseous substance contained within soft translucent capsules. Inoculation failed to produce tuberculosis in a guinea-pig.

Portal glands.—In one gland a minute caseous focus was found.

Spleen.—Normal.

Inguinal glands.—On one side there was an irregular, caseous nodule the size of a millet seed; it failed to produce tuberculosis in a guinea-pig.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XXVII.

Received from Birmingham on September 1st, 1911, as a case of apparently localised tuberculosis. Aged 6–9 months.

Submaxillary lymphatic glands.—On each side there was a mass, measuring (1) 6 × 5½ × 4 cm., and (2) 8 × 4 × 5 cm., composed throughout of firm caseo-necrotic tissue, with fine gritty lines. Attached to these masses were a few smaller glands similarly affected. In a smear tubercle bacilli were scanty. Cultures remained sterile, but inoculations produced general tuberculosis in four guinea-pigs.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands; the bacilli were not obtained in culture, but general tuberculosis was produced in guinea-pigs.

Pig XXVIII.

Received from Brighton on September 21st, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On one side they were normal. On the other there was a gland, the size of a small hen's egg, composed of hard, translucent tissue, beset with caseous streaks and foci, and containing two caseous, gritty nodules, 1 cm. in diameter. In a smear a few tubercle bacilli were found. Cultures remained sterile, but an emulsion produced general tuberculosis in two guinea-pigs.

Mesenteric glands.—Not received.

Lungs.—On each side, mainly just beneath the pleura, were scattered grey tubercles with opaque, slightly gritty centres; the largest tubercle was the size of a hemp seed. In a smear one tubercle bacillus was found.

Bronchial glands.—They were not enlarged, but showed a few caseous foci and small tubercles. In a smear, two tubercle bacilli were seen.

Liver.—Just beneath the surface was one small grey tubercle; no bacilli were found in it. On section nothing further was seen.

Portal glands.—Normal.

Spleen.—Just beneath the surface there was a minute grey tubercle, with an opaque centre. In a smear no bacilli were seen in it. On section four tubercles, the size of rape seed, were seen.

Summary.

Disseminated tuberculosis; the bacilli were not obtained in culture, but general tuberculosis was produced in guinea-pigs.

Pig XXIX.

Received from Brighton on November 17th, 1911, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—These were moderately enlarged, the largest being the size of a thrush's egg. Their substance was firm and beset with discrete, yellowish, irregular, miliary nodules, which easily shelled out of the gland tissue, leaving cavities with smooth walls; they were not obviously gritty. Tubercle bacilli were numerous and were found on culture to be of avian type. Similar cultures were obtained from three guinea-pigs which were inoculated with the lesions and showed to the naked eye slight local tuberculosis only.

Mesenteric glands.—Not received.

Lungs.—Parasitic nodules in the margins of the lungs; no tubercles were seen.

Bronchial glands.—Normal.

Liver.—In the centre of the liver there were two yellowish, caseous nodules with thin, grey, translucent capsules; the larger nodule was the size of a pea. A guinea-pig inoculated with the nodule remained healthy. In a smear a few blue staining bacilli were found, but no acid-fast bacilli. Avian tubercle bacilli were isolated from a guinea-pig inoculated with liver tissue.

Portal lymphatic glands.—In two, tubercles were found similar to those in the submaxillary glands.

Spleen.—Normal to the naked eye. A culture of avian tubercle bacilli was obtained from a guinea-pig inoculated with spleen tissue.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for the fowl. Macroscopic evidence of dissemination in the portal glands, with discovery of tubercle bacilli in apparently normal liver and spleen tissues.

PIG XXX.

Received from Birmingham on November 27th, 1911, as a case of apparently localised tuberculosis. Aged 10 months.

Submaxillary lymphatic glands.—On one side they were normal. On the other there were several enlarged glands, the largest about the size of a small hen's egg. On section they were found to be composed of very firm, fibroid, translucent tissue, containing a network of caseous, gritty substance. At a few points the translucent tissue was studded with discrete, yellowish, miliary tubercles. The lesions showed fairly numerous tubercle bacilli. Two guinea-pigs inoculated developed general tuberculosis; cultures obtained direct from the submaxillary glands and through the two guinea-pigs were of the mammalian type.

Mesenteric glands.—In one small gland there was an area, about 5 mm. in diameter, in which were a few discrete, yellowish, caseous foci. Cultures remained sterile.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic and mesenteric glands; the tubercle bacilli were of mammalian type, virulent for guinea-pigs and a rabbit.

PIG XXXI.

Received from Birmingham on November 29th, 1911, as a case of apparently localised tuberculosis. Aged about 8 months.

Submaxillary lymphatic glands.—Two glands on each side were slightly enlarged, and contained caseous, gritty nodules forming small collections up to a pea in size; they easily shelled out of the firm glandular tissue. One gland on each side was normal. In smears acid-fast bacilli were fairly numerous, short, and often degenerate in appearance. Two guinea-pigs inoculated with the lesions developed slight local tuberculosis only. Cultures obtained direct and through one of the guinea-pigs were of the avian type.

Mesenteric glands.—Normal.

Lungs.—Normal. Cultures made from three guinea-pigs inoculated with lung tissue remained sterile.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—Normal. Cultures made from three guinea-pigs inoculated with spleen tissue remained sterile.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for fowls.

PIG XXXII.

Received from Birmingham on November 30th, 1911, as a case of apparently localised tuberculosis. Aged about 10 months.

Submaxillary lymphatic glands.—On one side there was a gland measuring 3 × 2·2 × 1 cm. which contained 4 caseous gritty nodules easily shelling out and measuring up to 1 cm. in greatest diameter; they left smooth, fibrous walls. A second gland contained about half-a-dozen nodules similar to the above, the largest being the size of a hemp seed. A third gland contained five nodules, the largest being 5 cm. in diameter.

On the other side one gland contained four nodules, the largest being 1 × ·7 cm. on section. There were also two glands, about a sparrow's egg in size, which were almost replaced by caseous, gritty tissue easily shelling out. In a smear no tubercle bacilli were seen. Cultures made from several nodules remained sterile. No tuberculosis was produced in two guinea-pigs inoculated with the lesions.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Some scattered, irregular, yellowish grey, necrotic foci and patches were seen.

Spleen.—Normal.

Inguinal glands.—On one side there was a gland containing about 12 caseous, gritty nodules up to a millet seed in size, and also a few opaque, yellowish foci. In smears no acid-fast bacilli were seen. No tuberculosis was produced in two guinea-pigs inoculated with the lesions, and cultures sown from several of the nodules remained sterile.

Summary.

Tubercular lesions of submaxillary and inguinal lymphatic glands, from which no tubercle bacilli could be recovered.

PIG XXXIII.

Received from Birmingham on December 2nd, 1911, as a case of apparently localised tuberculosis. Aged about 9 months.

Submaxillary lymphatic glands.—On one side the glands showed a few areas containing hæmorrhagic points, but there were no foci of caseation.

On the other side there was a mass measuring roughly 7 × 6 × 3·5 cm. On section it was composed of firm translucent tissue beset with caseous gritty nodules and fine linear, whitish streaks of gritty substance; there was no sign of breaking down of tissue but there were some small congested patches in the centre. A smear showed a few tubercle bacilli. An emulsion produced general tuberculosis in two guinea-pigs, from each of which a culture of tubercle bacilli of mammalian type was obtained.

Mesenteric glands.—Normal.

Lungs.—Beneath the pleura were fairly numerous discrete, grey nodules up to a hemp seed in size, with central foci of caseation. Similar, but less numerous nodules were found on section.

Bronchial glands.—Caseous foci, containing a few tubercle bacilli were found.

Liver.—There were 2 soft, grey nodules of doubtful nature.

Portal glands.—Two showed a few caseous tubercles in the cortex.

Spleen.—Just beneath the capsule and on section there were altogether 9 grey nodules, with caseous centres, up to a millet seed in size and containing a few tubercle bacilli. A culture of mammalian tubercle bacilli was obtained direct from one nodule.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XXXIV.

Received from Birmingham on December 2nd, 1911, as a case of apparently localised tuberculosis. Aged about 9 months.

Submaxillary lymphatic glands.—They were very little, if at all, enlarged, but contained discrete, caseo-purulent, gritty nodules which shelled out easily and ranged up to a large pea in size. In smears, tubercle bacilli were moderately numerous. Three guinea-pigs inoculated with the lesions remained free from tuberculosis and cultures made from a number of nodules remained sterile.

Mesenteric glands.—Normal.

Lungs.—Normal. A guinea-pig, inoculated with 1 gm. of tissue remained healthy.

Bronchial glands.—Normal.

Liver.—Normal. Four guinea-pigs, inoculated with a total quantity of 5 gms. of tissue, and one rabbit with 2 gms. remained healthy.

Spleen.—Normal. Four guinea-pigs, inoculated with a total quantity of 5 gms. of tissue, and 1 rabbit with 2 gms. remained free from tuberculosis; cultures made from the spleen tissue of three of the guinea-pigs remained sterile.

Inguinal glands.—Normal.

Summary.

Localised tuberculosis of submaxillary lymphatic glands: the tubercle bacilli in the lesions were apparently dead.

Pig XXXV.

Received from Birmingham on December 8th, 1911, as a case of apparently localised tuberculosis. Aged 8 or 9 months.

Submaxillary lymphatic glands.—On each side was a group of enlarged glands, the largest being the size of a small hen's egg. On section they were composed of firm, fibroid, translucent tissue, containing caseous areas, with whitish, gritty streaks. An emulsion produced general tuberculosis in two guinea-pigs, from one of which a culture of mammalian tubercle bacilli was obtained.

Mesenteric glands.—Two minute caseous foci were found.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—There were found one hard nodule, about the size of a small pea, composed of caseating tissue, and a minute, grey tubercle with an opaque centre. In smears from these no tubercle bacilli were seen, but from the larger nodule a culture of mammalian tubercle bacilli was obtained, and an emulsion produced general tuberculosis in two guinea-pigs.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XXXVI.

Received from Brighton on December 28th, 1911, as a case of slightly disseminated tuberculosis.

Submaxillary lymphatic glands.—On one side only there was a single round gland, rather less than 1 cm. in diameter, which contained caseous, gritty, miliary nodules. A guinea-pig inoculated developed general tuberculosis, and a culture of mammalian tubercle bacilli was obtained from it, as well as direct from the submaxillary gland.

Mesenteric glands.—Normal.

Lungs.—Beneath the pleura on the left side there was a single small irregular caseous tubercle. On section of the lungs, areas of congestion could be seen, but no tubercles.

Bronchial glands.—These were moderately enlarged and were filled with caseous, gritty tubercles aggregated into caseo-calcareous areas. A culture was grown resembling that from the submaxillary gland.

Liver.—On section were seen about six caseous, gritty nodules, irregular in outline, and varying from a rape seed to a millet seed in size. Two only were just visible from the surface. There were also some scattered, irregular, necrotic foci on the surface.

Portal glands.—Enlarged and extensively caseo-calcareous. A culture of mammalian tubercle bacilli was grown.

Spleen.—There were about 20 tubercles, most of them visible beneath the capsule. They were not very evident, being about the size of rape seed, and not easy to distinguish, as they were merely enlarged and congested Malpighian bodies with a slight amount of central caseation. A culture of mammalian tubercle bacilli was grown.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XXXVII.

Received from Birmingham on January 5th, 1912, as a case of apparently localised tuberculosis. Aged 12 or 13 months.

Submaxillary lymphatic glands.—On one side were three small glands containing discrete, calcareous granules, easily picked out and situated mainly just beneath the capsule; they also contained small caseo-calcareous nodules, the largest the size of a hemp seed, in

which moderately numerous tubercle bacilli were found. A fourth small gland was almost replaced by an aggregation of calcareous granules.

On the other side there was one enlarged gland containing a mass of caseo-necrotic tissue with a fine calcareous network. In a smear one tubercle bacillus was seen. Two other glands contained small calcareous granules less than a millet seed. A fourth was normal. Two guinea-pigs inoculated developed general tuberculosis. Cultures obtained direct and through one of the guinea-pigs were of mammalian type.

Mesenteric glands.—Three showed in each a minute calcareous granule; the rest were normal.

Lungs.—Normal.

Bronchial glands.—One contained a minute calcareous tubercle; the rest were normal.

Liver.—There were scattered, irregular, necrotic foci in which no tubercle bacilli were found.

Portal glands.—One showed two small yellowish tubercles. A second contained a miliary calcareous granule.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic and mesenteric glands due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit. Slight evidence of dissemination in bronchial and portal glands.

Pig XXXVIII.

Received from Birmingham on January 6th, 1912, as a case of apparently localised tuberculosis. Aged about 12 months.

Submaxillary lymphatic glands.—On the left side was one moderately enlarged gland containing numerous, mainly discrete, soft, caseous, slightly gritty, miliary tubercles, easily shelling out of the gland tissue. A few of the tubercles had coalesced, forming a nodule the size of a pea. Two smaller glands were similarly affected.

On the right side there were two slightly enlarged glands which contained small nodules similar to those on the left side. Two glands were normal. A few tubercle bacilli were found in smears from some of the lesions. Cultures obtained direct from the submaxillary glands were avian in type. Three guinea-pigs inoculated with emulsions of the lesions showed no naked eye evidence of tuberculosis, but in the spleen of one tubercle bacilli were demonstrated and an avian culture was obtained from it; cultures were obtained also from the spleens of the other two guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Sparsely scattered, irregular, necrotic foci were found in the substance.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for a fowl.

Pig XXXIX.

Received from Birmingham on January 6th, 1912, as a case of apparently localised tuberculosis. Aged about 12 months.

Submaxillary lymphatic glands.—Two glands on one side and three on the other were slightly enlarged and contained discrete, yellowish, caseo-calcareous nodules easily shelling out and leaving smooth walled cavities in the gland substance. The two largest nodules measured from 1 to ·5 cm. in diameter. In smears a moderate number of tubercle bacilli were found. Cultures obtained direct from the submaxillary gland were avian in type. Three guinea-pigs were inoculated with emulsions of the lesions : one developed slight local tuberculosis and the other two were apparently free from tuberculosis. But from the spleens of all three animals cultures of avian tubercle bacilli were grown.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—In the substance there were a few scattered, yellowish grey, necrotic foci.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for a fowl.

Pig XL.

Received from Brighton on January 13th, 1912, as a case of slightly disseminated tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—From the left side was a small fibrous walled, purulent cyst which, having been completely cut across, was not available for animal inoculation. A smear from two parts of it showed no acid-fast bacilli.

Mesenteric glands.—Normal.

Lungs.—A few translucent nodules due to animal parasites.

Bronchial glands.—Normal.

Liver.—There was one grey nodule with a yellowish, necrosed centre ; it was unlike a tubercle. A smear showed no acid-fast bacilli.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

Pig XLI.

Received from Brighton on January 13th, 1912, as a case of slightly disseminated tuberculosis. Aged 7 months.

Submaxillary lymphatic glands.—On the left side one gland, the size of a thrush's egg, was replaced by caseo-necrotic tissue with

opaque, whitish, gritty streaks. In a second slightly enlarged and firm gland there were a few irregular caseous foci in small patches.

On the right side one gland contained a few small patches of minute, irregular, caseous foci; the rest were normal. In a smear a few tubercle bacilli were found, and an emulsion produced general tuberculosis in two guinea-pigs. Cultures obtained direct and through the two guinea-pigs were mammalian in type.

Mesenteric glands.—Normal.

Lungs.—On the right side there was one minute caseous tubercle* on the surface beneath the pleura; similar tubercles, some gritty, were found on section sparsely scattered throughout the lung, parenchyma. The condition of the left lung was similar to that of the right.

Bronchial glands.—Though not obviously enlarged, each contained a few minute, irregular, caseous foci, and one showed a few small, yellowish tubercles less than a rape seed. An emulsion produced general tuberculosis in two guinea-pigs. Cultures obtained direct and through one of the guinea-pigs were mammalian in type.

Liver.—Three minute opaque foci were seen just beneath the surface. No more were seen on section.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XLII.

Received from Brighton on January 18th, 1912, as a case of slightly disseminated tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—The glands from the left side were normal.

From the right side a gland measured 3 × 5 × 2·5 cm.; on section it was composed of firm, but not tough, grey, translucent tissue speckled with minute hæmorrhagic foci; in this firm tissue was a network, dense at one end of the gland, of yellowish, grey, necrotic streaks and patches. A second gland, measuring 3 × 2·3 × 1·5 cm., on section was composed of fairly firm tissue, a little firmer than normal gland tissue; this tissue was grey and translucent, but close inspection revealed very minute, irregular, caseous foci distributed throughout. In smear preparations tubercle bacilli were numerous. An emulsion produced general tuberculosis in two guinea-pigs. Cultures obtained direct and through one of the guinea-pigs were mammalian in type.

Mesenteric glands.—Normal.

Lungs.—In both lungs, slightly prominent beneath the pleura, there were numerous nodules composed of soft, grey, translucent tissue. On section similar nodules were found scattered throughout. The nodules varied in size from a rape seed up to 4 mm. in diameter. The centre of many was slightly more opaque than the periphery and yellowish grey. These nodules were very similar to the parasitic nodules sometimes found in the margins of the lungs. The apex of the right lung was reddish grey and solid. There were some

* *See* photograph, Plate III.

solid grey patches in the margins of the posterior lobes. No tubercle bacilli were found in smears from a nodule. An emulsion of the lung tissue was inoculated, after treatment with antiformin, into two guinea-pigs, and produced general tuberculosis in both; a culture of mammalian tubercle bacilli was grown from one.

Bronchial glands.—On the right side a gland was uniformly enlarged and firmer than normal; on section it showed a few somewhat indefinite minute, opaque foci. The majority of the bronchial glands were similar, but the opaque, yellowish and greyish foci of necrosis were in some cases more evident. In a smear preparation no tubercle bacilli could be seen.

Liver.— Beneath the capsule were seen 13 grey, translucent nodules the largest a little bigger than a millet seed, the majority smaller. In the largest could be seen a slight central opacity. On section of the liver similar nodules were found very sparsely scattered throughout the substance. In a smear from a nodule no tubercle bacilli could be seen. An emulsion of the liver tissue was inoculated, after treatment with antiformin, into two guinea-pigs, and produced general tuberculosis in both.

Spleen.—There were eight nodules, some deep in the substance, and some showing beneath the capsule, composed of rather soft, grey, translucent tissue with no evident opacity in the centre. The largest was the size of a hemp seed. In a smear no tubercle bacilli could be seen. An emulsion produced tuberculosis in a guinea-pig.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XLIII.

Received from Brighton on January 18th, 1912, as a case of slightly disseminated tuberculosis. Aged 7 months.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side there was a mass, measuring 4 × 2 × 3·2 cm., composed of fused glands. At the apex of this there was a little normal gland tissue representing either one or two fused glands; otherwise the tumour was composed throughout of caseo-calcareous nodules separated by bands of fibrous tissue. In a smear a few tubercle bacilli were found. An emulsion produced general tuberculosis in two guinea-pigs. Cultures obtained direct and through the guinea-pigs were mammalian in type.

Mesenteric glands.—Normal.

Lungs.—On the surface beneath the pleura, projecting slightly in many cases, were fairly numerous nodules ranging from 1 mm. to 4 mm. in diameter. On the convex dorsal surface of the left lung about 50 nodules were counted; on the ventral surface only 13. They were composed of caseous, perceptibly gritty material embedded in a matrix of translucent tissue and surrounded by a narrow zone of congested lung tissue. On section of the lung the nodules were found somewhat sparsely scattered throughout. The right lung was similar to the left. In a smear no tubercle bacilli were found.

Bronchial glands.—All were hard and slightly enlarged. On section they were fairly closely beset with yellow, caseous, gritty nodules surrounded by white, fibroid tissue, which replaced the

greater part of the gland substances. In a smear no tubercle bacilli were seen, but a culture was grown direct from the lesions.

Liver.—On the surface beneath the capsule there were 25 nodules measuring up to 3 mm. in diameter, the majority between 1 and 2 mm. They consisted of gritty, caseous tissue which shelled out, leaving grey, translucent capsules. On section similar nodules were more sparsely distributed throughout the organ. In a smear no tubercle bacilli were seen.

Portal glands.—These were firm, but only slightly enlarged. On section they contained discrete, yellow, caseous, gritty nodules ranging up to 5 mm. in diameter and in each case surrounded by a hard capsule of fibrous tissue.

Spleen.—There were visible just beneath the capsule six nodules, ranging up to 5 mm. in diameter and composed of translucent tissue containing one or more caseous, gritty foci or small nodules in each case. On section a few smaller tubercles about the size of a rape seed were seen. In a smear no tubercle bacilli were found, but a culture was grown direct from one of the nodules.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XLIV.

Received from Birmingham on January 22nd, 1912, as a case of apparently localised tuberculosis. Aged 12 months.

Submaxillary lymphatic glands.—On one side the fused glands measured 3·7 × 2·2 × 1 cm. The glands contained discrete, caseous, gritty nodules, replacing about half the gland substance. They shelled out readily and the gland substance remaining was apparently normal. The size of the nodules ranged from a millet seed up to 1 × 6 cm.

On the other side the condition was similar, except that there was a single free normal gland. Smears from four nodules showed tubercle bacilli to be numerous in one and moderately numerous in the others. The bacilli often occurred in small clumps. Cultures made direct were avian in type. An emulsion of the lesions was inoculated into three guinea-pigs which developed local tuberculosis only, and from which in each case an avian culture was obtained.

Mesenteric glands.—Not received.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Scattered throughout the substance were fairly numerous, irregular, yellowish grey, necrotic foci and small patches measuring about 2 mm. in greatest diameter.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for a fowl.

Pig XLV.

Received from Birmingham on January 24th, 1912, as a case of apparently localised tuberculosis. Aged 8 to 10 months.

Submaxillary lymphatic glands.—On one side there was a mass measuring 5 × 4 × 2·5 cm.; on the other, one measuring 3 × 5 × 2·5 cm.

On section each was composed of firm but not fibroid translucent tissue, closely beset with a network of yellowish, waxy, caseous tissue, which was not breaking down but showed centrally placed, opaque, whitish, gritty streaks and foci. A few tubercle bacilli were found in one smear and a moderately large number in another. An emulsion produced general tuberculosis in two guinea-pigs. Cultures obtained direct and through one of the guinea-pigs were mammalian in type.

Mesenteric glands.—Normal.

Lungs.—On the dorsal surface of the left lung there were 21 tubercles; on the ventral surface there was a single nodule. On the dorsal surface of the right lung were six tubercles and on the ventral three. The tubercles were distinctly palpable and rather hard; the majority were grey, with a minute opaque centre. They varied in size up to 2 mm. in diameter. On section through the lungs only one tubercle was found. A guinea-pig inoculated with an emulsion of the lung tissue developed general tuberculosis, and from it a culture of tubercle bacilli was obtained.

Bronchial glands.—In one gland there was a very minute caseous focus; the rest were normal.

Liver.—On the surface there were numerous areas, apparently cirrhotic, dense, white in the centre, and surrounded by an area in which the fibrous interlobular tissue was much hypertrophied. A few irregular, necrotic, grey foci were visible beneath the surface, and on section there was a single grey tubercle the size of a mustard seed.

Portal glands.—In each of two a single opaque focus was found.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XLVI.

Received from Birmingham on January 24th, 1912, as a case of apparently localised tuberculosis. Aged 15 months.

Submaxillary lymphatic glands.—On one side there was a tumour, measuring 3·5 × 3·5 × 3 cm., with two small glands attached.

On the other side was a tumour measuring 5·5 × 4 × 2·7 cm. On section, they were composed of soft, translucent tissue infiltrated with a close network of yellowish, waxy, caseous tissue which contained centrally placed, yellowish white streaks. In smears moderate numbers of tubercle bacilli were found. An emulsion produced general tuberculosis in three guinea-pigs. Cultures obtained direct and through two of the guinea-pigs were mammalian in type.

Mesenteric glands.—These were normal, except one which contained an opaque focus showing no tubercle bacilli in a smear preparation.

Lungs.—With the exception of two perfectly translucent nodules, these were normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic and mesenteric glands due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XLVII.

Received from Birmingham on January 24th, 1912, as a case of apparently localised tuberculosis. Aged 15 months.

Submaxillary lymphatic glands.—On one side the glands were small and normal, with the exception of a nodule, 1 × ·6 cm., composed of waxy, caseous tissue, embedded in a translucent matrix and beset with fine yellowish streaks.

On the other side there was a mass 5 × 5 × 3 cm., which on section consisted of translucent tissue, beset with a close, waxy, caseous network and containing opaque, yellowish, central streaks. Attached to this was a smaller gland, the size of a sparrow's egg, which was soft, translucent, and beset with small, irregular, waxy, caseous foci and small patches without any central, whitish streaks. A moderate number of tubercle bacilli was found in one smear but none in a second. An emulsion produced general tuberculosis in three guinea-pigs. Cultures obtained direct and through one of the guinea-pigs were mammalian in type.

Mesenteric glands.—A minute, calcareous grain was found in one; the rest were normal.

Lungs.—There were two minute, translucent tubercles with opaque centres in the right lung, which was otherwise normal. In a smear, one tubercle bacillus was seen.

Bronchial glands.—In one was a minute, calcareous grain.

Liver.—Normal.

Portal glands.—In two glands three caseous foci were seen. No tubercle bacilli were found.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XLVIII.

Received from Birmingham on January 24th, 1912, as a case of apparently localised tuberculosis. Aged 8 to 10 months.

Submaxillary lymphatic glands.—On one side there was a mass measuring 4 × 2·5 × 2 cm. On section it was composed of soft translucent tissue, which was a little firmer than normal gland and more friable; it was beset with yellowish, waxy, caseous streaks and patches of which the central parts were slightly more opaque than the rest; a considerable amount of the tissue was not caseous. A small, normal gland was attached to this mass.

On the other side the tumour measured 4 × 3·5 × 2·5 cm. On section it closely resembled the above, but the waxy, caseous tissue was more closely placed and was beset with bright red, haemorrhagic foci. Two small glands were normal. In smears a few tubercle bacilli were found. An emulsion produced general tuberculosis in three guinea-pigs. Cultures obtained direct and through one of the guinea-pigs were mammalian in type.

Mesenteric glands.—Three calcareous grains were found, but no bacilli were seen in them.

Lungs.—A single minute tubercle was seen, in which no bacilli were found. A guinea-pig inoculated with an emulsion of the lung tissue in which no tubercles were seen developed general tuberculosis.

Bronchial glands.—Normal.

Liver.—There was one caseo-purulent, gritty nodule of doubtful nature, the size of a pea, in which no tubercle bacilli were found.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic and mesenteric glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit. Slight macroscopic evidence of dissemination in the lungs. An emulsion of apparently normal lung tissue produced tuberculosis in a guinea-pig.

Pig XLIX.

Received from Birmingham on January 24th, 1912, as a case of apparently localised tuberculosis. Aged 13 months.

Submaxillary lymphatic glands.—On one side the fused glands formed a mass $8 \times 4{\cdot}7 \times 2{\cdot}7$ cm. On section this consisted almost throughout of a close network of caseous, gritty tissue, which in nearly half its extent had softened and become caseo-purulent.

On the other side there was a tumour measuring $7 \times 4 \times 2{\cdot}5$ cm., which, on section, was composed almost entirely of a close, caseous, gritty network. A smaller gland, loosely attached, was firm, and on section half was composed of caseous, gritty tissue, the other half being beset with caseous foci. In a smear a few tubercle bacilli were found. An emulsion produced general tuberculosis in three guinea-pigs. Cultures obtained direct and through one of the guinea-pigs were mammalian in type.

Mesenteric glands.—Normal.

Lungs.—In the right lung, beneath the pleura, there were eight minute tubercles, of which three were opaque in the centre and at least one was calcareous. In the left lung there were seven minute glassy tubercles, some caseous, others centrally calcareous. On section, tubercles were difficult to distinguish, but five were found, none larger than a rape seed; one was a calcareous grain, another caseo-calcareous, two others caseous and gritty, and the fifth transparent. In two smears no tubercle bacilli were found. Two guinea-pigs inoculated with an emulsion of lung tissue in doses of ·5 and 1 gramme respectively developed general tuberculosis.

Bronchial glands.—They were not enlarged, but the left showed scattered, irregular, caseous foci; the right showed a similar distribution of foci, which were irregular and in some cases gritty. A culture of tubercle bacilli was grown direct from the lesions.

Liver.—There were sparsely scattered, minute, yellowish-grey necrotic foci and small patches. Two calcareous grains were seen beneath the capsule.

Portal glands.—Six calcareous grains were found. In a smear no tubercle bacilli were seen.

Spleen.—In the substance there was a grey, miliary nodule showing two opaque, caseous foci. From this nodule a culture of tubercle

bacilli was grown. Three guinea-pigs, inoculated each with one gramme of tissue, showed after 41 days no tuberculosis.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

PIG L.

Received from Brighton on January 24th, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—These were not enlarged.

On the left side two were normal; two contained yellow, caseo-calcareous tubercles either singly placed or collected into small groups; many were easily picked out from the surrounding gland tissue, whilst others, especially the small caseous patches, were adherent, owing to their being surrounded by cicatricial, fibroid tissue.

On the right side three glands were normal; a fourth contained tubercles and small nodules similar to those on the left side. In smears tubercle bacilli were moderately numerous, and cultures obtained direct from the lesions were avian in type. Two guinea-pigs inoculated with an emulsion of the nodules developed generalised avian tuberculosis. A culture of avian tubercle bacilli was obtained from one.

Mesenteric glands.—In one there was a calcareous grain, and in another a nodule, 1 cm. by 5 cm., composed of caseous, gritty tissue easily shelling out and replacing about half the gland. Tubercle bacilli were moderately numerous. A culture obtained direct from the larger nodule was avian in type.

Lungs.—There were three minute, translucent foci just beneath the pleura.

Bronchial glands.—Normal.

Liver.—A few yellowish, calcareous grains of doubtful nature were found just beneath the capsule. In two smear preparations from them no tubercle bacilli were seen.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic and mesenteric glands, due to tubercle bacilli of avian type, virulent for a fowl; evidence of slight dissemination in lungs and liver.

PIG LI.

Received from Brighton on January 24th, 1912, as a case of slightly disseminated tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side there were two enlarged glands, one the size of a thrush's egg, the other the size of a sparrow's. In each case the gland was composed of caseo-calcarous tissue except at one end, where there was some fibroid, translucent tissue. A smear showed a moderate number of tubercle bacilli. An emulsion of the lesions produced

general tuberculosis in two guinea-pigs, and a direct culture was mammalian in type. Cultures were also obtained through the guinea-pigs.

Mesenteric glands.—In one gland there were a few calcareous grains. A second small gland, measuring 1·3 × 1 × ·7 cm., was almost completely replaced by a caseous, gritty nodule, which readily shelled out *en masse*. In a third gland there was a nodule the same size as the preceding, which also shelled out, leaving a smooth walled cavity in the gland.

Lungs.—On the left dorsal surface there were 18 nodules, the largest the size of a pea, the majority about a millet seed. They consisted of translucent tissue with caseous centres. On the left ventral surface there were three tubercles less than rape seed. In a smear no tubercle bacilli were seen. The right dorsal surface showed about 12 similar nodules, and also parasitic nodules. The right ventral surface showed six nodules, some with appreciably gritty centres, about the size of millet seed. On section the lung parenchyma contained sparsely distributed miliary tubercles. A culture was obtained direct from one of the nodules.

Bronchial glands.—They were not appreciably enlarged, but were affected on both sides, containing small, discrete nodules, consisting of waxy, caseous tissue beset with gritty points. The tissue around the nodules was firm and fibroid. The nodules occupied rather less than half the gland substance.

Liver.—On the surface beneath the capsule there were 12 yellow caseous tubercles enclosed in grey translucent capsules, and varying in size from a rape seed to a millet seed. On section similar tubercles were found sparsely scattered throughout. In a smear no tubercle bacilli were seen.

Portal glands.—These were three in number. They were not much enlarged, but contained discrete nodules, the largest measuring 7 × 5 mm., which consisted of waxy caseous tissue beset with opaque, yellowish points, the surrounding gland tissue being firmer, whiter, and more fibroid than normal.

Spleen.—There was a single irregular grey nodule, rather larger than a millet seed, and beset with caseous foci not apparently gritty. In a smear no tubercle bacilli were seen.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LII.

Received from Brighton on February 2nd, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—They were not obviously enlarged.

On the left side there was a gland containing a small, irregular, caseous, gritty patch, not readily separated from the surrounding gland tissue. Three or four small glands were normal.

On the right side there were two glands affected. One contained scattered, discrete, caseous, gritty tubercles; the other showed more numerous aggregations of caseous, gritty tubercles, replacing about one-third of the gland. The three remaining glands were normal. In a smear from the lesions, moderately numerous tubercle bacilli

were found. Cultures obtained direct were avian in type. Two guinea-pigs were inoculated with emulsions; one developed local tuberculosis, the other showed some generalisation of the disease. Cultures from both were avian in type.

Mesenteric glands.—Five glands were affected. One was slightly enlarged and consisted in two-thirds of its extent of pinkish, caseo-necrotic tissue which fairly easily separated from the surrounding gland, and was not appreciably gritty; the remaining third of the gland was beset with discrete, irregular, caseous foci. The other four glands each showed one or two waxy, caseous nodules with opaque, yellowish streaks and foci, measuring up to 1 cm. in their greatest diameter. In smears, tubercle bacilli were numerous. A direct culture was avian in type.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—On section three minute greyish foci of doubtful nature were found, showing no tubercle bacilli.

Four guinea-pigs were inoculated with a total quantity of 3·5 grammes of liver tissue; two died in 25 days and two were killed in 42 days. None showed any macroscopic tuberculosis, but cultures of avian tubercle bacilli were obtained from the spleens of the two latter.

Portal glands.—Normal.

Spleen. — Normal. Four guinea-pigs were inoculated with a total quantity of three grammes of tissue. One died in 27 days; three were killed in 42 days. None showed any macroscopic tuberculosis but a culture of avian tubercle bacilli was obtained from the spleen of one.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic and mesenteric glands due to tubercle bacilli of avian type, virulent for a fowl. No macroscopic evidence of dissemination, but the presence of avian tubercle bacilli was demonstrated in apparently normal tissue from the liver and the spleen.

Pig LIII.

Received from Brighton on February 2nd, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On the right side there was a small gland containing scattered, minute, caseous tubercles. In a second gland there were several waxy, caseous, gritty nodules, easily shelling out of the gland substance. Several small glands were normal.

On the left side one gland was enlarged and beset with waxy, caseous nodules, similar to those on the right side; around several of the nodules there was some fibrosis of the gland substance. A second gland showed a single pea-sized caseo-necrotic nodule and several discrete, irregular, caseous tubercles. In smears a few tubercle bacilli were found. A direct culture was avian in type.

Mesenteric glands.—Four contained caseous nodules easily shelling out and measuring up to 1 cm. in greatest diameter. The rest were normal. In smears tubercle bacilli were moderately numerous and in small groups. A direct culture was avian in type. The two guinea-pigs inoculated died too early for lesions to be visible, but

from the spleen of one, which had lived for nine days after inoculation, a culture of avian tubercle bacilli was obtained.

Lungs.—Normal. A guinea-pig was inoculated with lung tissue and killed after 42 days. It showed a caseous patch in the pyloric gland from which a culture of avian tubercle bacilli was obtained.

Bronchial glands.—Normal.

Liver.—There were sparsely scattered minute, irregular, yellowish, necrotic foci. Two guinea-pigs were inoculated with a total quantity of two grammes of liver tissue; they showed no macroscopic tuberculosis when killed in 42 days, but a culture of avian tubercle bacilli was obtained from the spleen of each.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic and mesenteric glands due to tubercle bacilli of avian type, virulent for a fowl. No macroscopic evidence of dissemination, but the presence of tubercle bacilli was demonstrated in apparently normal lung and liver tissue.

Pig LIV.

Received from Birmingham on February 1st, 1912, as a case of apparently localised tuberculosis. Aged about 10 months.

Submaxillary lymphatic glands.—On one side was a mass measuring 7 × 5 × 3·3 cm. composed almost throughout of fibro-caseous, gritty tissue.

On the other side was a similar mass measuring 8 × 5·2 × 3 cm. In a smear tubercle bacilli were moderately numerous. A direct culture was mammalian in type.

Mesenteric glands.—Normal.

Lungs.—In the left lung on the dorsal surface was a caseous tubercle the size of a rape seed; on the ventral surface were two similar tubercles. In the right lung on the ventral surface there was one caseous tubercle and on the dorsal surface four more, none larger than a rape seed. On section similar tubercles were seen scattered throughout the parenchyma. In smears a few tubercle bacilli were seen.

Bronchial glands.—There were a few scattered, minute, irregular, caseous foci, showing a few tubercle bacilli in a smear preparation.

Liver.—Just beneath the surface there was a pea-sized translucent nodule with a caseous centre. Scattered throughout the substance were yellowish, necrotic foci.

Spleen.—Just beneath the capsule there was a minute, grey tubercle with a yellow, caseous centre. On section nothing further was seen.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for a rabbit.

Pig LV.

Received from Brighton on February 7th, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On the right side they were normal.

On the left was a mass measuring 8 × 5·5 × 3·1 cm., which on section was composed of firm, translucent tissue containing a close network of waxy, caseating tissue with fine, central opaque streaks and foci. There was also a gland, 2·5 × 1 × 1·6 cm., which was uniformly enlarged but showed no signs of caseation. A guinea-pig inoculated with an emulsion developed general tuberculosis. Cultures obtained direct and through the guinea-pig were mammalian in type.

Mesenteric glands.—Normal.

Lungs.—Just beneath the pleura was a minute translucent tubercle with a calcareous centre.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit. Slight macroscopic evidence of dissemination in the lungs.

PIG LVI.

Received from Brighton on February 8th, 1912, as a case of slightly disseminated tuberculosis.

Submaxillary lymphatic glands.—On the left side they were normal.

On the right side there was a mass of enlarged, adherent glands measuring 7·5 × 4 × 3·2 cm. On section, it was composed of firm but not fibroid, translucent tissue closely beset with a yellowish, somewhat waxy, caseo-necrotic network containing opaque streaks and small patches of hæmorrhage and congestion ; in parts the caseous tissue was dense.

Mesenteric glands.—Normal.

Lungs.—On the surface just beneath the pleura were numerous grey, miliary tubercles with slight central caseation. Similar tubercles were distributed throughout the parenchyma.

Bronchial glands.—They were not obviously enlarged but a little firmer than normal and only slightly affected, showing in each case a few irregular, caseous foci.

Liver.—On the convex surface 50 tubercles were counted, the majority measuring 1 mm. in diameter. They consisted of grey, translucent tissue, some only with slight central opacity. There were similar tubercles in about equal numbers on the concave surface, and distributed throughout the substance.

Portal glands.—They showed scattered, ill-defined, irregular, caseous tubercles and foci.

Spleen.—On section there were moderately numerous grey, caseating nodules, the majority being the size of a millet seed and a few a little larger.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis ; as the disease was advanced, further investigation was not undertaken.

PIG LVII.

Received from Brighton on February 14th, 1912, as a case of apparently localised tuberculosis. Aged 3 years.

Submaxillary lymphatic glands.—On the left side they were normal.

On the right side were two hard, irregular glands, not enlarged, which on section contained calcareous nodules almost replacing the gland tissue. A third small gland was studded with calcareous granules up to a millet seed in size. In smears tubercle bacilli were rare and appeared somewhat degenerate. One guinea-pig inoculated remained healthy, and cultures made from this animal and from the original material remained sterile.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—In the margin of one lobe there were several translucent miliary nodules of doubtful nature. In a smear no tubercle bacilli were seen. Five guinea-pigs inoculated with a total quantity of 7 grammes of tissue remained free from tuberculosis.

Portal glands.—Normal.

Spleen.—Normal. Six guinea-pigs inoculated with a total quantity of 6 grammes of tissue remained free from tuberculosis.

Inguinal glands.—Normal.

Summary.

Localised tuberculosis of the submaxillary lymphatic glands; the tubercle bacilli in the lesions were apparently dead.

Pig LVIII.

Received from Brighton on February 17th, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the right side was a gland measuring $2 \times 2 \times 1{\cdot}3$ cm., which on section was composed of translucent tissue, firm but not hard, and studded with small, irregular, waxy caseous patches. A second, smaller gland was similarly affected; in a smear from this, one tubercle bacillus was found. A third showed a few discrete caseous tubercles. A fourth was normal.

On the left side was a gland measuring $3{\cdot}5 \times 1{\cdot}6 \times 1{\cdot}6$ cm.; on section it was similar to the large gland on the right side; in a smear a few tubercle bacilli were seen. Three other glands were normal. Cultures obtained direct yielded tubercle bacilli of avian type. Of three guinea-pigs inoculated from lesions, two showed no macroscopic tuberculosis after 32 and 42 days respectively; in the third, 42 days after inoculation, there was a minute tubercle in the omentum and enlargement of the Malpighian bodies of the spleen (tubercle bacilli in smear preparation). Cultures were isolated from the spleens of two of the guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—On the surface beneath the pleura were several parasitic nodules from 1 to 2 mm. in diameter. No lesions were seen on section.

Bronchial glands.—Normal.

Liver.—Normal. Eight guinea-pigs were inoculated with a total quantity of eight grammes of tissue; they were all killed after 42 days. Six showed no lesions; in two there was slight omental tuberculosis (tubercle bacilli in smears), and in one of these two cases there were three nodules in the spleen. From the spleens of seven of the guinea-pigs cultures of avian tubercle bacilli were obtained.

Portal glands.—Normal.

Spleen.—Normal. Five guinea-pigs inoculated with a total quantity of five grammes of tissue all appeared healthy when killed 42 days after inoculation. Culture from the spleen of one yielded avian tubercle bacilli.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for a fowl. No macroscopic evidence of dissemination, but the presence of avian tubercle bacilli was demonstrated in the apparently normal spleen and liver.

Pig LIX.

Received from Brighton on February 21st, 1912, as a case of apparently localised tuberculosis. Aged 5 months.

Submaxillary lymphatic glands.—On the left side was a gland measuring 3 × 2 × 2·5 cm. Three-fourths of its substance were replaced by fibro-caseous tissue with a few gritty points. An adjacent gland, 1 cm. in its longest diameter, contained three caseous foci. Three other glands were normal. In a smear from the first gland one beaded tubercle bacillus was found.

On the right side was a gland measuring 2·7 cm. in its longest diameter; two-thirds of its substance were replaced by fibro-caseous tissue with slightly gritty points. In a smear no tubercle bacilli were found. Partially fused with this was a second gland, about the same size and of similar structure internally. Three guinea-pigs inoculated died of general tuberculosis. Cultures from one of these and from the original material were mammalian in type.

Tonsils.—There was a yellow point, slightly larger than a pin's head, which did not shell out easily. In a smear no tubercle bacilli were found.

Mesenteric glands.—Normal.

Lungs.—On the surface beneath the pleura were about a dozen translucent nodules, from 1 to 1·5 mm. in diameter. Each had an opaque, yellowish grey centre, which was soft but not caseous and not gritty. In a smear no tubercle bacilli were found. No nodules were seen on section.

Bronchial glands.—Normal.

Liver.—On the surface beneath the capsule was one yellowish grey, soft but not definitely caseous nodule, 1 mm. in diameter. In a smear no tubercle bacilli were found. On section one similar nodule was found.

Portal glands.—These were not enlarged. One, of normal consistency, showed on section an area measuring 2 × 1 mm., which contained fine caseous streaks interspersed with fibrous strands. In a smear three tubercle bacilli were seen. The other glands were normal.

Spleen.—On the surface beneath the capsule was a yellow nodule, measuring 1 × 1·5 mm., which was soft but not caseous. In a smear no tubercle bacilli were seen. On section no other lesions were found.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LX.

Received from Brighton on February 28th, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—These were not enlarged. On the left side one gland was normal; the remainder each contained numerous discrete, caseous, non-gritty foci, and in two there were semi-confluent fibro-caseous areas each about 2·5 mm. in diameter.

On the right side two glands only were tuberculous; the lesions were less advanced than on the left, consisting merely of minute caseous, non-gritty foci, three in one gland and six in the other. Smears, two from the left side and one from the right, each showed tubercle bacilli in scanty numbers. A culture of avian tubercle bacilli was obtained. Three guinea-pigs inoculated with the lesions were killed in 42 days. Two showed foci in the omentum and translucent nodules in the spleen; the third appeared normal.

Mesenteric glands.—Normal.

Lungs.—Three small nodules, due to animal parasites, on the surface just beneath the pleura. On section, normal.

Bronchial glands.—Normal.

Liver.—Two small irregular fibroid areas visible on the surface. On section, normal. Six guinea-pigs inoculated with a total quantity of 10 grammes of tissue showed no lesions of tuberculosis. Cultures made in five cases from apparently normal spleens were negative.

Portal glands.—Normal.

Spleen.—Normal. Five guinea-pigs inoculated with a total quantity of 5 grammes of tissue, when killed in 42 days, showed no disease except in one instance where there were a few foci in the omentum containing tubercle bacilli. Cultures made from the apparently normal spleens were negative.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for a fowl. There was no macroscopic evidence of dissemination, but the presence of tubercle bacilli was demonstrated in the spleen.

Pig LXI.

Received from Birmingham on March 6th, 1912, as a case of apparently localised tuberculosis. Aged 9 months.

Submaxillary lymphatic glands.—On one side, a gland measured 3½ × 2 × 1½ cm.; scattered throughout its substance and replacing about half the normal tissue were nodules, varying in diameter from 1 to 8 mm., which were composed throughout of soft, caseous, gritty material, easily shelling out; another gland, not enlarged, contained about six similar discrete nodules, varying in size from 1 to 2 mm.; a third gland was normal.

On the other side was a gland, about 2½ cm. in its longest diameter, which contained discrete nodules, from 1 to 6 mm. in diameter, similar to the above; three other glands were normal. In a smear from the caseous material tubercle bacilli were very numerous. A culture of avian tubercle bacilli was obtained. Two guinea-pigs inoculated with the lesions were killed in 51 days. One showed a caseous focus in the pyloric gland; the other appeared normal, but a culture of avian tubercle bacilli was isolated from the spleen.

Mesenteric glands.—One gland measuring $2\frac{1}{2} \times 1\frac{3}{4} \times 1\frac{3}{4}$ cm. was completely replaced by caseous material similar to that described above ; in a smear, tubercle bacilli were numerous. The other glands were normal. Two guinea-pigs were inoculated with the lesions. One died in 39 days ; the other was killed in 51 days. Neither showed lesions.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal. Six guinea-pigs were inoculated with a total quantity of 6 grammes of tissue. None developed any lesions of tuberculosis.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic and mesenteric glands due to tubercle bacilli of avian type, virulent for a fowl. There was no macroscopic evidence of dissemination.

Pig LXII.

Received from Brighton on March 7th, 1912, as a case of apparently localised tuberculosis. Aged 2 years.

Submaxillary lymphatic glands.—On the left side a gland measuring $2\frac{1}{4} \times 1\frac{3}{4} \times 1\frac{1}{2}$ cm. was almost completely replaced by caseo-calcareous material ; two other glands, not enlarged, contained a few caseo-calcareous foci ; a fourth gland was normal.

On the right side one gland was normal ; a second contained about half-a-dozen discrete, caseo-calcareous tubercles from 1 to 2·5 mm. in diameter. In smears tubercle bacilli were very scanty. Three guinea-pigs were inoculated. One died in 35 days showing no tuberculosis ; one died in 46 days with only a single omental nodule containing a few tubercle bacilli ; the third, killed in 50 days, had chronic general tuberculosis. Cultures obtained direct and through one of the guinea-pigs were mammalian in character.

Mesenteric glands.—They were not enlarged, but four were tuberculous. One showed on section an area of about 7 × 3 mm. beset with irregular, semi-confluent, caseo-calcareous foci interspersed with fibrous trabeculæ ; a second showed a similar area about half the above size ; the third and fourth each showed two discrete caseo-calcareous nodules from 1 to 2 mm. in diameter. In a smear a few tubercle bacilli were found.

Lungs.—Normal.

Bronchial glands.—These were not enlarged, but five contained minute caseous and slightly calcareous foci, two or three in each gland. In a smear one tubercle bacillus was seen.

Liver.—The surface was normal. In the substance there was a cyst, measuring $2 \times 1\frac{1}{2} \times 1\frac{1}{2}$ cm. with tough fibrous walls and filled with soft, yellow material like hard boiled yolk of egg ; there were also two yellowish grey nodules with the appearance of tubercles ; one, 1 mm. in diameter, was rather soft and not gritty ; it shelled out easily ; the other, 2 mm. in diameter, also shelled out easily and was calcareous ; in smears, one from each, no tubercle bacilli were seen.

Portal glands.—On section one showed an area of $2\frac{1}{2} \times 1\frac{1}{2}$ mm. wherein the gland tissue was partially replaced by fibro-caseous streaks ; in a smear one doubtful tubercle bacillus was seen.

Spleen.—Normal.
Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for the guinea-pig.

Pig LXIII.

Received from Birmingham on March 12th, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On one side was a fused mass of glands, measuring 7 × 4 × 3 cm., which showed on section dense, fibro-caseous, gritty tissue occupying about three-fourths of the whole mass; on the same side two glands were normal.

On the other side one gland was tuberculous; it was not enlarged, but contained, chiefly in the medullary substance, numerous semi-confluent, fibro-caseous, gritty areas, up to 2·5 mm. in diameter. In smears tubercle bacilli were very scanty. General tuberculosis was produced in two guinea-pigs inoculated. Cultures from one of these and from the original material were mammalian in character.

Mesenteric glands.—One gland was tuberculous. It was not enlarged but contained discrete, slightly gritty foci scattered throughout one-third of its substance. In a smear no tubercle bacilli were seen; but a culture of mammalian type was obtained.

Lungs.—On the surface, beneath the pleura, were about 15 tubercles, each from 1 to 1·5 mm. in diameter, with opaque, yellow centres and translucent margins. On section two similar tubercles were seen.

Bronchial glands.—These were somewhat enlarged, the largest being 4 cm. in its longest diameter, and all tuberculous. On section were seen numerous discrete, caseous, slightly gritty areas, each from ·5 to 2 mm. in diameter.

Liver.—On the surface, beneath the capsule, were six yellowish grey tubercles, from 1 to 3 mm. in diameter, which shelled out easily; the largest were gritty in the centre, the smaller were soft and slightly caseous. On section four similar tubercles were seen, the largest being 2·5 mm. in diameter. In a smear no tubercle bacilli were seen.

Portal glands.—These were slightly enlarged and all were tuberculous, their condition being similar to that of the bronchial glands. In a smear one tubercle bacillus was seen.

Spleen.—On the surface was one yellow tubercle, 1·5 mm. in diameter, with a caseous, gritty centre; on section five similar tubercles were seen. In a smear no tubercle bacilli were found.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type virulent for guinea-pigs and a rabbit.

Pig LXIV.

Received from Brighton on March 22nd, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the right side there was a slightly enlarged gland which contained irregular, discrete, yellow, caseous, gritty tubercles, the majority about the size of rape seed, but varying up to nearly a hemp seed.

On the left side was a slightly enlarged gland beset with similar tubercles, rather more numerous and in parts coalescing to form small nodules. Most but not all of the tubercles could fairly readily be separated from the surrounding gland tissue. A culture of avian tubercle bacilli was obtained. Two guinea-pigs were inoculated with the lesions: one dying in 14 days showed tuberculosis of omentum and pyloric and sternal glands; the other after 28 days showed no disease.

Mesenteric glands.—Normal.
Lungs.—Normal.
Bronchial glands.—Normal.
Liver.—Normal.
Portal glands.—Normal.
Spleen.—Normal.
Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for a fowl. There was no macroscopic evidence of dissemination, but tubercle bacilli were demonstrated microscopically in a guinea-pig inoculated with the muscle.

PIG LXV.

Received from Brighton on March 23rd, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the right side they were adherent to each other and little if at all enlarged. At one extremity there was a soft caseous nodule 2 × 1 cm. in diameter, and in the remaining portion were discrete soft, gritty, miliary tubercles, easily picked out. No tubercle bacilli were seen in a smear preparation.

On the left side the glands were normal. A culture of mammalian tubercle bacilli was obtained. Two guinea-pigs inoculated with the lesions died of general tuberculosis.

Mesenteric glands.—Normal.

Lungs.—In the left, just beneath the pleura were two yellowish gritty tubercles less than rape seed. On section through the lung sparsely scattered minute grey tubercles with caseous, gritty centres were seen. In the right lung three tubercles were seen beneath the pleura similar to those on the left side but markedly calcareous and slightly larger. A few similar tubercles were seen on section.

Bronchial glands.—They were not obviously enlarged. All contained discrete soft, yellow, gritty nodules, easily shelling out and up to a mustard seed in size.

Liver.—Just beneath the capsule was a grey nodule (5 mm.) with an opaque yellow centre. No tubercle bacilli could be seen in a smear preparation. In addition there were two yellow caseo-calcareous tubercles the size of rape seed visible from the surface, and a single minute yellow tubercle was seen on section.

Portal glands.—In one there was a single nodule similar to those in the bronchial glands.

Spleen.—Beneath the capsule was a single yellow miliary tubercle; no tubercle bacilli were seen in a smear preparation. On section there was a small irregular, soft, yellow, slightly gritty tubercle.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs.

Pig LXVI.

Received from Brighton on March 27th, 1912, as a case of apparently localised tuberculosis. Aged 14 weeks.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side there was a slightly enlarged gland, which on section showed the substance beset with small discrete, irregular, caseous patches and streaks. The caseous substance was yellowish and waxy in appearance, and did not readily separate from the surrounding glandular tissue; there was no grittiness and no fibrosis of the gland. A small gland was beset with sparse minute, irregular, caseous foci. In the former gland smear preparations showed numerous tubercle bacilli. A culture of avian tubercle bacilli was obtained and, in one tube, an acid-fast bacillus differing in characters and rapidity of growth from the tubercle bacillus. Two guinea-pigs inoculated with the lesions died in 26 and 36 days respectively; the former showed tuberculosis of omentum, pyloric, lumbar and sternal glands, the latter nodules in the omentum only. From the spleen in both cases cultures of avian tubercle bacilli were obtained.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—There were three necrotic foci beneath the capsule. Avian tubercle bacilli were isolated from a guinea-pig inoculated with apparently normal tissue.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of avian type (virulent for a fowl), associated with an acid-fast bacillus other than a tubercle bacillus; dissemination of avian tubercle bacilli in apparently normal liver.

Pig LXVII.

Received from Birmingham on March 29th, 1912, as a case of apparently localised tuberculosis. Aged 6–7 months.

Submaxillary lymphatic glands.—On each side the glands were adherent, forming small masses, measuring respectively 3·3 × 2·2 × 1·6 cm. and 3·2 × 2·7 × 1·3 cm. On section they were closely beset with yellow waxy, caseous, nodules, measuring up to a pea in size; they were not appreciably gritty, though they showed in the centres minute foci and streaks, which were more opaque than the rest of the caseous material; the nodules shelled out readily from the gland substance leaving smooth walled cavities. Two smear preparations showed only a few tubercle bacilli. A culture of avian tubercle bacilli was obtained. Two guinea-pigs inoculated with the lesions and killed after 34 days showed a few translucent foci in the omentum and prominent Malpighian bodies in the spleen. A culture of avian tubercle bacilli was obtained from the spleens of both.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—There were a few necrotic foci of doubtful nature.

Portal glands.—Normal.
Spleen.—Normal.
Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of avian type, virulent for a fowl.

Pig LXVIII.

Received from Brighton on March 30th, 1912, as a case of apparently localised tuberculosis. Aged 8 months.

Submaxillary lymphatic glands.—On the left side the glands were adherent but not enlarged; in one, visible just beneath the capsule, were three yellow caseous encapsuled nodules ranging from a millet seed to a hemp seed in size, the gland substance being otherwise normal.

On the right side one gland showed scattered discrete, minute, irregular, yellow, caseo-calcareous foci, easily shelling out. The remaining glands were normal. In a smear preparation were numerous short, thick acid-fast bacilli, some apparently spherical in contour. A culture of an acid-fast bacillus different from tubercle bacilli was obtained. A guinea-pig inoculated with the lesions was apparently healthy when killed after 46 days, but a culture of avian tubercle bacilli was obtained from its spleen.

Mesenteric glands.—Normal.
Lungs.—Normal.
Bronchial glands.—Normal.
Liver.—Normal.
Spleen.—Normal.
Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of avian type, associated with an acid-fast bacillus other than a tubercle bacillus.

Pig LXIX.

Received from Brighton on April 4th, 1912, as a case of apparently localised tuberculosis. Aged 8 months.

Submaxillary lymphatic glands.—On the left side the glands were not enlarged, but two contained irregular, yellowish, gritty foci and tubercles, the largest being the size of a rape seed.

On the right side the glands were normal.

In a smear preparation no tubercle bacilli were found. A guinea-pig showed no tuberculosis when killed 40 days after inoculation. Cultures from the original material were of the dry mammalian type, resembling in some respects the eugonic "human" bacillus, but capable of growth at 22° C. (*see* p. 80). They failed to produce tuberculosis in guinea-pigs; in rabbits only slight disease was produced except after large intravenous doses, when acute tuberculosis of the avian type was produced. Intramuscular inoculation in fowls caused only slight disease.

Mesenteric glands.—In about 8 glands were 13 to 15 irregular calcareous foci and yellow gritty tubercles, the size of rape seed. In

two smears no tubercle bacilli were found. Cultures were made but remained sterile.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli which, though resembling the mammalian type in the dryness of their growth, are provisionally classed as avian owing to their failure to cause tuberculous lesions in guinea-pigs, and their capacity to produce typical avian tuberculosis in the rabbit.

PIG LXX.

Received from Brighton on April 13th, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the right side the glands were adherent. One was a little enlarged and contained an encapsuled caseo-calcareous nodule, the size of a sparrow's egg, which replaced almost the whole of the gland. In a second small gland there was a caseous focus just beneath the capsule. In two smears tubercle bacilli were scanty. General tuberculosis was produced in a guinea-pig.

On the left side the glands were normal.

Cultures obtained directly, with the aid of antiformin, and also through a guinea-pig, were of mammalian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—There was one nodule of doubtful nature in which no tubercle bacilli were found.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for a guinea-pig and a rabbit.

PIG LXXI.

Received from Brighton on April 19th, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On the left side one gland was slightly enlarged, with several projecting nodules of caseo-necrotic gritty material, easily shelling out and leaving smooth fibrous walled loculated cavities, which replaced about half of the glandular tissue; the largest of the cavities measured about ·6 cm. in greatest diameter. A second gland contained three miliary nodules of a similar nature. A third small gland showed several yellow gritty foci. Two smaller glands were normal.

On the right side one gland measured 2 × 1·2 cm. in its largest diameters and was practically replaced by caseo-necrotic, gritty

substance and completely encapsuled. A second gland, 1·2 × ·7 cm., was replaced to about one-third of its extent by similar substance. A third gland contained discrete, encapsuled, calcareous nodules, up to nearly a millet seed in size. Several smaller glands were normal. General tuberculosis was produced in two guinea-pigs.

A smear preparation showed a few tubercle bacilli. Cultures obtained directly and through a guinea-pig yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—They were not enlarged but two contained a few irregular caseo-calcareous tubercles, in smear preparations of which no tubercle bacilli were seen.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of submaxillary lymphatic glands, due to tubercle bacilli of mammalian type which exhibited scanty growth on culture media but were only slightly virulent for rabbits.

Pig LXXII.

Received from Birmingham on April 22nd, 1912, as a case of apparently localised tuberculosis. Aged 7 or 8 months.

Submaxillary lymphatic glands.—On each side the glands appeared slightly enlarged and were fused together. On section they were fairly closely beset with yellow caseo-calcareous tubercles up to a hemp seed in size. These shelled out readily from the surrounding tissue, leaving smooth walled cavities. In parts the tubercles were collected together, forming nodules up to ·7 cm. in diameter.

In smear preparations bacilli were moderately numerous. Three guinea-pigs were inoculated but failed to develop macroscopic tuberculosis. Cultures obtained directly and through a guinea-pig were typical of the avian tubercle bacillus.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of the avian type, virulent for a fowl.

Pig LXXIII.

Received from Birmingham on April 24th, 1912, as a case of apparently localised tuberculosis. Aged 10 months.

Submaxillary lymphatic glands.—On one side there was a single yellow, miliary tubercle.

On the other side the glands formed a mass, measuring 7 × 4·5 × 3 cm., which on section was composed of translucent tissue beset with a close network of yellow, caseo-calcareous material.

Cultures obtained directly yielded tubercle bacilli of mammalian type and general tuberculosis was produced in two guinea-pigs inoculated with the material.

Mesenteric glands.—Not sent.

Lungs.—On the surface beneath the pleura were seen five minute translucent tubercles with caseous centres. On section similar tubercles were seen very sparsely scattered throughout the parenchyma. In two smear preparations no tubercle bacilli were seen, but two out of three guinea-pigs inoculated with this tissue treated with antiformin developed general tuberculosis.

Bronchial glands.—In two there were a few very minute, irregular, caseous foci. No tubercle bacilli could be found in two smear preparations.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and rabbits.

Pig LXXIV.

Received from Brighton on April 25th, 1912, as a case of apparently localised tuberculosis. Aged 2½ years.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side there was a gland about the size of a pigeon's egg, being slightly enlarged compared with that of the other side. On section it consisted almost throughout of pinkish caseo-calcareous tissue, softening round the periphery and contained within a thick, almost cartilaginous capsule, from which it was easily shelled out. In the smaller glands adherent to it were a few calcareous grains.

A few tubercle bacilli were seen in smears. General tuberculosis was produced in guinea-pigs. Direct cultures yielded tubercle bacilli of mammalian type.

Mesenteric glands.—One gland showed a small area containing two irregular calcareous nodules about the size of hemp seed and a few calcareous grains. The rest were normal. In a smear no tubercle bacilli were seen.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic and mesenteric glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and rabbits.

Pig LXXV.

Received from Brighton on May 7th, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the left side they were normal,

On the right side they were not enlarged, but one contained three whitish calcareous nodules up to a small pea in size.

In smears a few tubercle bacilli were found; several of them were long and rather irregular in shape. General tuberculosis was produced in guinea-pigs. Cultures, obtained both directly and from a guinea-pig, produced luxuriant growths of tubercle bacilli of mammalian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—One showed a few doubtful opaque foci, in a smear from which no tubercle bacilli could be found.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, of luxuriant growth and of low virulence for rabbits.

Pig LXXVI.

Received from Birmingham on May 11th, 1912, as a case of apparently localised tuberculosis. Aged 12 to 14 months.

Submaxillary lymphatic glands.—On one side there was a mass measuring 3·5 × 3 × 2·2 cm., consisting of several adherent glands which on section were to a large extent replaced by yellow, caseous, gritty nodules. The nodules were typically encapsuled and could be readily shelled out, leaving smooth walls. Some small adjacent glands were normal.

On the other side there was a small mass of glands measuring 3·2 × 2·2 × 1·2 cm. On section they resembled those on the former side except that in one half the nodules were discrete, and there was some normal gland tissue remaining. Some small adjacent glands were normal.

In smears a few tubercle bacilli were seen. General tuberculosis was produced in guinea-pigs. Cultures obtained directly and through the guinea-pigs yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXVII.

Received from Birmingham on May 15th, 1912, as a case of apparently localised tuberculosis. Aged 12 to 14 months.

Submaxillary lymphatic glands.—On one side there was a mass measuring 5·6 × 4·3 × 2·6 cm. On section this was composed of translucent tissue partially beset with areas of waxy, caseous material

containing whitish, gritty lines. The rest of the tissue showed numerous discrete, yellow, caseous tubercles and small irregular nodules. Two small glands adherent to the mass were normal.

On the other side was a rather larger mass, which on section resembled the above. There was, however, less translucent tissue, and between the nodules it was more fibrous in appearance. The caseous tissue could not readily be separated from the fibrous tissue. There was also a gland, 3·5 × 1·7 × 1·2 cm., which on section showed a moderate number of small, irregular, caseous foci and tubercles distributed throughout.

In a smear a few tubercle bacilli were seen. Cultures, obtained directly and from a guinea-pig were of mammalian type, growth being scanty. General tuberculosis was produced in a guinea-pig.

Mesenteric glands.—In one, two irregular calcareous granules were found. No tubercle bacilli were seen in a smear.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of mammalian type, of scanty cultural growth but of low virulence for rabbits.

Pig LXXVIII.

Received from Birmingham on June 4th, 1912, as a case of apparently localised tuberculosis. Aged eight months.

Submaxillary lymphatic glands.—On one side was a mass of adherent glands measuring 5 × 5·2 × 2·3 cm., with a smaller gland the size of a thrush's egg attached. On section the mass consisted of firm, fibro-caseous substance, with whitish calcareous patches.

On the other side was a mass measuring 6·5 × 4·8 × 2·7 cm., of similar nature to the former.

In a smear two tubercle bacilli were seen. A direct culture was of mammalian type and produced general tuberculosis in a guinea-pig.

Mesenteric glands.—One gland contained a caseous gritty nodule, 5 mm. in diameter, which was soft and shelled out easily. In a smear tubercle bacilli were very numerous. A culture of avian tubercle bacilli was obtained; two guinea-pigs, each inoculated subcutaneously with 1 mg. of this culture were healthy when killed 197 days later. The other glands appeared normal.

Lungs.—Not received.

Liver.—On section there were two greyish translucent nodules, one with central gritty foci. In a smear no tubercle bacilli were seen.

Spleen.—Normal.

Inguinal, lumbar, and mammary lymphatic glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for a guinea-pig and a rabbit. Tuberculosis of a mesenteric gland due to tubercle bacilli of avian type, virulent for a fowl and not virulent for guinea-pigs.

Pig LXXIX.

Received from Birmingham on June 6th, 1912, as a case of apparently localised tuberculosis. Aged 12 months.

Submaxillary lymphatic glands.—On one side was a mass of adherent glands measuring $5{\cdot}5 \times 4 \times 2{\cdot}5$ cm. On section they were composed practically throughout of firm, fibro-caseous, gritty tissue.

On the other side was an irregular mass resembling the above and measuring $7 \times 5 \times 2{\cdot}5$ cm.

General tuberculosis was produced in guinea-pigs. Cultures obtained directly and from a guinea-pig were of mammalian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—On section a single greyish nodule about the size of a hemp seed was seen. It consisted of a firm capsule containing soft grey substance with two yellowish, gritty foci. In a smear no tubercle bacilli were seen. A guinea-pig inoculated with the nodule was found healthy when killed 62 days afterwards.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXX.

Received from Brighton on July 5th, 1912, as a case of apparently localised tuberculosis. Aged six months.

Submaxillary lymphatic glands.—On the right side they were normal.

On the left side one gland contained four yellowish green, purulent nodules, 1 to 3 mm. in diameter, embedded in apparently normal tissue and without any fibrous peripheral zone. They did not resemble tuberculous lesions.

In a smear a few blue bacilli and cocci were seen but no acid-fast bacilli.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

Pig LXXXI.

Received from Birmingham on July 31st, 1912, as a case of apparently localised tuberculosis. Aged 9 months.

Submaxillary lymphatic glands.—On one side was a gland measuring $4{\cdot}4 \times 3{\cdot}2 \times 2{\cdot}3$ cm. On section one half of the gland

was replaced by a network of caseo-calcareous tissue; in the other half there was grey translucent tissue, closely beset with soft, yellowish, gritty tubercles, which easily shelled out. The caseo-necrotic network could also be separated fairly readily from the thickened gland capsule. A second gland was pear-shaped, measuring 3·6 cm. by 1·2 cm. at its broadest extremity. On section it consisted of grey translucent tissue closely beset with softening, caseous, gritty tubercles, the majority of which were easily picked out.

On the other side the glands were normal.

Smears showed a moderate number of tubercle bacilli. General tuberculosis was produced in guinea-pigs. A direct culture yielded tubercle bacilli of mammalian type.

Mesenteric glands.—In one there was one greyish yellow tubercle, less than 1 mm. in diameter. In a smear no tubercle bacilli were seen.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Just beneath the capsule was a yellow, caseous, slightly gritty tubercle, about 1½ mm. in diameter. One similar tubercle was found on section. Smears from each showed no tubercle bacilli.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic and mesenteric glands, with evidence of slight dissemination in the spleen, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXII.

Received from Brighton on August 2nd, 1912, as a case of apparently localised tuberculosis.

Submaxillary lymphatic glands.—On the left side the glands were normal.

On the right side was an enlarged gland, measuring $3\frac{3}{4} \times 2\frac{1}{2} \times 2\frac{1}{4}$ cm. On section this was beset with grey ramifying streaks of fibrous tissue, interspersed with yellow, firm, caseous nodules, up to 2 mm. in diameter, easily shelling out from the surrounding fibrous tissue. In a second gland, not enlarged, was one yellow caseous focus.

In one smear preparation tubercle bacilli were numerous; in two others they were scanty. A direct culture was of mammalian type. General tuberculosis was produced in guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXIII.

Received from Brighton on September 13th, 1912, as a case of apparently localised tuberculosis. Aged 11 months.

Submaxillary lymphatic glands.—On the left side the glands were normal.

On the right side there was a mass, measuring $8 \times 5 \times 3$ cm., composed of firm translucent tissue, which contained a network of yellowish, caseo-necrotic tissue interspersed with more opaque, fine, gritty streaks.

In a smear a few tubercle bacilli were found. Guinea-pigs inoculated developed general tuberculosis. A growth of mammalian tubercle bacilli was obtained by culture from the original material.

Mesenteric glands.—Normal.

Lungs.—Beneath the pleura were four translucent tubercles with opaque centres, up to a rape seed in size. In a smear one tubercle bacillus was seen.

Bronchial glands.—A minute caseous focus was found in one. In a smear one tubercle bacillus was seen.

Liver.—Two miliary caseating tubercles were found.

Portal glands.—Normal.

Spleen.—The spleen contained three tubercles, the size of rape seed, with opaque caseous centres. In a smear from one, one tubercle bacillus was found.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXIV.

Received from Brighton on September 13th, 1912, as a case of apparently localised tuberculosis. Aged 11 months.

Submaxillary lymphatic glands.—On the left side the glands were normal.

On the right side there was an enlarged gland, measuring $6{\cdot}5 \times 4{\cdot}3 \times 3$ cm. On section it consisted of firm, translucent tissue, which contained, in the greater part, a network of yellow, caseous material with fine, more opaque streaks, and, in the lesser part, scattered, irregular, yellowish, caseous foci.

In a smear a few tubercle bacilli were found. A direct culture yielded a growth of tubercle bacilli of mammalian type. General tuberculosis was produced in guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—Beneath the pleura were two small caseating tubercles, the size of a rape seed and a mustard seed. In a smear from one a few tubercle bacilli were seen. The other produced general tuberculosis in a guinea-pig. The rest of the lungs was normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXV.

Received from Birmingham on October 9th, 1912, as a case of apparently localised tuberculosis. Aged nine months.

Submaxillary lymphatic glands.—On each side the glands were enlarged, measuring 6·5 × 4 × 3 cm. and 4·5 × 4 × 3 cm. They were composed of firm, grey, translucent tissue, beset with caseous patches which showed fine, gritty and more opaque streaks.

One tubercle bacillus was found in two smear preparations. General tuberculosis was produced in guinea-pigs. Cultures from the original material and from a guinea-pig yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Normal.

Lungs.—The parenchyma contained a moderate number of translucent tubercles with minute caseous centres, up to a millet seed in size. On the dorsal surface of the right posterior lobe 20 tubercles were counted. No tubercle bacilli were seen in two smear preparations.

Bronchial glands.—These contained minute, irregular, discrete, caseous foci. In a smear no tubercle bacilli were seen.

Liver.—There were a few submiliary grey tubercles with opaque centres. In a smear no tubercle bacilli were seen.

Portal glands.—There were patches of minute irregular caseous foci.

Spleen.—In the centre was a minute grey tubercle and also a caseating tubercle the size of a millet seed.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXVI.

Received from Brighton on October 12th, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the left side two glands were moderately enlarged, and contained ill-defined firm grey areas beset with a network of yellowish grey caseating tissue.

On the right side there was slight enlargement of two glands; they were a little firm, and close inspection showed that they were beset with minute irregular foci of caseous substance.

In a smear a few slender, faintly stained tubercle bacilli were found. A direct culture yielded tubercle bacilli of mammalian type. General tuberculosis was produced in guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXVII.

Received from Brighton on October 16th, 1912, as a case of apparently localised tuberculosis. Aged 3 years.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side there was a gland, slightly enlarged compared with those on the other side, measuring 2·7 × 1·7 cm. and less than 1 cm. in thickness. On section the gland was almost replaced by caseo-calcareous nodules, which measured up to ·6 cm. in diameter and were surrounded by firm fibrous tissue.

In three smear preparations no tubercle bacilli were seen. Three guinea-pigs were found normal 47 days after inoculation, cultures from their spleens being negative. Direct cultures from the original material remained sterile.

Mesenteric glands.—In each of two glands, which were not enlarged, there was a small patch of soft caseous and gritty material, easily separated from the surrounding gland tissue. In two smears no tubercle bacilli were seen.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tubercular lesions of the submaxillary lymphatic and mesenteric glands, from which no tubercle bacilli could be recovered.

Pig LXXXVIII.

Received from Brighton on November 9th, 1912, as a case of apparently localised tuberculosis. Aged 6 months.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side one gland was enlarged, measuring 5 × 3 × 2 cm. On section it was about half replaced by pinkish caseo-necrotic substance, with a gritty network; this shelled out fairly readily, leaving a cavity with fibrous walls.

In a smear tubercle bacilli were fairly numerous. General tuberculosis was produced in guinea-pigs, and from two of these cultures of tubercle bacilli of mammalian type were obtained.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig LXXXIX.

Received from Brighton on November 14th, 1912, as a case of apparently localised tuberculosis. Aged 10 months.

Submaxillary lymphatic glands.—On each side there were two or three small glands adherent to each other. They showed beneath the capsule and on section discrete, yellow, caseo-calcareous nodules up to a millet seed in size; and in places these were aggregated, forming nodules up to a hemp seed. They were completely encapsuled and readily shelled out.

In a smear tubercle bacilli were moderately numerous and short. Cultures yielded tubercle bacilli of avian type. Two guinea-pigs inoculated were healthy when killed 49 days later, but cultures of avian tubercle bacilli were obtained from their spleens.

Mesenteric glands.—Normal.

Lungs—Normal.

Bronchial glands.—Normal.

Liver.—On the surface was a grey translucent nodule of doubtful nature; it was the size of a hemp seed, with a minute, opaque, yellow centre, and failed to produce tuberculosis in a guinea-pig which was killed 49 days later. A culture from the guinea-pig's spleen remained sterile.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for a fowl.

Pig XC.

Received from Brighton on November 15th, 1912, as a case of apparently localised tuberculosis. Aged 7 months.

Submaxillary lymphatic glands.—On the left side was a group of adherent glands measuring $5{\cdot}2 \times 3{\cdot}5 \times 2{\cdot}2$ cm. On section these were composed almost entirely of slightly pink, caseo-necrotic tissue with an opaque, whitish, gritty network.

On the right side there was a mass of adherent glands measuring $5 \times 3{\cdot}3 \times 2$ cm. On section about one-fourth was composed of tissue similar to the above; the remainder consisted of firm, translucent tissue containing numerous small, yellowish, caseous nodules, up to ·5 cm. in diameter.

In a smear tubercle bacilli were very scanty. General tuberculosis was produced in guinea-pigs. Cultures obtained directly and from a guinea-pig yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Two were affected, each containing a single yellow caseous nodule the size of a hemp seed and a small pea respectively.

Lungs.—The substance contained moderately numerous grey tubercles with yellow gritty centres about the size of rape seed. There were a few rather larger nodules apparently formed by aggregation of these tubercles.

Bronchial glands.—These were somewhat enlarged and contained discrete yellow, waxy, caseous nodules up to a hemp seed in size.

Liver.—There were sparsely scattered grey, submiliary tubercles, a few with opaque centres.

Portal glands.—There were a few discrete nodules resembling those in the bronchial glands.

Spleen.—There were found five yellow, caseous and gritty tubercles, up to a millet seed in size.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XCI.

Received from Brighton on November 20th, 1912, as a case of apparently localised tuberculosis. Aged 4 months.

Submaxillary lymphatic glands.—On the left side the glands were normal.

On the right side was a gland about the size of a partridge's egg, which on section was composed of translucent tissue with a caseo-necrotic, slightly gritty network. This material separated readily from the capsule of the gland.

In a smear tubercle bacilli were very numerous and of moderate length. A direct culture yielded tubercle bacilli of mammalian type. General tuberculosis was produced in guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—A few translucent, parasitic nodules; otherwise normal.

Bronchial glands.—Normal.

Liver.—Apparently normal, but an antiforminised emulsion produced general tuberculosis in the two guinea-pigs inoculated. Cultures from these yielded tubercle bacilli of mammalian type with the characters of the eugonic bacillus of human origin.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands due to tubercle bacilli of mammalian type (dysgonic), virulent for guinea-pigs and a rabbit. From guinea-pigs inoculated with the apparently normal liver were obtained tubercle bacilli of mammalian type (eugonic), virulent for guinea-pigs and of slight virulence for a rabbit.

Pig XCII.

Received from Brighton on November 26th, 1912, as a case of apparently localised tuberculosis. Aged 1½ years.

Submaxillary lymphatic glands.—On the right side the glands were normal.

On the left side they were very slightly enlarged and three contained a few discrete yellow, caseous, gritty nodules, the size of rape seed. In several parts of the glands, just beneath the capsules, these nodules were aggregated into masses up to a hemp seed in size; they were all completely encapsuled.

In a smear tubercle bacilli were moderately numerous and for the most part short. In the three guinea-pigs inoculated only slight local tuberculosis was produced, but from the apparently normal spleens of these and also from the original material cultures of avian tubercle bacilli were obtained.

Mesenteric glands.—Normal.
Lungs.—Normal.
Bronchial glands.—Normal.
Liver.—Normal.
Portal glands.—Normal.
Spleen.—Normal.
Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for a fowl.

Pig XCIII.

Received from Birmingham on November 26th, 1912, as a case of apparently localised tuberculosis. Aged 8 months.

Submaxillary lymphatic glands.—On each side the glands were enlarged, measuring 8 × 3·5 × 3 cm. on the one side and 6·5 × 4 × 2·8 cm. on the other. They were composed on section of firm translucent tissue, with a yellow, waxy, caseous network and scattered hæmorrhagic foci.

In smears tubercle bacilli were fairly numerous. A direct culture yielded tubercle bacilli of mammalian type. General tuberculosis was produced in guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—There were a moderate number of tubercles, ranging from a rape seed to nearly a millet seed in size; a few were congested; most of them showed central caseation. In a smear no tubercle bacilli were found

Bronchial glands.—On close examination scattered, very indefinite, slightly yellowish foci were seen. In a smear no tubercle bacilli were found.

Liver.—Scattered caseous miliary tubercles were seen beneath the capsule. In a smear no tubercle bacilli were found.

Portal glands.—Normal.
Spleen.—Normal.
Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig. XCIV.

Received from Brighton on December 12th, 1912, as a case of apparently localised tuberculosis. Aged 7 months.

Submaxillary lymphatic glands.—On the left side one gland, about the size of a pigeon's egg, contained two nodules of caseo-calcareous tissue which could be shelled out, though not readily,

leaving ragged-walled cavities; these replaced about half the gland, the remaining half containing numerous minute, irregular, caseous and gritty foci. A second gland contained numerous similar foci and one or two small calcareous nodules.

On the right side there was a small mass of adherent glands, measuring 5·5 × 2·5 × 1·5 cm. On section this was about half composed of caseo-calcareous tissue, the remaining portion being beset with minute, irregular, caseo-calcareous granules. These granules and the calcareous material could be shelled out, though not very readily.

In a smear no tubercle bacilli were seen. General tuberculosis was produced in guinea-pigs. Cultures obtained directly and through a guinea-pig yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Five glands showed small collections of minute caseo-calcareous granules, which could be shelled out fairly readily.

Lungs.—In both lungs, beneath the pleura, were sparsely scattered minute, yellowish, gritty tubercles; a few were also found on section. A guinea-pig inoculated with the tissue developed general tuberculosis.

Bronchial glands.—There were a few minute, yellowish, caseous and gritty foci.

Liver.—There were two greyish, submiliary nodules, not definitely tuberculous.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XCV.

Received from Brighton on December 12th, 1912, as a case of apparently localised tuberculosis. Aged 4 months.

Submaxillary lymphatic glands.—On the left side they were normal.

On the right side there was a small mass, measuring 3·5 × 3 × 1 cm., about half of which was composed of caseo-calcareous substance, readily shelling out; in the other half were discrete caseous foci.

In a smear a few short tubercle bacilli were found. General tuberculosis was produced in the two guinea-pigs inoculated. Cultures obtained directly and from a guinea-pig yielded tubercle bacilli of mammalian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XCVI.

Received from Brighton on December 14th, 1912, as a case of apparently localised tuberculosis. Aged 8 months.

Submaxillary lymphatic glands.—On the right side there was a gland, measuring 3 × 1·7 × 1·5 cm., which was beset with discrete yellow, caseo-calcareous, encapsuled nodules, up to a hemp seed in size. A second small gland contained a few similar nodules; a third and fourth were normal.

On the left side two glands were very slightly enlarged, and contained scattered nodules similar to those on the right side and completely encapsuled.

In a smear no tubercle bacilli were seen. The two guinea-pigs inoculated failed to develop tuberculosis. Cultures made from the original material and from two of the guinea-pigs remained sterile.

Mesenteric glands.—Scattered throughout were discrete caseous and gritty nodules, up to a small pea in size, which readily shelled out. A guinea-pig inoculated failed to develop tuberculosis. A culture from the spleen of this animal and also a culture from the original material remained sterile.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tubercular lesions of the submaxillary lymphatic and mesenteric glands, from which no tubercle bacilli could be recovered.

Pig XCVII.

Received from Brighton on December 31st, 1912, as a case of apparently localised tuberculosis. Aged 7 months.

Submaxillary lymphatic glands.—On the left side they were normal.

On the right side one gland, about the size of a sparrow's egg, contained collections of small caseo-calcareous tubercles, which shelled out fairly readily.

In a smear a few short tubercle bacilli were seen. In the two guinea-pigs inoculated local tuberculosis only was produced. Cultures obtained directly and from the guinea-pigs yielded tubercle bacilli of avian type.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Normal.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands, due to tubercle bacilli of avian type, virulent for a fowl.

Pig XCVIII.

Received from Brighton on January 4th, 1913, as a case of apparently localised tuberculosis. Aged 4 months.

Submaxillary lymphatic glands.—On the left side the glands were normal.

On the right side there were two adherent glands, about the size of thrushes' eggs, which on section were about half replaced by caseous, gritty material which shelled out readily.

In a smear tubercle bacilli were moderately numerous; some appeared degenerate; others were long and beaded. General tuberculosis was produced in the two guinea-pigs inoculated. Cultures obtained directly and from one of the guinea-pigs yielded tubercle bacilli of mammalian type.

Mesenteric glands.—One was affected, and contained caseous, gritty nodules, about 1 cm. in diameter, which shelled out easily. In a smear one tubercle bacillus was found. A guinea-pig was inoculated and developed general tuberculosis. A culture from this animal yielded tubercle bacilli of mammalian type,

Lungs.—On the surface, beneath the pleura, were four grey tubercles with caseous centres; none were found on section.

Bronchial glands.—These were only slightly enlarged, firm, and beset with small, irregular, caseo-calcareous tubercles.

Liver.—On the surface, beneath the capsule, were small, irregular, grey nodules with opaque, caseous centres, not appreciably gritty. About four similar nodules were seen on section.

Portal glands.—These resembled the bronchial glands, but there was rather closer aggregation of the tubercles.

Spleen.—On section there were found a small group of minute grey tubercles and a single calcareous, yellow tubercle, the size of a rape seed.

Inguinal glands.—Normal.

Summary.

Disseminated tuberculosis, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and a rabbit.

Pig XCIX.

Received from Brighton on January 15th, 1913, as a case of apparently localised tuberculosis. Aged 1¼ years.

Submaxillary lymphatic glands.—On the left side they were normal.

On the right side one gland, about the size of a thrush's egg, was rather more than half replaced by caseo-necrotic, gritty substance; the remaining portion contained discrete caseous, gritty tubercles, easily shelling out. A second gland, about the same size, was beset with caseo-calcareous, yellow nodules, up to a millet seed in size.

In a smear tubercle bacilli were fairly numerous. General tuberculosis was produced in guinea-pigs.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—These were not obviously enlarged, but two on each side contained caseous, gritty nodules, up to a millet seed in size, which easily shelled out.

In a smear two tubercle bacilli were seen. A guinea-pig was found healthy when killed six weeks after inoculation.

Liver.—A yellowish nodule of doubtful nature was found.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Tuberculosis of the submaxillary glands, with evidence of slight macroscopic dissemination in the bronchial glands, due to tubercle bacilli of mammalian type, virulent for guinea-pigs and rabbits.

PIG C.

Received from Brighton on January 16th, 1913, as a case of apparently localised tuberculosis. Aged 10 months.

Submaxillary lymphatic glands.—Normal on both sides.

Mesenteric glands.—Normal.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—Several firm, yellow nodules were visible on the surface, and a few more were found in the substance. On section these nodules were found to be due to animal parasites.

Portal glands.—Normal.

Spleen.—Normal.

Inguinal glands.—Normal.

Summary.

Not tuberculosis.

TABULAR SUMMARIES SHOWING THE DISTRIBUTION OF LESIONS AND BACILLI IN THE TISSUES (pp. 63-78).

From the preceding detailed accounts it is evident that the cases investigated may conveniently be classified into the following four groups.

(1) *Infections due to tubercle bacilli of mammalian type.*—These are tabulated in order according to the amount of dissemination observed macroscopically. Those cases where the lesions are limited to the submaxillary lymphatic and the mesenteric glands are placed first; they are followed by cases showing disseminated lesions, beginning with those where the amount of dissemination is slightest (see Table I, p. 63).

(2) *Infections due to tubercle bacilli of avian type.*—These cases are tabulated according to the same method as (1). Mention is made of the fact when tubercle bacilli were demonstrated in the apparently normal tissues of the pig (see Table II., p. 71).

(3) *Tuberculous infections where the type of bacilli was not identified.*—In seven cases, viz., VII., XIII., XXXII., XXXIV.,

LVII., LXXXVII. and XCVI., the negative results obtained by culture and animal inoculation indicated that the tubercle bacilli were probably dead. In one case, viz., II., the cultures remained sterile, and, unfortunately, no guinea-pigs were inoculated. In another case, viz., VIII., the material was not in a fresh condition, and the guinea-pigs died prematurely. In the remaining case, viz., LVI., dissemination was so extensive that the case was not considered suitable for investigation (see Table III., p. 76).

(4) *Cases found not to be tuberculous.*—Nine cases of this nature were met with. The reasons for excluding tuberculosis are specified in the table (see Table IV., p. 78).

TABLE I.—*Macroscopic evidence of tuberculosis in pigs infected with tubercle bacilli of mammalian type.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
XIV.	Mass of softening caseo-necrotic glands.		Nil	Nil	Necrotic foci(?). No T.B.		Nil	Nil
XXVII.	Masses of firm caseo-necrotic glands. T.B. scanty.		Nil	Nil	Nil		Nil	Nil
XXX.	Large; caseous gritty network. T.B. fairly numerous.	Caseous patch in one gland.	Nil	Nil	Nil		Nil	Nil
XLVI.	Masses of waxy caseous glands. T.B. moderately numerous.	Opaque focus in one gland.	Nil	Nil	Nil	Nil	Nil	Nil
LXXIV.	One gland enlarged and caseo-calcareous. T.B. scanty.	Two calcareous nodules in one. No T.B.	Nil	Nil	Nil	Nil	Nil	Nil
LXXVI.	Enlarged and adherent, containing many caseo-calcareous, encapsuled nodules. T.B. scanty.	Nil	Nil	Nil	Nil	Nil	Nil	Nil

TABLE I.—*continued.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
LXXVII.	Enlarged and fibro-caseous. T. B. scanty.	Two calcareous granules in one. No T.B.	Nil	Nil	Nil	Nil	Nil	Nil
LXXXII.	One enlarged and fibro-caseous. T.B. numerous.	Nil	Nil	Nil	Nil		Nil	Nil
LXXXVI.	Enlarged and beset with caseous areas. T.B. scanty.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
LXXXVIII.	One enlarged and contained caseo-necrotic substance easily shelling out. T.B. numerous.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
XCI.	One was composed of caseo-necrotic substance, easily shelling out. T.B. very numerous.	Nil	Nil	Nil	Nil visible, but T.B. demonstrated through guinea-pigs.	Nil	Nil	Nil
XCV.	A group were enlarged and partially caseo-calcareous. T.B. scanty.	Nil	Nil	Nil	Nil	Nil	Nil	Nil

LXXV.	Three small calcareous nodules in one. T.B. scanty.	Nil	Nil	Nil	A few doubtful foci. No T.B.	Nil	Nil
LXX.	One enlarged and caseo-calcareous; a caseous focus in another. T.B. scanty.	Nil	Nil	One doubtful nodule. No T.B.	Nil	Nil	Nil
LXVIII.	Enlarged and fibro-caseous T.B. scanty. (Mammalian.)	A caseous, gritty nodule in one. T.B. numerous. (Avian.)		Two doubtful greyish nodules, one with gritty foci. No T.B.		Nil	Nil
LXXIX.	Enlarged, gritty and fibro-caseous throughout.	Nil	Nil	One doubtful greyish nodule with gritty foci. No T.B.	Nil	Nil	Nil
I.	Two enlarged caseous gritty glands. One T.B.	Nil	Nil	Minute gritty tubercle.	Nil	Nil	Nil
XLVIII.	Masses of glands composed of translucent tissue beset with waxy caseous areas. Few T.B.	Three calcareous grains.	Single minute tubercle.	Nil	Nil	Nil	Nil
XXXV.	Large firm fibro-caseous glands.	Two caseous foci.	Nil	Nil		Pea-sized caseating nodule.	
LV.	Mass of firm caseating glands.	Nil	Minute calcareous tubercle.	Nil	Nil	Nil	

TABLE I.—*continued.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
LXXI.	Enlarged; caseo-necrotic. T.B. scanty.	Nil	Nil	Nil	Nil	A few caseo-calcareous tubercles in two. No T.B.	Nil	Nil
LXXXI.	Two enlarged glands partially replaced by caseo-calcareous tissue, easily shelling out. T.B. moderately numerous.	A small tubercle in one. No T.B.	Nil	Nil	Nil	Nil	Two small caseous tubercles. No T.B.	Nil
LXXXIV.	One enlarged and caseous. T.B. scanty.	Nil	Two small caseous tubercles. A few T.B.	Nil	Nil	Nil	Nil	Nil
XCIX.	Two were enlarged and caseo-calcareous. T.B. fairly numerous.	Nil	Nil	Caseous gritty nodules in two. T.B. seen.	One nodule of doubtful nature.		Nil	Nil
XIX.	Enlarged caseous glands.		Five caseous tubercles. T.B.	Small caseous patch. No T.B.		Nil	Nil	Nil
XXII.	Caseous gritty nodule in one gland. Few T.B.		Nil	Nil	Calcareous nodule. No T.B.	Caseo-calcareous foci in four glands. T.B. moderately numerous.	Nil	Nil

LXXIII.	Enlarged; caseo-calcareous.		Sparsely scattered minute, caseous tubercles. No T.B.	A few minute caseous foci. No T.B.	Nil		Nil	Nil
XXXVII.	Discrete calcareous granules and small caseo-calcareous nodules. One T.B.	Minute calcareous granule in each of three glands.	Nil	Minute calcareous tubercles.	Necrotic foci(?).	Two tubercles and a calcareous granule.	Nil	Nil
XCIII.	Enlarged, firm, and caseous. T.B. fairly numerous.	Nil	Fairly numerous minute tubercles. No T.B.	Several doubtful foci. No T.B.	Scattered miliary tubercles. No T.B.	Nil	Nil	Nil
XCIV.	Enlarged and caseo-calcareous. No T.B. seen.	Minute caseo-calcareous granules in five.	Sparsely scattered gritty tubercles.	A few caseous and gritty foci.	Two greyish nodules of doubtful nature.	Nil	Nil	Nil
XI.	Slightly enlarged caseous gritty glands.	Caseous gritty nodules in five glands.	Nil	Nil	Scattered caseous miliary nodules. T.B.	Caseous gritty nodules in one gland.	Two small caseous nodules.	
XLVII.	Mass of waxy caseating glands. T.B. moderately numerous.	Minute calcareous grain.	Two minute opaque tubercles.	Minute calcareous grain.	Nil	Three caseous foci in two glands.	Nil	Nil
LXXXIII.	Enlarged and caseo-necrotic. T.B. scanty.	Nil	Four minute tubercles. One T.B. seen.	One minute caseous focus. One T.B. seen.	Two caseous tubercles.	Nil	Three small tubercles. One T.B. seen.	Nil
LIX.	Enlarged; fibro-caseous and gritty.	Nil	Twelve nodules (?). No T.B.	Nil	Two yellowish miliary nodules. No T.B.	Small fibro-caseous area. Three T.B.	Single yellowish nodule. No T.B.	Nil

TABLE I.—*continued.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
LXII.	One gland enlarged and caseo-calcareous; caseous gritty tubercles. T.B. scanty.	Not enlarged; four contained caseo-calcareous areas and nodules. T.B. scanty.	Nil	Not enlarged; five showed caseous gritty foci. One T.B.	Two yellowish nodules, one gritty. No T.B.	Fibro-caseous area in one gland. (?) One T.B.	Nil	Nil
XVI.	Moderately enlarged. One caseo-necrotic, others beset with gritty nodules. T.B. moderately numerous.		Scattered caseous gritty miliary tubercles. No T.B.	Majority showed caseo-calcareous nodules. T.B.	Three minute gritty tubercles and a caseous miliary nodule. No T.B.		Nil	Nil
*XLI.	Slightly enlarged caseo-necrotic glands. Caseous foci and patches in others.	Nil	Sparsely scattered minute caseous and gritty tubercles.	Each contained caseous foci and tubercles.	Three opaque foci.	Nil	Nil	Nil
XXI.	Nil		Eight translucent nodules. No T.B.	Nil	Numerous yellowish grey nodules. T.B.		Four nodules as in liver.	
XXVIII.	Enlarged; hard, fibro-caseous and gritty. Few T.B.		Scattered small caseous tubercles. T.B. scanty.	Few caseous foci and tubercles.	Single grey nodule.	Nil	Five minute caseous tubercles.	

XLV.	Masses of firm waxy caseous glands. T.B. moderately numerous.	Nil	Moderate number of small caseating tubercles.	Minute caseous focus.	Single grey tubercle. Necrotic foci (?).	Opaque focus in each of two glands.	Nil	Nil
LIV.	Masses of fibro-caseous glands. T.B. moderately numerous.	Nil	A few submiliary caseous tubercles. Few T.B.	A few irregular caseous foci. T.B.	Single caseous nodule. Necrotic foci (?).		Single caseous tubercle.	Nil
*XLII.	Large firm caseating glands. T.B. numerous.	Nil	Numerous grey translucent nodules.	Enlarged and firm with foci of necrosis.	Scattered grey translucent nodules.		Eight soft grey nodules.	
XXIV.	Moderately enlarged glands with caseous gritty patches and tubercles. One T.B.	Five glands; two almost wholly caseous, three with discrete nodules.	Moderate number of miliary tubercles with calcareous centres.	All showed yellow caseous patches and tubercles.	Numerous grey nodules with caseous foci.		Five nodules with soft caseous centres.	
LXV.	Soft caseous nodule and gritty miliary tubercles. No T.B. seen.	Nil	Scattered minute caseous gritty tubercles.	Small soft yellow gritty nodules.	Single grey nodule with opaque centre.	Single nodule as in bronchial glands.	Yellow miliary tubercle. No T.B.	Nil
LXXXV.	Enlarged and fibro-caseous. T.B. very scanty.	Nil	Numerous minute tubercles. No T.B.	Discrete caseous foci. No T.B.	A few grey tubercles. No T.B.	Small caseous foci.	Two small tubercles.	Nil
XCVIII.	Two were enlarged and caseo-calcareous. T.B. moderately numerous.	One contained caseous, gritty nodules. One T.B. seen.	Four minute tubercles.	Numerous small tubercles.	Several caseous nodules.	Numerous small tubercles.	A few tubercles.	Nil

* These cases were sent as specimens of slightly disseminated tuberculosis.

TABLE I.—*continued.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
XC.	Enlarged and caseo-necrotic. T.B. very scanty.	A caseous nodule in each of two.	Moderately numerous tubercles.	Discrete caseous nodules.	Scanty grey tubercles.	A few discrete caseous nodules.	A few caseous tubercles.	Nil
LXIII.	Large adherent glands composed of fibro-caseous gritty tissue. T.B. very scanty.	One gland showed discrete gritty foci. No T.B.	About 17 caseating miliary tubercles.	Slightly enlarged, showing numerous caseous gritty areas.	About 10 yellowish tubercles, some gritty. No T.B.	Slightly enlarged, resembling the bronchial glands. One T.B.	Six yellow caseous gritty miliary tubercles. No T.B.	
*LI.	Two moderately enlarged and caseo-calcareous. T.B. moderately numerous.	Two glands with encapsuled caseous nodules; one with calcareous grains.	Moderate number of caseating nodules up to a pea in size.	Discrete waxy caseous and gritty nodules.	Scattered yellow caseous miliary tubercles.	Three showed yellow caseous nodules.	Single miliary caseous nodule.	Nil
XXV.	Nil		Sparsely scattered caseous miliary tubercles.	Enlarged and extensively caseated.	Two caseous nodules.	Firm and partly caseo-calcareous.	Six caseous nodules.	Caseous patch in one (T.B.).
XXVI.	Enlarged, hard, fibro-caseous and calcareous. Few T.B.		Single caseous focus.	Two glands on one side containing caseous foci.	Three softening yellow nodules. No T.B.	One minute caseous focus.	Nil	Caseous miliary nodule. No T.B.
XXXIII.	Mass of firm caseous gritty glands. Few T.B.	Nil	Fairly numerous caseating nodules.	Caseous foci (T.B.).	Three soft grey nodules (?).	Caseous tubercles in two glands.	Nine caseous miliary nodules.	Nil

*XXXVI.	Single small gland with caseous gritty miliary tubercles.	Nil	Single caseous tubercle.	Three filled with caseous gritty tubercles.	Six caseous gritty miliary nodules.	Enlarged and extensively caseo-calcareous.	About 20 minute caseating tubercles.	Nil
*XLIII.	Fused glands almost entirely caseo-calcareous. Few T.B.	Nil	Fairly numerous caseous gritty nodules.	Hard and closely beset with caseous gritty nodules.	Moderately numerous caseo-calcareous nodules.	Extensively fibro-caseous.	Scattered caseous nodules with gritty foci.	Nil
XLIX.	Masses of caseo-calcareous glands, in part softening. Few T.B.	Nil	Scattered minute calcareous tubercles. No T.B.	Irregular caseous and gritty foci.	Two calcareous grains.	Six calcareous grains.	Single grey nodules with caseous foci.	Nil

TABLE II.—*Macroscopic evidence of tuberculosis in pigs infected with tubercle bacilli of avian type.*

XXXI.	Encapsuled caseous gritty nodules. T.B. fairly numerous.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
LXVIII.	Small encapsuled caseous nodules and caseo-calcareous foci. Acid-fast bacilli numerous.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
XXXIX.	Enlarged; discrete encapsuled caseo-calcareous nodules. T.B. moderately numerous.	Nil	Nil	Nil	Few necrotic foci (?).	Nil	Nil	Nil

* These cases were sent as specimens of slightly disseminatad tuberculosis.

TABLE II.—*continued.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
LII.	Caseous patch and numerous gritty tubercles. T.B. moderately numerous.	Caseo-necrotic nodules in five glands.	Nil	Nil	No lesions, but T.B. in culture from substance through G.P.	Nil	No lesions, but T.B. in culture through G.P.	Nil
XXXVIII.	Enlarged; numerous encapsuled caseous gritty nodules. Few T.B.	Nil	Nil	Nil	Necrotic foci (?).			
LIII.	Encapsuled caseous gritty nodules. Few T.B.	Caseous nodules in four glands. T.B. moderately numerous.	No lesions. T.B. in culture from tissue through G.P.	Nil	Necrotic foci (?). T.B. in culture from tissue through G.P.	Nil	Nil	Nil
XLIV.	Enlarged; encapsuled caseous gritty nodules. T.B. numerous.		Nil	Nil	Necrotic foci (?).	Nil	Nil	Nil
LXVI.	Discrete irregular caseous patches and foci. T.B. numerous.	Nil	Nil	Nil	No lesions, but T.B. in culture from substance through G.P.	Nil	Nil	Nil

LXVII.	Slightly enlarged adherent glands; beset with small encapsuled caseous nodules. T.B. scanty.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
LXIV.	Slightly enlarged; discrete caseous gritty tubercles. T.B. fairly numerous.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
LVIII.	Slightly enlarged; waxy caseous patches and discrete tubercles. T.B. scanty.	Nil	Nil	Nil	No lesions, but T.B. in culture from substance through G.P.	Nil	No lesions, but T.B. in culture through G.P.	Nil
LX.	Not enlarged; small fibro-caseous areas and caseous foci. T.B. scanty.	Nil	Nil	Nil	Nil	Nil	No lesions, but T.B. demonstrated through G.P.	Nil
LXI.	Moderately enlarged; soft caseous gritty encapsuled nodules. T.B. very numerous.	One gland completely caseous. T.B. numerous.	Nil	Nil	Nil	Nil	Nil	Nil
LXIX.	Not enlarged; gritty foci and small tubercles in two. No T.B.	Gritty foci and tubercles in several. No T.B.	Nil	Nil	Nil	Nil	Nil	

TABLE II.—*continued.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
LXXII.	Slightly enlarged; numerous caseo-calcareous tubercles, easily shelling out. T.B. moderately numerous.	Nil	Nil	Nil	Nil	Nil	Nil	
LXXXIX.	Small encapsuled, caseo-calcareous nodules. T.B. moderately numerous.	Nil	Nil	Nil	One grey nodule of doubtful nature. No T.B. from inoculated G.P.	Nil	Nil	Nil
XCII.	Slightly enlarged; caseous, gritty, encapsuled nodules in three. T.B. moderately numerous.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
XCVII.	Groups of small caseo-calcareous tubercles in one. T.B. scanty.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
IX.	Nil	Discrete caseous gritty nodules in four glands. T.B. numerous.	Nil	Nil	One minute tubercle. No T.B.		Nil	Nil
X.	Enlarged; soft caseous gritty nodules.		Nil	Four yellow caseous foci. T.B.	Nil		Nil	Nil

XVII.	Nil	Encapsuled caseo-necrotic nodules in 14 glands. T.B. moderately numerous.	Nil	Nil	Five minute opaque tubercles.		Nil	Nil
XVIII.	Nil	Caseous gritty network in three glands; minute tubercles in two. Few T.B.	Nil	Nil	Numerous minute translucent tubercles. T.B. in smears and direct culture.		Nil	Nil
XV.	Enlarged; firm caseo-calcareous nodules. Few T.B.		Miliary tubercle (?). No T.B.	Calcareous grain.	Nil		Nil	Nil
L.	Caseous patches and caseo-calcareous tubercles. T.B. moderately numerous.	Caseous gritty nodule and calcareous grain in two glands. T.B. moderately numerous.	Three translucent foci (?).	Nil	Few yellow calcareous grains. No T.B.	Nil	Nil	Nil
XXIII.	Nil	Encapsuled softening caseous gritty nodules in majority. T.B. moderately numerous.	Scattered minute caseating tubercles. No T.B.	Nil	Several yellow caseous tubercles.		Nil	Nil
XXIX.	Enlarged; encapsuled yellow caseous nodules. T.B. numerous.		Nil	Nil	Two caseous nodules (?). T.B. in culture from substance.	Discrete miliary tubercles in two glands.	No lesions. T.B. in culture from substance.	Nil

TABLE III.—*Pigs infected with tubercle bacilli, of which the types were not identified.*

Number of pig.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.	Inguinal glands.
II.	Single gland containing six yellow caseous foci.	Three caseous foci.	A few caseous tubercles.	Several glands beset with caseous gritty patches.	Nil		Nil	Nil
*VII.	Nil	Six glands containing encapsuled yellow caseous gritty nodules.	Nil	Nil	Nil		Nil	Nil
VIII.	Nil	About six contained encapsuled yellow caseous gritty nodules.	Nil	Nil	Sparsely scattered minute caseous tubercles. T.B.		Nil	Nil
*XIII.	Nil	Majority enlarged and beset with caseous gritty patches. T.B. numerous.	Nil	Nil	Substance peppered with grey translucent foci. No T.B.		Nil	Nil
*XXXII.	Enlarged glands containing encapsuled caseous gritty nodules. No T.B.	Nil	Nil	Nil	Necrotic foci (?).		Nil	In one gland 12 caseous gritty miliary nodules. No T.B.

*XXXIV.	Discrete encapsuled soft caseous gritty nodules. T.B. moderately numerous.	Nil	Nil	Nil	Nil		Nil	Nil
LVI.	Mass of adherent glands composed of firm fibro-caseous tissue.	Nil	Numerous miliary caseating tubercles.	A few irregular caseous foci.	Numerous miliary caseating tubercles.	Irregular caseous foci and tubercles.	Moderately numerous caseating miliary nodules.	Nil
*LVII.	Not enlarged; calcareous nodules and granules. T.B. scanty.	Nil	Nil	Nil	Several miliary nodules (?). No T.B.	Nil	Nil	Nil
*LXXXVII.	One gland was almost replaced by caseo - calcareous nodules surrounded by fibrous tissue. No T.B.	Two glands contained patches of caseous gritty material. No T.B.	Nil	Nil	Nil	Nil	Nil	Nil
*XCVI.	Four contained small caseo - calcareous, encapsuled nodules. No T.B.	Numerous glands contained small caseous and gritty nodules. No T.B.	Nil	Nil	Nil	Nil	Nil	Nil

* In these cases the tubercle bacilli were probably dead.

TABLE IV.—*Distribution and characters of lesions in pigs found not to be tuberculous.*

Number of pig.	Distribution and characters of lesions.	Remarks.
III.	In the liver there were three nodules, from a millet seed to a small pea in size, composed of translucent tissue with soft chalky substance in the centre.	No tubercle bacilli were seen in smear preparations; a guinea-pig inoculated remained healthy.
IV.	In the liver there were about 30 yellowish miliary nodules similar to those in Pig III.	No tubercle bacilli were seen in smear preparations; a guinea-pig inoculated remained healthy.
V.	In the liver there were from 20 to 30 nodules varying in size up to a small pea; some were similar to those in Pigs III. and IV., but the greater number consisted of slightly congested necrotic tissue.	No tubercle bacilli were seen in smear preparations; a guinea-pig inoculated remained healthy.
VI.	In the liver there were two or three grey nodules similar to those in Pigs III. and IV., and a few areas of necrosis on the surface. In the lungs were two translucent nodules (parasitic).	A guinea-pig inoculated with a lung nodule remained healthy.
XII.	In the liver there were two nodules, each about 3 mm. in diameter, similar to those in Pigs III. and IV. The lungs showed numerous grey transluscent nodules (parasitic).	In smear preparations no tubercle bacilli were seen. A guinea-pig inoculated with a liver nodule, and two inoculated with lung nodules, remained healthy.
XX.	In the submaxillary lymphatic glands from each side of the neck there were nodules composed of putty-like tissue and surrounded with hard fibroid capsules. In the liver were several nodules similar to those in Pigs III. and IV.	In smear preparations no tubercle bacilli were seen. Cultures from the submaxillary gland remained sterile. Two guinea-pigs inoculated with these glands and two inoculated with liver nodules remained healthy.
XL.	A submaxillary lymphatic gland contained a small, fibrous walled, purulent cyst. In the liver there was a grey nodule with a yellowish necrosed centre.	In smear preparations no tubercle bacilli were seen.
LXXX.	In one submaxillary lymphatic gland there were four small yellowish green, purulent nodules embedded in apparently normal tissue.	The nodules contained cocci and other organisms, but no acid-fast bacilli.
C.	In the liver several firm, yellow nodules were visible on the surface, and a few more were found in the substance.	On section these nodules were found to be due to animal parasites.

Summary of Experimental Work upon the Tissues and Cultures obtained from Tuberculous Pigs.

Cultural Characters of the Viruses.

For the purpose of identifying in each case the type of bacillus causing the disease, cultures were made directly from the tuberculous submaxillary or mesenteric glands and occasionally also from the disseminated lesions in the organs of the pigs examined. Several nodules from each group of glands were removed, emulsified in test tubes with a small quantity of normal saline solution, and spread over the surface of a number of tubes of egg medium.

Cultures were made also from many of the guinea-pigs inoculated with portions of the same material, but in only four instances was there failure to obtain pure growths of tubercle bacilli from the tubes inoculated directly with the pigs' lesions, with the exception of those cases where the bacilli were probably dead, as shown by the negative results of the inoculation experiments.

Pure cultures were obtained after treatment with antiformin in four cases (mesenteric glands of Pigs IX. and XVIII. and submaxillary glands of Pig XIX. and Pig LXX.) where the tubes sown with untreated material became overgrown, and in one case (Pig XVIII.) direct from the liver tissue.

When the growth on the primary tubes was well established, usually after three weeks' incubation, subcultures were made on bovine serum. As soon as the bacilli grew readily on this medium, subcultures were made from a young and vigorous growth on to media containing glycerin, which were used to bring out the cultural differences between various types of tubercle bacilli.

Whilst recognising that, with careful attention to detail, various media may be usefully employed for this purpose, we have found that we obtained the most reliable results by adopting glycerin-agar as the standard medium, supplemented when requisite by confirmatory tests on glycerinated potato, broth or litmus milk. Special care should be taken to secure a good batch of medium. Our glycerin-agar was prepared from veal broth, which we found better than the broth made from the muscle of adult bovines, with the addition of 5 per cent. glycerin. The broth should be prepared in large quantities at a time, and agar tubes made from each batch should first be tested as to their capacities for growing the tubercle bacillus. When a good medium has been obtained by these means, it should be reserved for the differential culture tests. Our glycerin-agar tubes were always sown from young and vigorous serum cultures (four to seven days old), which had been propagated since isolation from the animal body on media free from glycerin. In order to obtain on glycerin-agar the maximum growth of which a particular strain is capable, it is advisable to inoculate more than one tube at the same time, and often it is necessary to repeat the test from successive generations of serum tubes. With these precautions we have always obtained growth on this medium, even from the most dysgonic bacillus; and we have avoided the error of classifying as dysgonic a bacillus which with further perseverance would be found capable of growing abundantly. In addition to recording the maximum growth obtainable with every strain, it is useful to note the rate of growth. Occasionally a bacillus is met with which possesses for the rabbit the virulence of the bovine bacillus, whilst the ultimate amount of its growth on glycerin-agar is almost equal to that yielded by eugonic bacilli of human origin. In these cases, however, the rate of growth of the former bacillus is much slower than that of the latter. On a good glycerin-agar tube

the eugonic "human" bacillus generally covers the surface in from two to three weeks with an opaque, wrinkled growth, whilst the dysgonic "bovine" bacillus after the same period shows either a grey, translucent layer of variable thickness or a variable number of very delicate and minute grey colonies. After further incubation the translucent layers may become opaque, warty and finely wrinkled, though occasionally additional increase is only slight in amount; the discrete colonies usually increase slowly in size and number, becoming raised, warty, and confluent (see photographs, Plate I.).

From their characters on the various media employed the cultures of tubercle bacilli obtained from pigs are divisible into avian and mammalian types. Those classified as tubercle bacilli of avian type produced characteristic growths, slimy in appearance and easily emulsified, with the exception of Pig LXIX., which is discussed below; the mammalian type was distinguished by the dry and coherent nature of the growths. And in primary culture on egg medium there was often a difference in the appearance of the colonies, those formed by the avian bacillus being umbilicated and crater-like. When examined microscopically these opaque avian colonies differed materially from similarly dense mammalian colonies in that they contained branched bacilli and long thread-like forms (see photograph, Plate II.).

The culture from Pig LXIX. (submaxillary gland) was at first considered to be identical in characters with an ordinary "human" tubercle bacillus. When grown at 37° C., it produced on glycerin-agar a thick, dry, wrinkled layer; a similar growth, with the production of acid, was obtained on glycerin-potato coloured with litmus; on glycerin-broth there was a continuous, thick, wrinkled pellicle, spreading up the sides of the flask. But on further observation the following peculiarities were noted. Growth also took place, though rather less rapidly, at 22° C.; the characters of the growth were similar to those obtained at 37° C. on the same media, except that yellowish or reddish pigment was produced on glycerin-agar at the lower temperature. Capacity for growth at 22° C. has not been observed with any of our strains of undoubtedly mammalian tubercle bacilli, but we have obtained growth at this temperature with several strains of avian tubercle bacilli. In this respect, therefore, the culture of Pig LXIX. resembles the avian bacillus, though it differs from ordinary avian strains in that the growth of the latter is moist and slimy. It has also been found that the culture of Pig LXIX. grows fairly well on broth and agar without added glycerin. The bacilli are strongly acid-fast and uniformly short and straight on all the media on which they have been grown; they contrast in these respects with the variability in resistance to acid and the tendency to pleomorphism commonly found in the ordinary non-pathogenic acid-fast bacilli.

With two exceptions, all the mammalian tubercle bacilli were in culture identical with tubercle bacilli of bovine origin. These exceptions were the cultures of Pig LXXV. (submaxillary gland) and of Pig XCI. (liver) which resembled eugonic tubercle bacilli of human origin.

A culture of an acid-fast bacillus, differing in characters from all the above types of tubercle bacilli, was obtained from one case, Pig LXVIII. (see p. 44). The lesions in this pig were limited to the submaxillary lymphatic glands and were definitely of a tuberculous nature in appearance. In a smear preparation numerous short, thick acid-fast bacilli, differing morphologically from the

tubercle bacillus, were found. A guinea-pig inoculated with an emulsion of the same material was found to be apparently healthy when killed 46 days afterwards, but a culture of avian tubercle bacilli was isolated from its spleen. In another case, Pig LXVI. (see p. 43), where an abundant growth of avian tubercle bacilli was obtained in culture from the submaxillary lymphatic gland, one of the culture tubes also yielded a pigmented growth of an acid-fast bacillus closely resembling that mentioned above.

The characteristics of these acid-fast organisms are as follows. In primary culture on egg the medium was covered in a few days with a pinkish orange growth, which was moist, shiny and easily emulsified. Smears from these cultures showed short, thick, acid-fast bacilli, together with a variable number of small, oval and spherical, acid-fast forms (see photograph, Plate II.), similar to those present in the lesions; there were also present organisms which were not acid-fast, consisting generally of short bacilli with some admixture of longer forms. By repeated plating and the investigation of numerous single colonies it was established that the acid-fast and non-acid-fast forms were derived from one and the same organism. On glycerin-agar and agar the growth in a few days was a moist, easily emulsified, glistening layer, which subsequently assumed a reddish tinge. On these media the acid-fast property was completely lost. It was recovered, however, by transference to milk where, from the second day onwards after inoculation with a completely non-acid-fast culture, short, thick, acid-fast bacilli were found, together with non-acid-fast organisms, some of which were of similar shape, whilst others were longer and often contained unstained and slightly refractile areas suggestive of spore formation. These cannot be regarded as true spores, since the cultures containing them were killed by heating at 70°C. for one hour and at 99°C. for a few minutes, although they resisted 60°C. for one hour. Pleomorphism was particularly marked in milk. In some of the colonies obtained by subculture on agar from milk long, non-acid-fast, branched forms were found; these broke up into short acid-fast bacilli, when again transferred to milk. Cultures on coagulated serum, which yielded a thin, moist, shiny layer, were partially acid-fast. Growth occurred on all the above-mentioned media at 22°C and 37°C.

Virulence of the Viruses for Experimental Animals.

As previously mentioned, the lesions of the pigs were invariably inoculated into guinea-pigs. The results of these tests afforded preliminary indication of the nature of the viruses. The inoculation of the lesions of those pigs from which bacilli with mammalian cultural characters were obtained produced, in the case of every pig except two, typical generalised tuberculosis in the guinea-pigs. In one of the exceptional cases (Pig XIV.), where the bacilli in culture were identical with bovine tubercle bacilli, the disease in two guinea-pigs, 42 days after inoculation, had remained localised, probably owing to the smallness of the number of bacilli introduced. (See Table V. A, p. 85.)

In the second case (Pig LXIX.) no tuberculosis was produced in a guinea-pig inoculated with the lesions from which a eugonic tubercle bacillus was obtained. After further investigation this virus has been provisionally classed as avian.

The guinea-pigs inoculated with those lesions which were afterwards shown to contain avian tubercle bacilli developed only slight

tuberculosis and the majority were killed in apparently good health after 42 days. The visible tuberculosis produced was limited to the omentum, abdominal and sternal lymphatic glands, with occasionally some enlargement of the Malpighian bodies of the spleen; but even in the entire absence of macroscopic disease there was dissemination of avian tubercle bacilli in the guinea-pig, and their presence could generally be demonstrated by culture from the spleen. (See Table V. B, p. 88.)

Differentiation according to cultural characters of the various strains of tubercle bacilli obtained was controlled by inoculation experiments on animals with weighed quantities of culture. The mammalian cultures used for this purpose were always grown on pure solidified serum; the avian strains were raised on glycerin-serum or glycerin-agar. The growth was scraped from the surface with a platinum spatula, and weighed on a chemical balance without preliminary drying. It was then emulsified as finely as possible in normal saline solution, and the required doses were prepared by dilution.

Cultures which were mammalian in character were inoculated into rabbits, either in an intravenous dose of ·01 mg., or in a subcutaneous dose of 10 mg., the latter inoculation being made into the loose tissues of the back between the shoulders; in exceptional cases higher doses were also used.

With the exception of four strains, the mammalian viruses invariably produced fatal generalised tuberculosis in the rabbits, with typical consolidation of the lungs, in periods ranging from 19 to 45 days after intravenous inoculation, and from 27 to 97 days after subcutaneous inoculation (see Table VI. A and B). These results were all in accordance with the dysgonic cultural characteristics of the viruses inoculated.

Two of the exceptional viruses Pig LXXI. and Pig LXXVII., were typically "bovine" in culture, the first being highly dysgonic and the second producing no more than a thin, translucent, somewhat moist, finely wrinkled or warty layer on glycerin-agar. But, in marked contrast to the typical "bovine" bacillus, the virulence of these two viruses for rabbits was low (see Table VII., p. 96); it was even less than that of some strains of typical eugonic bacilli of human origin; so far, the virulence of these strains has not been increased by passage through rabbits. As regards the virulence of these three strains for guinea-pigs, emulsions of the original porcine lesions produced general tuberculosis in each case; culture inoculations were fully virulent in the case of Pig LXXI., but in the guinea-pigs inoculated with culture of Pig LXXVII. the duration of life was considerably greater than the usual period (see Table IX., p. 100). Interesting parallels to the peculiarities of these two viruses are to be found in strains isolated from human lupus and from cases of equine tuberculosis by the investigators of the Royal Commission on Tuberculosis.

The remaining two exceptional strains of mammalian tubercle bacilli, Pig LXXV. and Pig XCI. (liver), were of low virulence for rabbits (see Table VIII., p. 98), these results being in accordance with the luxuriance of their cultural growth. These two viruses, therefore, are in every respect identical with the "human" type of bacillus.

The culture of Pig LXIX., which was dry and eugonic, was tested on a series of six rabbits (see Table VIII., p. 98) and produced only slight disease, even in the high dose of 1 mg. inoculated intravenously. These results are not incompatible with effects produced by bacilli of

"human" type. But, on the other hand, cultures of this virus proved to be non-pathogenic for the guinea-pig. This fact was confirmed by numerous experiments, and it was found that even after doses of 1 mg. subcutaneously or intraperitoneally the animals remained in good health and showed no visible lesions beyond a small local abscess, when killed after 188 days; tubercle bacilli were, however, recovered in culture, even after the lapse of this period, from apparently normal liver and spleen. These results are in marked contrast to the pathogenicity of mammalian bacilli, "human" or "bovine," but are identical with the effects often produced by avian bacilli. For the purpose of throwing further light on the relation of this virus to the avian group, additional experiments were performed. Two rabbits were inoculated intravenously with 2 and 10 mg., respectively; acute fatal tuberculosis was produced, with multiplication and distribution of bacilli typical of avian viruses. Two fowls were also inoculated; one killed 133 days after intramuscular inoculation of 15 mgs. showed necrotic tissue at the seat of inoculation but no lesions or tubercle bacilli could be found in the organs; the other received 1 mg. intravenously and died 56 days afterwards from peritonitis due to retention of an egg; there were no visible lesions of tuberculosis and no bacilli were found, except one in the spleen. Were it not for the dryness of its growth in culture and its low virulence for the fowl, this virus would be typically avian. As these two exceptional features occasionally occur with avian bacilli, we have placed it, provisionally, in the avian group, the production of typical avian tuberculosis in the rabbit and the absence of pathogenicity for the guinea-pig being sufficient to exclude it from the mammalian class. Experiments are being made on frogs.

The cultures of avian character were inoculated intramuscularly into fowls in doses of 10 mg. Post-mortem examination of these animals demonstrated that the cultures, in all but one instance, possessed specific virulence and confirmed the evidence that the bacilli were of avian type. The exceptional case was the culture of Pig XVII., which failed to produce more than localised disease in fowls after intramuscular inoculation, though the culture was avian in appearance and virulent for mice, and the guinea-pigs inoculated with the original material developed no more than the local tuberculosis typical of avian infection; in addition, two guinea-pigs, inoculated subcutaneously with 10 and 50 mg. of culture, were found healthy when killed 153 days afterwards.

Further experiments were performed with this culture upon fowls, by intravenous inoculation and by feeding. (See Table X., p. 101.) Two fowls, which died in 28 and 22 days respectively after the intravenous inoculation of ·1 and 1 mg. of culture, showed no visible tuberculous lesions and tubercle bacilli, though present in the organs, had not multiplied abundantly. Two fowls were fed with culture of this virus in drinking water, each receiving 100 mg. One was killed after 144 days and showed three yellowish tubercles in the glandular tissue of the proventriculus, two caseous nodules in the small intestine, a single nodule at the entrance to one of the caeca, and scattered tubercles up to a rape seed in size in the liver; the plantar surface of one claw was swollen, and on incision caseo-necrotic tissue was found around the tendons (moderately numerous T.B. in smear). The second fowl, killed after 166 days, showed a pea-sized caseo-necrotic nodule in a cervical gland, a single nodule in the proventriculus and one in the liver; tubercle bacilli were numerous in all these three lesions. In order to ascertain whether residence in the body of the fowl would increase the virulence of the virus, a

culture was obtained from the local lesion of Fowl 5, which had been inoculated intramuscularly; this culture, inoculated intravenously in a dose of ·1 mg. into Fowl 26, was found to have produced no evidence of tuberculosis when the animal was killed 172 days afterwards.

The cultures of the two acid-fast bacilli from Pigs LXVI. and LXVIII. were also tested on fowls. Two fowls inoculated intravenously with 1 mg. and 5 mg. of culture of Pig LXVIII. showed no lesions when killed 113 and 196 days later. In the case of the culture of Pig LXVI. a fowl inoculated intraveneously with 10 mg. and killed after 131 days showed a single necrotic nodule in a lung, the size of a hemp seed, from which a typical avian culture was obtained. The probable explanation of this result is that this strain of acid-fast bacilli had not been completely freed from the admixture of avian bacilli present in the original material. No evidence of tuberculosis was found in any other tissue of the fowl. The culture of Pig LXVIII. was also tested on a rabbit intravenously and on guinea-pigs subcutaneously and intraperitoneally. The rabbit and three guinea-pigs inoculated with doses up to 5 mgs. intraperitoneally and 10 mgs. subcutaneously remained healthy, but larger doses (10 to 50 mgs. intraperitoneally) killed guinea-pigs in from 15 to 22 days. No lesions resembling tuberculosis were produced when the acid-fast bacilli were inoculated into guinea-pigs in an emulsion to which fat was added.

Inoculation Experiments with apparently Normal Tissues from Tuberculous Pigs.

In the case of a certain number of pigs where no lesions could be found in the lungs, liver, or spleen, portions of these tissues were inoculated into guinea-pigs with the object of ascertaining whether a general dissemination of tubercle bacilli had occurred without the production of lesions. These organs were selected because it was considered that there would be little likelihood of demonstrating tubercle bacilli in the muscles if their presence could not be detected in these highly vascularised organs. Inoculation experiments with muscle were, however, made in certain cases where tubercles were visible in some of the above mentioned organs. Preliminary treatment with a small percentage of antiformin was adopted in cases where there was reason to believe that the tissues contained a large number of extraneous organisms.

The results of those experiments which were made with the apparently normal tissues of pigs in which the infection was due to mammalian tubercle bacilli were with one exception entirely negative. (See Tables XI. A and XII. A, p. 104 and p. 108.)

From Pig XCI., in which the local tuberculosis of the submaxillary glands was due to virulent bacilli of bovine type, the apparently normal liver produced general tuberculosis in two guinea-pigs from each of which a eugonic bacillus of low virulence for the rabbit was recovered in culture.

In seven pigs where the infection was due to avian bacilli without visible disease except in the submaxillary or mesenteric glands and in one case in the portal glands, avian tubercle bacilli were demonstrated in the following tissues:—The livers of Pigs XXIX., LII., LIII., LVIII., and LXVI; the spleens of Pigs XXIX., LII., LVIII., and LX.; the lungs of Pig LIII.; and the muscle of Pig LXIV. In two of the above instances, viz., the spleen of Pig XXIX. and the lungs of Pig LIII., the tissue had been treated with antiformin before inoculation. The amount of disease produced in the guinea-pigs

inoculated with all the above tissues was very slight, and in many instances in which positive results were obtained the guinea-pigs at the post-mortem examination appeared healthy and showed no indication, even after the microscopic examination of smear preparations, that tubercle bacilli had been introduced into the body. It had, however, been observed (by F. G.) in the course of the present enquiry that in a guinea-pig inoculated intraperitoneally with tissue known to contain avian tubercle bacilli, though the only macroscopic effect of the inoculation was the production of slight tuberculosis of the omentum, the bacilli were recoverable from the apparently normal spleen. This observation led to the making of cultures, as a routine procedure, from the spleen, even when no local disease had been produced, and when it was not known whether the inoculum contained tubercle bacilli, with the result that the above mentioned examples of dissemination of tubercle bacilli in swine not associated with lesions were brought to light. (See Tables XI. B and XII. B, p. 105 and p. 108.)

TABLE V.—*Intraperitoneal inoculation experiments on guinea-pigs with tuberculous lesions from pigs.*

A.—With lesions due to mammalian tubercle bacilli.

Number of pig.	Tissue inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
I.	Submaxillary gland ...	D 44	General tuberculosis.
XI.	Submaxillary gland ...	K 37	General tuberculosis.
	Mesenteric gland ...	K 37	" "
	Spleen nodule	K 44	" "
	Liver nodule	K 44	" "
XIV.	Submaxillary gland ...	K 42	Soft, yellow nodule in muscle at site of inoculation ; one grey nodule in omentum.
	" " ...	K 42	Two minute tubercles in omentum.
XVI.	Submaxillary gland ...	K 42	General tuberculosis.
	Bronchial glands ...	K 42	" "
	" " ...	K 42	" "
	Liver nodule	K 42	No tuberculosis.
XXI.	Liver nodules	D 25	General tuberculosis.
	" "	D 30	" "
XXII.	Submaxillary gland ...	D 21	Early general tuberculosis.
XXIV.	Submaxillary gland ...	D 31	General tuberculosis.
	" " ...	D 27	Early general tuberculosis.
	Lung	K 44	General tuberculosis.
	Liver nodules	K 44	" "
	" "	D 43	" "
XXVI.	Submaxillary gland ...	D 32	General tuberculosis.
	" " ...	D 48	" "
	Bronchial glands ...	K 48	" "
	Liver nodules	K 48	No tuberculosis.
	Inguinal gland	K 48	" "

TABLE V.—*continued.*

Number of pig.	Tissue inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
XXVII.	Submaxillary gland ...	D 39	General tuberculosis.
	,, ,, ...	K 35	,, ,,
XXVIII.	Submaxillary gland ...	D 42	General tuberculosis.
	,, ,, ...	K 42	,, ,,
XXX.	Submaxillary gland ...	D 24	Early general tuberculosis.
	,, ,, ...	D 21	,, ,, ,,
XXXIII.	Submaxillary gland ...	D 22	General tuberculosis.
	,, ,, ...	D 25	,, ,,
XXXV.	Submaxillary gland ...	K 29	General tuberculosis.
	,, ,, ...	D 31	,, ,,
	Spleen	D 48	,, ,,
	,, ...	D 47	,, ,,
XXXVI.	Submaxillary gland ...	K 47	General tuberculosis.
	,, ,, ...	D 19	No tuberculosis.
XXXVII.	Submaxillary gland ...	D 24	No tuberculosis.
	,, ,, ...	D 31	Early general tuberculosis.
	,, ,, ...	K 42	General tuberculosis.
XLI.	Submaxillary gland ...	K 45	General tuberculosis.
	,, ,, ...	D 23	Early general tuberculosis.
	Bronchial gland ...	D 23	Omental tuberculosis only.
	,, ,, ...	D 25	Early general tuberculosis.
XLII.	Submaxillary gland ...	D 21	General tuberculosis.
	,, ,, ...	D 25	,, ,,
	Spleen nodule	D 23	Localised tuberculosis.
XLIII.	Submaxillary gland ...	D 29	General tuberculosis.
	,, ,, ...	D 23	,, ,,
XLV.	Submaxillary gland ...	D 24	General tuberculosis.
	,, ,, ...	D 21	,, ,,
	Lung tissue	D 38	,, ,,
XLVI.	Submaxillary gland ...	D 29	General tuberculosis.
	,, ,, ...	D 26	,, ,,
XLVII.	Submaxillary gland ...	D 31	General tuberculosis.
	,, ,, ...	D 26	,, ,,
	,, ,, ...	D 27	,, ,,
XLVIII.	Submaxillary gland ...	D 22	Localised tuberculosis.
	,, ,, ...	D 25	General tuberculosis.
	,, ,, ...	D 28	,, ,,
XLIX.	Submaxillary gland ...	D 25	General tuberculosis.
	,, ,, ...	D 26	,, ,,
	,, ,, ...	D 27	,, ,,
	Lung tissue	K 41	,, ,,
	,, ,, ...	K 41	Early general tuberculosis.
LI.	Submaxillary gland ...	D 26	General tuberculosis.
	,, ,, ...	D 28	,, ,,

TABLE V.—*continued.*

Number of pig.	Tissue inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
LV.	Submaxillary gland ...	D 12	Early tuberculosis.
LIX.	Submaxillary gland ...	D 37	General tuberculosis.
	" "	D 26	" "
	" "	D 36	" "
LXII.	Submaxillary gland ...	D 46	Yellow nodule in omentum only (few tubercle bacilli).
	" " ...	D 35	No tuberculosis.
	" " ..	K 50	General tuberculosis.
LXIII.	Submaxillary gland ...	D 23	Early general tuberculosis.
	" "	D 49	General tuberculosis.
LXV.	Submaxillary gland ..	D 29	General tuberculosis.
	" "	D 41	" "
LXX.	Submaxillary gland ..	D 49	General tuberculosis.
LXXI.	Submaxillary gland ...	D 30	General tuberculosis.
	" " ...	D 34	" "
LXXIII.	Submaxillary gland ...	D 28	General tuberculosis.
	" " ...	D 19	" "
	Lung (antiforminised) ..	D 21	No tuberculosis.
	" " ...	D 48	General tuberculosis.
	" " ...	D 42	Early general tuberculosis.
LXXIV.	Submaxillary gland ...	D 32	General tuberculosis.
	" " ...	D 35	" "
LXXV.	Submaxillary gland ...	D 33	Early general tuberculosis.
	" " ...	D 65	General tuberculosis.
LXXVI.	Submaxillary gland ...	D 38	General tuberculosis.
	" " ...	D 32	" "
LXXVII.	Submaxillary gland ...	D 37	General tuberculosis.
LXXIX.	Submaxillary gland ...	D 26	General tuberculosis.
	" " ...	D 32	" "
	Liver nodule	K 62	Healthy.
LXXXI.	Submaxillary gland ...	K 56	General tuberculosis.
	" " ...	D 56	" "
LXXXII.	Submaxillary gland ...	D 22	General tuberculosis.
	" " ...	K 22	" "
	" " ...	D 22	" "
LXXXIII.	Submaxillary gland ...	K 42	General tuberculosis.
	" " ...	D 39	" "
LXXXIV.	Submaxillary gland ...	K 42	General tuberculosis.
	" " ...	K 42	" "
	Lung tubercle	K 49	" "

TABLE V.—*continued.*

Number of pig.	Tissue inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
LXXXV.	Submaxillary gland ...	K 28	General tuberculosis.
	" " ...	K 28	" "
LXXXVI.	Submaxillary gland ...	K 28	General tuberculosis.
	" " ...	K 23	" "
LXXXVIII.	Submaxillary gland ...	K 26	General tuberculosis.
	" " ...	K 26	" "
	" " ...	K 26	" "
XC.	Submaxillary gland ...	K 31	General tuberculosis.
	" " ...	K 31	" "
XCI.	Submaxillary gland ...	K 19	General tuberculosis.
	" " ...	K 19	" "
XCIII.	Submaxillary gland ...	K 19	General tuberculosis.
	" " ...	K 19	" "
XCIV.	Submaxillary gland ...	K 26	General tuberculosis.
	" " ...	K 26	" "
	Lung tubercles	K 26	Early general tuberculosis.
XCV.	Submaxillary gland ...	D 52	General tuberculosis.
	" " ...	D 39	" "
XCVIII.	Submaxillary gland ...	K 30	General tuberculosis.
	" " ...	K 30	" "
	Mesenteric gland ...	K 30	" "
XCIX.	Submaxillary gland ...	K 42	General tuberculosis.
	" " ...	K 42	" "
	Bronchial gland ...	K 42	Healthy.

B.—With lesions due to avian tubercle bacilli.

X.	Submaxillary gland ...	K 43	No tuberculosis.
XV.	Submaxillary gland ...	K 42	Slight omental and peritoneal tuberculosis.
XVII.	Mesenteric glands ...	K 42	Sternal gland slightly enlarged. Culture obtained.
	" " ...	K 42	Caseo-purulent peritoneal nodule. Culture obtained.
XVIII.	Mesenteric glands ...	K 45	Subcutaneous caseo-purulent nodule; similar nodules in inguinal glands containing tubercle bacilli: (Inoculation subcutaneous).
	" " ...	K 45	Caseo-purulent nodules in omentum only.
	Liver tissue	K 45	Healthy.

TABLE V.—*continued.*

Number of pig.	Tissue inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
XXIII.	Mesenteric glands ...	K 45	Single fibro-caseous nodule in omentum.
	" " ...	K 45	Two minute tubercles in omentum. A few necrotic foci in liver and two translucent nodules in spleen.
	Lung nodules	K 45	Healthy.
	" "	K 45	"
	Liver tubercles	K 45	"
	" "	K 45	"
XXIX.	Submaxillary gland ...	K 34	A few minute tubercles in omentum; soft, caseous focus in pyloric gland; yellowish grey necrotic patches in liver; Malpighian bodies of spleen prominent (tubercle bacilli moderately numerous); soft nodules in portal and mediastinal glands. Cultures from spleen and mediastinal gland.
	Liver nodule	K 42	No tuberculosis.
XXXI.	Submaxillary gland ...	K 33	A few translucent tubercles in omentum only (tubercle bacilli).
	" " ...	K 35	Two fibrous nodules in omentum; slight enlargement of pyloric gland. Culture from omentum.
XXXVIII.	Submaxillary gland ...	K 39	No local tuberculosis; translucent nodule in spleen (tubercle bacilli). Culture from spleen.
	" " ...	K 39	No tuberculosis. Cultures from spleens.
	" " ...	K 39	
XXXIX	Submaxillary gland ...	K 39	No local tuberculosis; several enlarged Malpighian bodies in spleen (no tubercle bacilli in smear). Culture from spleen.
	" " ...	K 39	Two caseous foci in pyloric gland.
	" " ...	D 28	No tuberculosis.

TABLE V.—*continued.*

Number of pig.	Tissue inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
XLIV.	Submaxillary gland ...	K 40	Omentum thickened (tubercle bacilli numerous); spleen enlarged and speckled with grey foci (no tubercle bacilli in smear).
	,, ,, ...	K 40	Inguinal glands enlarged and caseous (inoculation subcutaneous); spleen speckled with grey foci (no tubercle bacilli in smear).
	,, ,, ...	K 40	Omentum thickened (tubercle bacilli); spleen enlarged and speckled with grey foci.
L.	Submaxillary gland ...	D 35	Omental tuberculosis; caseous foci in enlarged sternal glands with numerous tubercle bacilli; foci in spleen (tubercle bacilli).
	,, ,, ...	K 43	Similar to above.
LII.	Submaxillary gland ...	D 25	Omentum tuberculous; pyloric, sternal, and lumbar glands caseous; spleen enlarged, with numerous yellowish nodules (tubercle bacilli); yellowish areas in liver.
	,, ,, ...	D 18	Omentum slightly thickened (tubercle bacilli); a few grey points in spleen.
LIII.	Mesenteric gland ...	D 9	A focus in omentum containing moderately numerous tubercle bacilli.
LVIII.	Submaxillary gland ...	D 32	No tuberculosis.
	,, ,, ...	K 42	Healthy. Culture from spleen
	,, ,, ...	K 42	Minute tubercle in omentum; greyish nodules in the spleen, one yellow in the centre; tubercle bacilli numerous Culture from spleen.
LX.	Submaxillary gland ...	K 42	Translucent foci in omentum; soft yellow nodule in portal gland (tubercle bacilli numerous); translucent nodule in spleen.
	,, ,, ...	K 42	No lesions of tuberculosis.
	,, ,, ...	K 42	Translucent foci in omentum and grey nodules in spleen.
LXI.	Submaxillary gland ...	K 51	Healthy.
	,, ,, ...	K 51	Caseous focus in pyloric gland.
	Mesenteric glands ...	D 39	No tuberculosis.
	,, ,, ...	K 51	Healthy.

TABLE V.—*continued.*

Number of pig.	Tissues inoculated.	Duration of life of guinea-pig in days. D = died. K = killed.	Post-mortem results.
LXIV.	Submaxillary gland ...	D 14	Early tuberculosis of omentum, pyloric and sternal glands.
	,, ,, ...	D 28	No tuberculosis.
LXVI.	Submaxillary gland ...	D 26	Omentum thickened; pyloric, lumbar, and sternal glands enlarged; Malpighian bodies of spleen prominent; tubercle bacilli in lumbar gland and spleen.
	,, ,, ...	D 36	Soft, yellow caseous nodules in the omentum (tubercle bacilli numerous). Cultures from omentum and spleen.
LXVII.	Submaxillary gland ...	K 34	A few translucent foci in omentum; Malpighian bodies of spleen prominent. No tubercle bacilli in smear preparation but a culture was obtained from the spleen.
	,, ,, ...	K 34	Like above.
LXVIII.	Submaxillary gland ...	D 22	No tuberculosis.
	,, ,, ...	K 46	No lesions of tuberculosis. Culture from spleen.
LXIX.	Submaxillary gland ...	D 40	No tuberculosis.
LXXII.	Submaxillary gland ...	D 37	No visible tuberculosis, but culture from spleen.
	,, ,, ...	D 106	No tuberculosis.
	,, ,, ...	D 106	,, ,,
LXXXIX.	Submaxillary gland ...	K 49	No visible tuberculosis, but culture from spleen.
	,, ,, ...	K 49	No visible tuberculosis, but culture from spleen.
	Liver nodule	K 49	Healthy.
XCII.	Submaxillary gland ...	K 36	Grey nodules in omentum and opaque foci in a lumbar gland; culture from spleen.
	,, ,, ...	K 36	Early caseation of pyloric gland; culture from spleen.
	,, ,, ...	K 36	Caseous foci in iliac, inguinal and manubrial glands (inoculation subcutaneous); culture from spleen.
XCVII.	Submaxillary gland ...	K 42	Inguinal glands caseous (inoculation subcutaneous); culture from spleen.
	,, ,, ...	D 41	No visible tuberculosis; culture from omentum.

TABLE VI.—A. *Inoculation experiments on rabbits with cultures of dysgonic and virulent mammalian tubercle bacilli obtained from pigs.*

Dose, in each case, ·01 mg. inoculated intravenously.

Number of pig.	Source of culture.	Details of culture.			Number of rabbit.	Weight of rabbit in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Generation.	Total duration of culti-vation in days.		Initial.	Final.		
I.	Submaxillary lymphatic gland (through G.P.).	11	4th	186	8	1820	1150	Died, 21 days	General tuberculosis.
XI.	Submaxillary lymphatic gland (through G.P.).	16	3rd	197	15	2870	2500	Died, 28 days	General tuberculosis.
	" " " "	16	3rd	197	16	2920	2620	" 32 "	" "
XIV.	Submaxillary lymphatic gland (direct)...	11	3rd	200	11	970	820	Died, 19 days	General tuberculosis.
XVI.	Submaxillary lymphatic gland (direct) ..	4	2nd	192	4	1870	1400	Died, 21 days	General tuberculosis.
	" " " " ...	4	2nd	193	10	880	770	" 26 "	" "
XIX.	Submaxillary lymphatic gland (direct) ...	9	6th	227	26	2500	2060	Died, 28 days	General tuberculosis.
XXI.	Liver (direct)	8	5th	195	19	2970	2420	Died, 30 days	General tuberculosis.
XXIV.	Mesenteric gland (direct)	9	5th	174	27	1650	1278	Died, 24 days	General tuberculosis.
XXV.	Bronchial gland (direct)	18	6th	127	17	1700	1370	Died, 26 days	General tuberculosis.
	" " "	18	6th	127	18	3550	2550	" 26 "	" "
XXVI.	Submaxillary lymphatic gland (direct) ...	4	3rd	76	6	1940	1370	Died, 35 days	General tuberculosis.

XXX.	Submaxillary lymphatic gland (direct) ...	8	5th	115	32	2980	2720	Died, 26 days	General tuberculosis.
XXXIII.	Spleen (direct)	8	5th	110	31	2950	2720	Died, 23 days	General tuberculosis.
XXXV.	Spleen (direct)		4th	109	38	1840	1450	Died, 27 days	General tuberculosis.
XXXVI.	Submaxillary lymphatic gland (direct) ...	16	2nd	92	45	1700	1350	Died, 26 days	General tuberculosis.
XXXVII.	Submaxillary lymphatic gland (direct) ...	8	4th	76	33	2380	2090	Died, 32 days	General tuberculosis.
XLI.	Bronchial gland (direct)		3rd	73	40	1940	1550	Died, 23 days	General tuberculosis.
XLII.	Submaxillary lymphatic gland (direct) ...	7	3rd	70	42	2150	1550	Died, 27 days	General tuberculosis.
XLIII.	Submaxillary lymphatic gland (direct) ...	6	6th	82	50	1320	1150	Died, 17 days	General tuberculosis.
XLV.	Submaxillary lymphatic gland (direct) ...	14	3rd	65	46	1920	1510	Died, 25 days	General tuberculosis.
XLVI.	Submaxillary lymphatic gland (direct) ...	8	4th	65	47	1670	1320	Died, 45 days	General tuberculosis.
XLVII.	Submaxillary lymphatic gland (direct) ...	7	4th	64	43	1870	1600	Died, 20 days	General tuberculosis.
XLVIII.	Submaxillary lymphatic gland (direct) ...	7	5th	62	41	1970	1750	Died, 20 days	General tuberculosis.
XLIX.	Submaxillary lymphatic gland (direct) ...		2nd	62	39	1950	1500	Died, 28 days	General tuberculosis.
LI.	Submaxillary lymphatic gland (direct) ...	7	3rd	64	44	1570	1420	Died, 27 days	General tuberculosis.
LIV.	Submaxillary lymphatic gland (direct) ...	6	4th	60	48	1770	1500	Died, 29 days	General tuberculosis.
LV.	Submaxillary lymphatic gland (direct) ...	10	4th	54	49	1220		Died, 30 days	General tuberculosis.
LIX.	Submaxillary lymphatic gland (direct) ...	13	2nd	49	51	1550	1200	Died, 23 days	General tuberculosis.
LXIII.*	Mesenteric gland (direct)	9	3rd	55	53	1300	1130	Killed, 63 days	General tuberculosis.
LXX.	Submaxillary lymphatic gland (direct) ...	4	5th	123	94	1510		Died, 29 days	General tuberculosis.

* The dose in this case was ·001 mg.

TABLE VI.—A.—*continued.*

Number of pig.	Source of culture.	Details of culture.			Number of rabbit.	Weight of rabbit in grammes.		Duration of life.	Results.
		Age of sub-culture in days.	Generation.	Total duration of culti-vation in days.		Initial.	Final.		
LXXIII.	Submaxillary lymphatic gland (direct) ...	10	4th	54	71	1210	1070	Died, 24 days	General tuberculosis.
	" " " " ...	10	4th	54	72	1130	1050	" 24 "	" "
LXXIV.	Mesenteric gland (direct)	10	3rd	53	73	1800	1380	Died, 23 days	General tuberculosis.
	" " "	10	3rd	53	74	1230	1010	" 23 "	" "
LXXVI.	Submaxillary lymphatic gland (direct) ...	11	3rd	69	83	2960	2450	Died, 26 days	General tuberculosis.
LXXVIII.	Submaxillary lymphatic gland (direct) ...	14	4th	78	98	1620	1440	Died, 37 days	General tuberculosis.
LXXIX.	Submaxillary lymphatic gland (direct) ...	6	4th	68	88	2750	2340	Died, 28 days	General tuberculosis.
LXXXI.	Submaxillary lymphatic gland (direct) ...	5	4th	61	113	3600	2640	Died, 25 days	General tuberculosis.
LXXXII.	Submaxillary lymphatic gland (direct) ...	4	3rd	25	100	2440	1900	Died, 17 days	General tuberculosis.
LXXXIII.	Submaxillary lymphatic gland (direct) ...	13	4th	52	124	2100	1820	Died, 21 days	General tuberculosis.
LXXXIV.	Submaxillary lymphatic gland (direct) ...	13	5th	52	125	2100	1800	Died, 31 days	General tuberculosis.
LXXXV.	Submaxillary lymphatic gland (direct) ...	7	6th	58	180	2800	2000	Died, 27 days	General tuberculosis.
LXXXVI.	Submaxillary lymphatic gland (direct) ...	11	4th	53	149	2980	1810	Died, 29 days	General tuberculosis.
XCIX.	Submaxillary lymphatic gland (direct) ...	6	11th	183	363	2550	2150	Died, 26 days	General tuberculosis.

TABLE VI.—B. *Inoculation experiments on rabbits with cultures of virulent tubercle bacilli obtained from pigs.*
Method of inoculation :—subcutaneous.

Number of pig.	Source of culture.	Details of culture.			Number of rabbit.	Dose.	Weight of rabbit in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Genera-tion.	Total duration of culti-vation in days.			Initial.	Final.		
						Mg.				
LXXVI.	Submaxillary lymphatic gland (direct) ...	10	9th	380	350	10	3840	2600	Died, 35 days	General tuberculosis.
LXXXII.	Submaxillary lymphatic gland (direct) ...	5	9th	292	349	11	2190	1800	Died, 40 days	General tuberculosis.
LXXXVI.	Submaxillary lymphatic gland (direct) ...	5	9th	221	347	11	2770	1700	Died, 81 days	General tuberculosis.
LXXXVIII.	Submaxillary lymphatic gland (through G.P.).	9	7th	103	257	10	1520	1300	Died, 37 days	General tuberculosis.
	" " " "	5	10th	165	348	11	3370	2270	" 62 "	" "
XC.	Submaxillary lymphatic gland (direct) ...	9	8th	136	272	10	2400	1640	Died, 44 days	General tuberculosis.
XCI.	Submaxillary lymphatic gland (direct) ...	14	4th	54	182	10	3280	2520	Died, 40 days	General tuberculosis.
XCIII.	Submaxillary lymphatic gland (direct) ...	12	5th	104	217	10	3140	2190	Died, 62 days	General tuberculosis.
XCIV.	Submaxillary lymphatic gland (direct) ...	9	5th	98	258	10	1250	1000	Died, 33 days	General tuberculosis.
XCV.	Submaxillary lymphatic gland (direct) ...	13	5th	116	297	10	2720	2320	Died, 43 days	General tuberculosis.
XCVIII.	Submaxillary lymphatic gland (direct) ...	9	4th	75	256	10	1690	1500	Died, 27 days	General tuberculosis.
XCIX.	Submaxillary lymphatic gland (direct) ...	6	5th	99	336	10	2170	1500	Died, 97 days	General tuberculosis.
	" " " " ...	7	9th	131	352	13	3056	1850	" 75 "	" "

TABLE VII.—*Inoculation experiments on rabbits with cultures of dysgonic but only slightly virulent mammalian tubercle bacilli obtained from pigs.*

Number of pig.	Source of culture.	Details of culture.			Dose.	*Method of inoculation.	Number of rabbit.	Weight of rabbit in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Generation.	Total duration of cultivation in days.				Initial.	Final.		
					Mg.						
LXXI.	Submaxillary lymphatic gland (direct).	10	4th	59	·01	i.v.	69	2490	3040	Killed, 93 days	A few discrete caseating nodules in lungs; spleen normal; miliary nodule in one kidney and a few in the liver.
	„ „	10	4th	59	·01	i.v.	70	1640	1620	„ 64 „	Scattered miliary caseating nodules in lungs; a few minute tubercles in the kidneys and two in the liver; spleen normal.
	„ „	5	5th	116	·1	i.v.	89	2020	2750	„ 133 „	A moderate number of caseating nodules in lungs; spleen and liver normal; a caseous focus in one kidney; tuberculosis of testes.
	„ „	5	5th	116	18	sub.	90	1720	2230	„ 148 „	Pea-sized local lesion; one grey tubercle in lung; other tissues healthy.
	„ „	8	8th	138	·01	i.v. & sub.	102	2070	3040	„ 215 „	Small cystic local lesion; a few minute grey tubercles in lungs; other tissues healthy.
	„ „	8	8th	138	10	sub.	103	2850	2870	„ 154 „	Caseo-purulent cystic local lesion; moderately numerous chronic caseous nodules in lungs; spleen, kidneys and liver normal.
	„ „	8	8th	138	10	sub.	104	3090	3390	„ 215 „	Cystic local lesion; a few chronic caseous nodules in lungs; other tissues normal.
	Submaxillary lymphatic gland (rabbit 89).	7	8th	111	10	sub.	325	1350	2420	„ 105 „	Large cystic local lesion; a few minute tubercles in lungs; other tissues normal.
	Submaxillary lymphatic gland (rabbit 103).	9	5th	50	10	sub.	262	1110	2320	„ 109 „	Small cystic local lesion; a few small nodules in lungs; other tissues normal.

* i.v. = intravenous inoculation; sub. = subcutaneous inoculation.

LXXVII.	Submaxillary lymphatic gland (direct).	10	3rd	33	·01	i.v.	75	2530	2640	Killed, 93 days	Moderate number of miliary caseous tubercles in lungs ; caseous patch in bronchial gland ; rape seed sized yellow tubercles in spleen ; a few small tubercles in liver and kidneys.
	,, ,,	10	3rd	33	·01	.v.	76	2300	2530	,, 64 ,,	Moderately numerous miliary tubercles in lungs, kidneys and spleen ; caseous foci in bronchial and inguinal glands ; caseating nodules in heart muscle and a few yellowish nodules in liver.
	,, ,,	5	5th	90	·01	i.v.	91	2020	1650	,, 111 ,,	Moderately numerous caseating nodules in lungs ; caseation of a bronchial gland ; numerous soft yellow tubercles in spleen ; scattered caseating nodules in kidneys and caseo-pus in one pelvis ; caseous nodule in testis.
	,, ,,	6	5th	91	3	sub.	95	1770		,, 142 ,,	Cystic local lesion ; numerous discrete caseating nodules in lungs ; soft caseous nodules in bronchial glands ; scattered tubercles in kidneys ; spleen and liver normal.
	,, ,,	13	8th	117	10	sub.	106	2120	2300	,, 176 ,,	Caseo-purulent, cystic local lesion ; fairly numerous minute caseating tubercles in lungs and kidneys ; liver, spleen, and bronchial glands normal ; gritty tubercles in lumbar fat ; tuberculosis of a joint.
	,, ,,	13	8th	117	10	sub.	107	2320	1970	,, 149 ,,	Soft caseous, cystic local lesion ; numerous caseating nodules in lungs ; a few tubercles in kidneys ; no tuberculosis elsewhere.
	Submaxillary lymphatic gland (rabbit 91).	7	3rd	42	·01	i.v.	183	3570	2450	,, 114 ,,	Numerous softening caseous nodules in lungs, confluent in margins ; numerous irregular pits and tubercles in kidneys ; tubercles in areolar tissues ; otherwise normal.
	,, ,,	7	3rd	42	25	sub.	184	2790	2400	,, 114 ,,	Cystic local lesion ; lungs similar to 183 but less severely affected ; numerous miliary tubercles in kidneys ; caseous nodule in testis ; otherwise normal.

TABLE VII.—*continued.*

Number of pig.	Source of culture.	Details of culture.			Dose.	*Method of inoculation.	Number of rabbit.	Weight of rabbit in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Generation.	Total duration of cultivation in days.				Initial.	Final.		
					Mg.						
LXXVII. —*cont.*	Submaxillary lymphatic gland (rabbit 106).	8	2nd	23	10	sub.	263	980	1050	Killed, 56 days	Killed on account of ulcerated local lesion; a few minute tubercles in lungs; single tubercle in spleen and in one kidney; soft caseous nodules in axillary and bronchial glands.
	Submaxillary lymphatic gland (rabbit 95).	9	6th	63	10	sub.	264	880	1390	,, 56 ,,	Animal killed for same reason as 263; post mortem appearances identical with same.
	Submaxillary lymphatic gland (rabbit 184).	22	2nd	41	10	sub.	358	2820	3000	,, 105 ,,	Soft caseous local lesion; occasional tubercle in lungs; caseating nodules, up to a pea, in kidneys; no disease elsewhere.

* i.v. = intravenous inoculation: sub. = subcutaneous inoculation.

TABLE VIII.—*Inoculation experiments on rabbits with cultures of Pigs LXIX., LXXV. and XCI.*

					Mg.						
LXIX.	Submaxillary lymphatic gland (direct).	10	4th	74	·01	i.v.	67	2250	2790	Killed, 93 days	Single minute tubercle in lungs; two grey foci in kidney; other tissues normal.
	,, ,,	13	5th	139	9	sub.	97	3010	3650	,, 120 ,,	Cystic local lesion, containing watery fluid and caseous flakes; other tissues normal.
	,, ,,	12	8th	168	·01	i.v.	109	1810	1860	,, 111 ,,	Six caseating miliary nodules in lungs; minute tubercle in kidney; other tissues normal.

	„ „	12	8th	168	·1	i.v.	110	1400	1060	„ 111 „	Fairly numerous grey nodules with soft caseous centres in lungs; three minute tubercles in each kidney; other tissues normal.
	„ „	12	8th	168	1	i.v.	111	2220	2400	„ 96 „	A few transparent foci in lungs; occasional minute tubercles in kidneys; other tissues normal.
	„ „	12	8th	168	1	sub.	112	1870	1900	„ 106 „	Small local lesion; soft caseous nodules in nearest gland; other tissues normal.
	„ „	6	26th	537	2	i.v.	378	2260	2020	Died, 25 „	Lungs grey and markedly œdematous, minnte tubercles with opaque centres scattered throughout; spleen swollen; a network of grey foci in liver; bronchial glands œdematous; whitish tubercles in areolar tissues of lumbar regions and limb flexures; T.B. very numerous in spleen and areolar tubercles, typical rosette formations in liver and lungs in histological sections.
	„ „	6	26th	537	10	i.v.	379	2310	1350	„ 14 „	Lungs firm and grey, just floating in water, occasional caseous points; spleen swollen; liver and kidneys pale; T.B. numerous in all the organs.
LXXV.	Submaxillary lymphatic gland (direct).	8	4th	70	·01	i.v.	79	1450	2200	Killed, 94 days	A few caseous tubercles in lungs; minute tubercles and pits in kidneys, with pus in one pelvis; minute foci in liver; spleen normal.
	„ „	8	4th	70 { 20	·1	i.v. i.p. }	80	2950	3120	„ 93 „	Caseous nodules in omentum and on peritoneum; confluent caseating nodules in lungs; numerous miliary tubercles in kidneys, with pus in one pelvis.
XCI.	Liver (through G.P.) ...	9	4th	76	12	sub.	248	2400	2490	Killed, 104 days	Cystic local lesion; moderately numerous dark grey nodules beset with caseous foci in the lungs; other tissues normal.

* i.v., sub., and i.p. = respectively, intravenous, subcutaneous, and intraperitoneal inoculation.

TABLE IX.—*Inoculation experiments on guinea-pigs with cultures of Pigs LXIX., LXXI. and LXXVII.*

Number of pig.	Source of culture.	Details of cultures.			Dose.	*Method of inoculation.	Weight of guinea-pig in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Generation.	Total duration of cultivation in days.			Initial.	Final.		
					Mg.					
LXIX.	Submaxillary lymphatic gland (direct).	12	8th	168	·1	sub.	410	670	Killed, 188 days	Small yellow subcutaneous nodule; otherwise healthy.
	,, ,,	12	8th	168	1	sub.	360	520	,, 179 ,,	Healthy.
	,, ,,	12	8th	168	1	i.p.	410	600	,, 188 ,,	Purulent nodule in omentum; otherwise healthy, but cultures of T.B. obtained from liver and spleen.
LXXI.	Submaxillary lymphatic gland (direct).	8	8th	138	·01	sub.	800	500	Died, 87 days	Chronic general tuberculosis.
	,, ,,	8	8th	138	·01	i.p.	700	600	,, 38 ,,	General tuberculosis.
	,, ,,	8	8th	138	·1	sub.	870	510	,, 47 ,,	,, ,,
	,, ,,	8	8th	138	1	sub.	650	400	,, 60 ,,	,, ,,
	Submaxillary lymphatic gland (rabbit 103).	9	5th	50	·1	sub.	380	270	,, 53 ,,	,, ,,
	,, ,,	9	5th	50	1	sub.	370	260	,, 59 ,,	,, ,,
LXXVII.	Submaxillary lymphatic gland (direct).	13	8th	117	·01	sub.	420	490	Died, 162 days	Chronic general tuberculosis.
	,, ,,	13	8th	117	·01	i.p.	380	300	,, 101 ,,	,, ,,
	,, ,,	13	8th	117	·1	sub.	360	340	,, 82 ,,	,, ,,
	,, ,,	13	8th	117	1	sub.	370	310	,, 108 ,,	,, ,,
	Submaxillary lymphatic gland (rabbit 95).	9	6th	63	·1	sub.	350	350	,, 65 ,,	,, ,,
	,, ,,	9	6th	63	1	sub.	430	400	,, 55 ,,	General tuberculosis.

* sub. and i.p. = subcutaneous and intraperitoneal inoculation respectively.

TABLE X.—*Experiments on fowls with cultures of avian tubercle bacilli obtained from pigs.*

Number of pig.	Source of culture.	Details of culture.			Dose.	*Method of inoculation.	Number of fowl.	Weight of fowl in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Generation.	Total duration of cultivation in days.				Initial.	Final.		
IX. ...	Mesenteric gland (direct)	27	3rd	205	mg. 10	i. m.	4	2120	1300	Died, 75 days	General tuberculosis.
X. ...	Submaxillary lymphatic gland (direct).	15	4th	202	10	i. m.	2	1900	850	„ 33 „	„ „
XV. ...	„ „ „	27	3rd	188	10	i. m.	1	1120	620	„ 61 „	„ „
XVII. ...	Mesenteric gland (through G.P.).	69	3rd	139	10	i. m.	5	1760	2200	Killed, 138 „	Local tuberculosis.
	Mesenteric gland (direct)	16	7th	293	21	i. m.	9	2470	2160	„ 133 „	„ „
	„ „ „	14	8th	493	·1	i. v.	23	1690	1490	Died, 28 „	T. B. in liver and spleen; rupture of spleen.
	„ „ „	„	„	„	1	i. v.	24	2450	1570	„ 22 „	T.B. in liver and spleen; no visible lesions
	„ „ „	„	„	„	75	i. m.	25	—	2120	Killed, 172 „	Local tuberculosis.
	„ „ (Fowl 5)	14	3rd	216	·1	i. v.	26	2270	1770	„ 172 „	No tuberculosis.
	„ „ „	„	„	„	25	i. m.	27	3270	2700	„ 172 „	Local tuberculosis.

* i. m. = intramuscular inoculation; i. v. = intravenous inoculation; f. = feeding.

TABLE X.—*Experiments on fowls with cultures of avian tubercle bacilli obtained from pigs*—continued.

Number of pig.	Source of culture.	Details of culture.			Dose.	*Method of inoculation.	Number of fowl.	Weight of fowl in grammes.		Duration of life.	Result.
		Age of sub-culture in days.	Generation.	Total duration of cultivation in days.				Initial.	Final.		
					mg.						
XVII. ...	Mesenteric gland (direct)	55	11th	744	100	f.	33	1700	1520	Killed, 144 days	Slight tuberculosis of proventriculus, small intestine and caecum; scattered tubercles in liver; tuberculous infiltration beneath plantar surface of claw.
	,, ,, ,,	,,	,,	,,	100	f.	34	2230	1570	,, 166 ,,	Caseo-necrotic nodule in cervical gland, proventriculus and liver.
XVIII. ...	Liver (direct)	27	2nd	156	10	i. m.	3	1750	—	Died, 79 ,,	General tuberculosis.
XXIII. ...	Mesenteric gland (direct)	69	3rd	111	10	i. m.	6	1450	920	,, 39 ,,	,, ,,
XXIX. ...	Submaxillary lymphatic gland (direct).	7	3rd	90	9	i. m.	7	2700	1470	,, 42 ,,	,, ,,
XXXI. ...	,, ,, ,,	7	3rd	78	10	i. m.	8	2600	1920	,, 37 ,,	,, ,,
	,, ,, ,,	—	4th	113	10	i. m.	11	1570	700	,, 51 ,,	,, ,,
XXXVIII.	,, ,, ,,	10	4th	88	10	i. m.	12	2070	1330	,, 38 ,,	,, ,,
XXXIX....	,, ,, ,,	11	3rd	65	9	i.m.	10	2050	1120	,, 30 ,,	,, ,,

XLIV. ...	„ „ „	20	2nd	72	10	i. m.	13	2050	1670	„ 26 „	„	„
L.	„ „ „	20	3rd	70	10	i. m.	14	2150	850	„ 58 „	„	„
II. ...	„ „ „	12	3rd	61	10	i. m.	15	2150	—	„ 80 „	„	„
LIII. ...	Mesenteric gland (direct)	14	3rd	62	10	i. m.	16	1950	1200	„ 32 „	„	„
LVIII. ...	Submaxillary lymphatic gland (direct).	18	2nd	53	10	i. m.	18	1450	1050	„ 25 „	„	„
LX. ...	„ „ „	16	2nd	42	10	i. m.	17	1820	950	„ 36 „	„	„
LXI. ...	„ „ „	13	4th	439	10	i. m.	38	2370	970	„ 64 „	„	„
LXIV. ...	„ „ „	10	4th	419	10	i. m.	36	1750	1050	„ 45 „	„	„
LXVI. ...	„ „ „	11	4th	425	10	i. m.	40	2020	970	„ 43 „	„	„
LXVII. ...	„ „ „	13	4th	416	10	i. m.	39	1850	1220	„ 33 „	„	„
LXVIII. ...	„ * (through G.P.)	10	7th	366	10	i. m.	35	2130	1120	„ 122 „	„	„
LXXII. ...	„ „ (direct)	8	3rd	83	10	i. m.	21	2620	1300	„ 57 „	„	„
LXXVIII.	Mesenteric gland (direct)	11	3rd	84	10	i. m.	22	1590	1000	„ 49 „	„	„
LXXXIX.	Submaxillary lymphatic gland (direct).	51	3rd	131	10	i. m.	30	2030	1090	„ 45 „	„	„
XCII. ...	„ „ „	27	4th	119	10	i. m.	29	1770	800	„ 38 „	„	„
XCVII. ...	„ „ „	15	4th	84	10	i. m.	28	1870	900	„ 90 „	„	„

* i. m. = intramuscular inoculation ; i. v. = intravenous inoculation ; f. = feeding.

TABLE XI.—*Inoculation experiments with weighed quantities of apparently normal tissues of tuberculous pigs.*

A.—Pigs affected with mammalian tuberculosis.

Number of pig.	Tissue inoculated.	Weight of organ, in grammes.	Weight of portion inoculated, in grammes.	Number of guinea-pigs inoculated.	Duration of life and result.*
XIV.	Spleen ...	110	1·5	3	All killed in 51 days.
	Liver ...	1300	3	3	„ „ „
XXX.	Spleen ..	100	3	4	All killed in 45 days.
	Liver ...	1670	3	4	Three killed in 44 days; one died in 27 days.
	Lungs ...	620	4·5	5	All killed in 44 days.
XXXVI.	Muscle (filtrate of emulsion).	—	56	9	Four killed in 47 days; the remainder died in from 26 to 39 days.
XXXVII.	Spleen ...	105	1	1	Died in 21 days.
	Liver ...	1611	3	3	All killed in 42 days.
	Muscle ...	—	2	1	Died in 41 days.
XLI.	Muscle ...	—	25	11	Two died in 21 and 24 days; the rest were killed in 43 days.
XLII.	Muscle ...	—	14	4	Two died in 30 days; two were killed in 43 days.
	Heart muscle	—	12·5	5	Two died in 26 and 32 days; three were killed in 43 days.
XLIII.	Muscle ...	—	10·5	3	All died in from 26 to 29 days.
	Heart muscle	—	12·5	5	Two killed in 43 days; three died in from 25 to 38 days.
XLVI.	Spleen ...	90	5	5	Three died in from 26 to 42 days; two were killed in 42 days.
	Liver ...	1400	4	4	Two died in 26 and 28 days; two were killed in 42 days.
	Lungs ...	810	1	1	Killed in 42 days.
XLVII.	Spleen ...	80	2	2	One died in 36 days; one was killed in 42 days.
XLVIII.	Spleen ...	70	2	2	Died in 30 and 36 days.
	Liver ...	1110	2	2	Died in 24 and 41 days.
	Lungs† ...	550	2·7	5	Three died in from 27 to 36 days; two were killed in 42 days, one showing general tuberculosis.
LI.	Muscle ...	—	12	6	All died in from 22 to 42 days.
LV.	Spleen ...	90	1·5	2	One died in 32 days; one was killed in 42 days.
LIX.	Muscle ...	—	30	10	One died in 34 days; the rest killed in 42 days.
LXII.	Muscle ...	—	30	9	One died in 38 days; the rest killed in 50 days.

* In every case except one the inoculated animal was found free from tuberculosis.
† In part of the lung tissue not inoculated a single minute tubercle was seen.

TABLE XI.—*continued.*

Number of pig.	Tissue inoculated.	Weight of organ, in grammes.	Weight of portion inoculated, in grammes.	Number of guinea-pigs inoculated.	Duration of life and result.
LXV.	Muscle ...	—	18	6	Two died in 25 days; four killed in 48 days.
LXX.	Lungs ...	490	2	2	Both killed in 59 days.
	Liver ...	2250	4	4	Two died in 39 and 43 days; two killed in 59 days.
	Spleen ...	80	3	3	One died in 29 days; two killed in 59 days.
LXXI.	Liver ...	780	2	2	Both killed in 54 days.
	Spleen ...	60	2	2	" " "
LXXIV.	Liver ...	3350	4	4	All killed in 51 days.
	Spleen ...	250	4	4	" " "
	Muscle ...	—	12	4	" " "
LXXIX.	Spleen ...	110	1·2	1	Killed in 70 days (seven other guinea-pigs died prematurely).
	B.—Pigs affected with avian tuberculosis.				
X.	Spleen ...	170	·5	1	
	Spleen (centrifugalised deposit of emulsion).		9 (deposit of).	2	Killed in 48 days. No lesions of tuberculosis.
	Liver ...	1370	2	2	One died in 36 days; one killed in 48 days. No lesions of tuberculosis.
XV.	Spleen ...	120	2	4	All killed in 48 days (one subcutaneous). No lesions of tuberculosis.
	Liver ...	1500	4	4	
	Lungs ...	1000	3	3	All killed in 49 days (one subcutaneous). No lesions of tuberculosis.
XVII.	Spleen ...	60	3·2	4	All killed in 42 days (one subcutaneous). No lesions of tuberculosis.
	Liver ...	880	4	4	
	Lungs ...	420	1	1	Killed in 42 days (subcutaneous). No lesions of tuberculosis.
	Muscle ...	—	23	4	All killed in 42 days. No lesions of tuberculosis.
XXIX.	Spleen ...	85	1·5	3	Died in from 21 to 34 days. No lesions of tuberculosis.
	Liver ...	1480	3	3	Two died in 28 and 31 days; one killed in 45 days, apparently healthy, but culture of avian tubercle bacilli obtained from spleen.
	Muscle ...	—	4·5	3	Two died in 30 and 31 days; one killed in 45 days. No lesions of tuberculosis.

TABLE XI.—*continued.*

Number of pig.	Tissue inoculated.	Weight of organ, in grammes.	Weight of portion inoculated, in grammes.	Number of guinea-pigs inoculated.	Duration of life and result.
XXXI.	Spleen ...	80	6·5	6	All killed in from 44 to 47 days. No lesions of tuberculosis. Cultures from three guinea-pigs remained sterile.
	Liver ...	1650	5·5	4	Two died in 30 and 41 days; two killed in 33 days. No lesions of tuberculosis.
	Lungs ...	700	7·5	6	One died in 27 days; five killed in from 44 to 47 days. No lesions of tuberculosis. Cultures (from three) remained sterile.
XXXVIII.	Spleen ...	120	3	3	All killed in 45 days. No lesions of tuberculosis.
	Liver ...	1650	1	1	Killed in 45 days. No lesions of tuberculosis.
	Lungs ...	800	2	2	Died in 21 and 41 days. No lesions of tuberculosis.
L.	Spleen ...	60	1	2	Killed in 42 days. No lesions of tuberculosis.
	Liver ...	1150	3	3	One died in 25 days; two killed in 42 days. No lesions of tuberculosis.
	Lungs ...	360	·5	1	Killed in 42 days No lesions of tuberculosis.
	Muscle ...	—	21	7	Three died in from 25 to 38 days; four killed in 42 days. No lesions of tuberculosis.
LII.	Spleen ...	90	3	4	One died in 27 days; three killed in 42 days. No lesions of tuberculosis, but culture of avian tubercle bacilli derived from the spleen of one.
	Liver ...	900	3·5	4	Two died in 23 and 25 days; two killed in 42 days. No lesions of tuberculosis, but cultures of avian tubercle bacilli from the spleens of the two latter.
	Muscle ...	—	18	6	Two died in 25 and 32 days; four killed in 42 days. No lesions of tuberculosis; cultures from the spleens of four were negative.
LIII.	Liver ...	1050	2	2	Both killed in 42 days. No lesions of tuberculosis, but cultures of avian tubercle bacilli from both spleens.

TABLE XI.—*continued.*

Number of pig.	Tissue inoculated.	Weight of organ, in grammes.	Weight of portion inoculated, in grammes.	Number of guinea-pigs inoculated.	Duration of life and result.
LVIII.	Spleen ...	70	5	5	All killed in 42 days; none showed lesions of tuberculosis. Culture from spleen of one yielded avian tubercle bacilli.
	Liver ...	1320	8	8	All killed in 42 days; six showed no lesions of tuberculosis, but from the spleens of five of these, cultures of avian tubercle bacilli were obtained. In the seventh and eighth guinea-pigs there was slight omental tuberculosis and enlargement of the Malpighian bodies of the spleens, from which cultures were obtained.
LX.	Spleen ...	60	6	6	One died in 29 days; five were killed in 42 days. None showed lesions of tuberculosis except one with a few foci in the omentum, containing tubercle bacilli. Cultures from the spleens of five were negative.
	Liver ...	850	10	6	One died in 24 days; five were killed in 42 days. None showed lesions of tuberculosis. Cultures from the spleens of five were negative.
LXI.	Spleen ...	150	5	5	Two died in 29 and 40 days; three were killed in 51 days. None showed lesions of tuberculosis. Cultures from the spleens of four were negative.
LXIV.	Spleen ...	110	·5	1	Killed in 40 days; no lesions of tuberculosis.
	Liver ...	1120	2·5	3	Killed in 40 days; no lesions of tuberculosis.
	Muscle ...	—	4	1	Died in 33 days; peritoneal nodule containing numerous tubercle bacilli.
LXVI.	Spleen ...	50	2	2	Died in 23 and 28 days; no lesions of tuberculosis.
	Liver ...	1050	3	3	Died in from 24 to 28 days; no lesions of tuberculosis.

TABLE XII.—*Inoculation experiments with weighed quantities, treated with antiformin, of apparently normal tissues of tuberculous pigs.*

A.—Pigs affected with mammalian tuberculosis.*

Number of pig.	Tissue inoculated.	Strength of antiformin.	Time of exposure in minutes.	Weight of tissue inoculated, in grammes.	Number of guinea-pigs inoculated.	Duration of life and result.
XXVII.	Spleen ...	5%	30	4·6	2	Both killed in 44 days.
	Lungs ...	,,	,,	7·6	2	,, ,, ,,
XXX.	Liver ...	5%	,,	8	2	Both killed in 45 days.
	,, ...	1%	,,	6	2	One died in 42 days; one killed in 45 days.
	Lungs ...	,,	,,	7	2	Both killed in 45 days.
LXX.	Liver ..	2%	60	9	3	Death occurred in 14, 28 and 39 days.
	Spleen ..	,,	,,	9	3	Two died in 25 and 34 days; one killed in 58 days.
	Lungs ...	,,	,,	9	3	One died in 20 days; two killed in 58 days.
XCI.	Liver ...	2%	30	—	2	General tuberculosis in both.

B.—Pigs affected with avian tuberculosis.

XV.	Spleen ...	1%	60	6	2	Both killed in 48 days. No lesions of tuberculosis.
	Liver ...	,,	,,	20	2	Both died in from one to three days.
	Lungs ...	,,	,,	12	2	Both killed in 48 days. No lesions of tuberculosis.
XVII.	Lungs ...	2%	40	14	2	Both killed in 42 days. No lesions of tuberculosis.
XXIX.	Spleen ...	1%	45	5	2	One died in 33 days; one killed in 43 days. No lesions of tuberculosis, but a culture of avian tubercle bacilli from the spleen of the latter.
	Liver ...	,,	,,	30	3	All died in one day.
	Muscle	,,	,,	3·5	1	Died in 36 days. No lesions of tuberculosis.
XXXIX.	Spleen ...	2%	60	10·5	3	All died in from 10 to 22 days. No lesions of tuberculosis.
	Liver ...	,,	,,	12	3	All died in one day.
	Lungs ...	,,	,,	13·5	3	One died in 34 days; two killed in 44 days. No lesions of tuberculosis.

* In these cases the inoculation experiments were all negative, with the exception of the last.

TABLE XII.—*continued.*

Number of pigs.	Tissue inoculated.	Strength of anti-formin	Time of exposure in minutes.	Weight of tissue inoculated, in grammes.	Number of guinea-pigs inoculated.	Duration of life and result.
XLIV.	Liver ...	2%	60	28	8	One died in 12 days; three died in from 30 to 40 days; four killed in 42 days. No lesions of tuberculosis.
	Lungs ...	"	"	18	6	One died in nine days; three died in from 30 to 39 days; two killed in 42 days. No lesions of tuberculosis.
LIII.	Lungs ...	2%	40	20	5	Three died in from 14 to 28 days; two killed in 42 days. No lesions of tuberculosis except in one of the latter two, which showed caseation of the pyloric gland (tubercle bacilli found and culture obtained); from the spleen of the same animal a culture of avian tubercle bacilli was obtained.
LXIV.	Spleen ...	2%	70	9	3	One died in 32 days; two killed in 39 days. No lesions of tuberculosis.
LXVI.	Liver ...	2%	60	20·4	5	All killed in 36 days; none showed lesions of tuberculosis, but from the spleen of one a culture of avian tubercle bacilli was obtained.
	"	"	"	12	3	Three died in from three to eight days.
LXVII.	Spleen ...	2%	50	16·8	4	Two died in 14 and 29 days; two killed in 34 days. No lesions of tuberculosis.
	Liver	2% 1%	50 40	20	4	All killed in 34 days. No lesions of tuberculosis.
	Lungs ...	2%	50	12	4	All killed in 34 days. No lesions of tuberculosis.
LXVIII.	Spleen ...	1%	75	14	4	Two died in 23 and 40 days; two killed in 46 days. Lesions of tuberculosis in none. Cultures from spleens of last two negative.
	"	"	"	7	2	One died in 17 and one in 18 days.
	Liver ...	"	"	10	5	Death occurred in 2, 3, 6, 14 and 14 days.
LXXII.	Spleen ...	5%	45	10	5	Four died in 23, 36, 47 and 15 days; one killed in 53 days. Lesions of tuberculosis in none. Cultures from spleens of last two negative.

Part II.

EXPERIMENTS ON THE PRODUCTION OF LOCALISED TUBERCULOSIS IN PIGS BY FEEDING WITH MAMMALIAN TUBERCLE BACILLI.

Introduction.

In the preceding part of this Report the work on naturally acquired tuberculosis has furnished ample evidence that tubercle bacilli of avian type may be ingested by the pig and infect its tissues without causing lesions except in the glands of the alimentary tract. But as regards the possibility of similar latent dissemination of mammalian tubercle bacilli, the data therein reported are insufficient to justify a general statement. Had the material received at the laboratory from the slaughter-house always been perfectly fresh, and had it been possible, by direct inspection of the local lesion, to distinguish with certainty the avian from the mammalian cases, further examination of slaughter-house material of the latter type would probably have served to elucidate this point. Experience showed, however, that the material received was often not sufficiently fresh for animal inoculation in suitable bulk, nor was it possible to decide from inspection of the local lesion in cases of slight tuberculosis whether the infection was due to the avian or to the mammalian bacillus. Hence it was found expedient to attempt the experimental production of localised tuberculosis by feeding pigs with small doses of tested strains of mammalian bacilli. In this way the unnecessary investigation of further cases of avian tuberculosis was obviated, and it was easy to obtain, under fuller precautions than are feasible at a slaughter-house, a supply of apparently normal tissues which could be inoculated into guinea-pigs in adequate quantity without the risk of causing premature death owing to post-mortem infection of the pig's tissues with extraneous organisms.

In the last week of July, 1912, six pigs, aged four months, were obtained from a model farm near Cambridge. After arrival their temperatures were taken for several days and were found to be sufficiently steady for a tuberculin test, which was made on August 3rd, ·3 cc. of old tuberculin from Meister, Lucius, and Bruning being inoculated subcutaneously at the root of the ear. A negative result was obtained in each case.

The pigs were then fed with culture from Pig XXI., the cultural characters and virulence of which were typical of the bovine tubercle bacillus. Each pig was fed separately. The estimated dose of culture in normal saline solution was poured into sterile milk in the feeding trough ; the mixture was readily drunk by the pig.

A second batch of six pigs was fed on October 31st, with the same virus as the first, after the tuberculin test, following the same procedure as before, had been applied with negative results.

A third batch of six pigs, also proved free from tuberculosis by application of the tuberculin test, was fed on February 4th, 1913. Four of the pigs received the same virus as the former. The remaining two were fed with culture from Pig LXXV., a mammalian virus of abundant cultural growth, virulent for guinea-pigs and of low virulence for rabbits.

Detailed Records of the Feeding Experiments.

Pig 1.

Fed on August 3rd, 1912, when four months old, with ·01 mg. of culture of tubercle bacilli of bovine type.

Tested with ·3 cc. of tuberculin on October 23rd, 1912, with negative result.

Fed on October 30th, 1912, with ·01 mg. of culture of bovine tubercle bacilli.

Killed on January 16th, 1913.

Duration of experiment—166 days.

Post-mortem Results.

Left submaxillary lymphatic glands.—The glands in front of the salivary gland were normal in appearance. They were inoculated into three guinea-pigs, which were found healthy when killed six weeks afterwards.

One gland (anterior cervical), posterior to the salivary gland was firm and yellowish but not tuberculous in appearance. It was inoculated into two guinea-pigs, which were found healthy when killed six weeks afterwards.

Right submaxillary lymphatic glands.—These were normal in appearance. Portions were inoculated into three guinea-pigs, each of which died from acute infection in from two to five days.

Mesenteric glands.—Normal in appearance. Portions were inoculated into three guinea-pigs, which were found free from tuberculosis when killed six weeks afterwards.

All other tissues.—Macroscopically normal.

Summary.

No macroscopic evidence of tuberculosis; all the guinea-pigs inoculated remained free from tuberculosis.

Pig 2.

Fed on August 3rd, 1912, when four months old, with ·01 mg. of culture of tubercle bacilli of bovine type.

Tested with ·3 cc. of tuberculin on October 23rd, 1912, with negative result.

Killed on October 29th, 1912.

Duration of experiment—87 days.

Post-mortem Results.

Right submaxillary lymphatic glands.—These on careful section appeared normal. They were inoculated (weight 4 gms.) into four guinea-pigs, which were killed 44 days afterwards and all found to be healthy.

Left submaxillary lymphatic glands.—These on careful section appeared normal. They were inoculated (weight 4 gms.) into four guinea-pigs, all of which developed general tuberculosis.

Mesenteric glands.—All normal in appearance. Seven gms. were inoculated into five guinea-pigs, all of which were found healthy when killed 44 days afterwards.

All other tissues.—Macroscopically normal.

Summary.

There were no visible lesions of tuberculosis, but tubercle bacilli were present in the left submaxillary lymphatic glands.

PIG 3.

Fed on August 3rd, 1912, when four months old, with ·001 mg. of culture of tubercle bacilli of bovine type.

Tested with ·3 cc. of tuberculin on October 23rd, 1912, with negative result.

Killed on October 30th, 1912.

Duration of experiment—88 days.

Post-mortem Results.

All the tissues were macroscopically normal; no further investigations were made.

PIG 4.

Fed on August 3rd, 1912, when four months old, with ·001 mg. of culture of tubercle bacilli of bovine type.

Tested with ·3 cc. of tuberculin on October 23rd, 1912; with positive result.

Killed on October 29th, 1912.

Duration of experiment—87 days.

Post-mortem Results.

Submaxillary lymphatic glands.—On both sides the glands anterior to the salivary glands were tuberculous. They were only moderately enlarged and were closely beset with discrete, caseous nodules, the largest measuring between 3 and 4 mm. in diameter.

Mesenteric glands.—Macroscopically normal.

Lungs.—Beneath the pleura were two minute grey tubercles with opaque centres. One of these, together with the surrounding tissue, weighing 9·5 gms., was emulsified and inoculated into five guinea-pigs, all of which developed tuberculosis.

The remainder of the lung tissue was macroscopically normal. 22·5 gms. of this tissue were removed from various parts of the lungs and inoculated into 11 guinea-pigs, all of which were found to be free from tuberculosis when killed 43 days afterwards.

Bronchial glands.—Macroscopically normal. Portions weighing 2·1 gms. were inoculated into three guinea-pigs, all of which were found to be free from tuberculosis when killed 43 days afterwards.

Liver.—Three grey foci of doubtful nature were found. These, together with the surrounding tissue, weighing 1 gm., were inoculated into two guinea-pigs, which were found free from tuberculosis when killed 43 days afterwards.

The remainder of the liver was macroscopically normal. Portions from various sites were removed for inoculation. 36 gms. were inoculated into 13 guinea-pigs, all of which were found free from tuberculosis when killed six weeks afterwards. Another guinea-pig, inoculated with 4 gms., died in 31 days; another, inoculated with 2 gms., died in 29 days; both were found free from tuberculosis. In addition, three guinea-pigs, inoculated with various doses, died in less than three weeks but were found free from tuberculosis.

Spleen.—Macroscopically normal. 47·3 gms. were inoculated into 19 guinea-pigs, all of which failed to show tuberculosis when killed six weeks afterwards. One additional guinea-pig died prematurely (in 16 days) after inoculation with 1 gm., and was found free from tuberculosis.

All other tissues.—Normal.

Summary.

Tuberculosis of the submaxillary lymphatic glands and of a piece of lung which contained a minute tuberculous focus. All other tissues free from tubercle bacilli, as shown by animal tests with 22·5 gms. of lung, 2·1 gms. of bronchial glands, 42 gms. of liver, and 47·3 gms. of spleen.

PIG 5.

Fed on August 3rd, 1912, when four months old, with ·0001 mg. of culture of tubercle bacilli of bovine type.*

Tested with ·3 cc. of tuberculin on October 21st, 1912, with negative result.

Fed on October 30th, 1912, with ·1 mg. of culture of tubercle bacilli of bovine type.

Killed on January 16th, 1913.

Duration of experiment—166 days.

Post-mortem Results.

Left submaxillary lymphatic glands.—One, the largest, contained four tubercles, the smallest a minute focus; the two largest were yellow, caseous, gritty and the size of millet seed. No other lesions were seen. Three guinea-pigs were inoculated with apparently normal tissue and were found healthy when killed 42 days afterwards.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found healthy when killed 56 days afterwards.

Mesenteric glands.—In one gland there was a yellow, caseous, gritty nodule, with fine, gritty streaks; it was larger than a hemp seed and easily shelled out from the surrounding tissue. The other mesenteric glands appeared normal. Three guinea-pigs were inoculated with the apparently normal tissue; one was found free from tuberculosis when it died 36 days afterwards; the other two were found healthy when killed 56 days after inoculation.

Lungs.—Apparently normal. Twelve guinea-pigs were inoculated, each with 2·4 gms. of tissue; 11 of these died from acute infection in from one to four days; the twelfth was found healthy when killed 56 days after inoculation.

Bronchial glands.—Normal.

Liver.—Apparently normal. 25 guinea-pigs were inoculated, each with 2·7 gms. Eight died prematurely; one died in 23 days and was found free from tuberculosis; sixteen were found healthy when killed in from six to eight weeks after inoculation.

Spleen.—Apparently normal. Eighteen guinea-pigs were inoculated, each with 2 gms. One died 27 days afterwards and was found free from tuberculosis; 17 were found free from tuberculosis when post-mortemed from six to eight weeks after inoculation.

All other tissues.—Normal.

* On each of the five following days, Pigs 5 and 6 shared in their ordinary food a single dose of ·0001 mg.

Summary.

Macroscopic tuberculosis in one submaxillary lymphatic gland and one mesenteric gland; no tubercle bacilli in apparently normal tissue, as shown by three guinea-pigs inoculated with left submaxillary glands, three inoculated with right submaxillary glands, three inoculated with mesenteric glands, one inoculated with 2·4 gms. of lung, 17 inoculated with 45·9 gms. of liver, and 18 inoculated with 36 gms. of spleen.

PIG 6.

Fed on August 3rd, 1912, when four months old, with ·0001 mg. of culture of tubercle bacilli of bovine type.

Tested with ·3 cc. of tuberculin on October 23rd, 1912, with negative result.

Fed on October 30th, 1912, with ·1 mg. of culture of tubercle bacilli of bovine type.

Killed on January 17th, 1913.

Post-mortem results.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found free from tuberculosis. One died in 29 days; the other two were killed in 42 days.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found healthy when killed 42 days afterwards.

Mesenteric glands.—One gland, about the size of a thrush's egg, was found on section to be composed throughout of caseo-necrotic tissue in which were yellowish caseous patches and fine streaks, rather more opaque but not obviously gritty. The whole mass readily shelled out, leaving only the capsule, which was slightly thickened. In a smear two tubercle bacilli were found.

Lungs.—There were scattered, minute hæmorrhagic points on the surface. In the left anterior margin was a minute grey tubercle which contained a gritty centre. In the posterior lobe of the right lung there was a yellowish tubercle, less than a rape seed, with a fibrous capsule in a soft caseous centre. In smear preparations two tubercle bacilli were seen in one of three tubercles and one in another.

The rest of the lung tissue appeared normal. Portions of it were inoculated into 18 guinea-pigs, each receiving 1·5 gms. Two died prematurely and a third, showing no tuberculosis, in 22 days; 14 were found free from tuberculosis when post-mortemed from six to eight weeks after inoculation. One killed in 56 days was found affected with tuberculosis which from its distribution was obviously due to spontaneous infection.

Liver.—There were two minute opaque tubercles. In a smear no tubercle bacilli were seen.

The rest of the tissue appeared normal. Portions were inoculated into 18 guinea-pigs, each receiving two gms.; five died prematurely; eight were found tuberculous; five were found free from tuberculosis when killed seven weeks after inoculation.

Portal glands.—In one there was an irregular caseous focus. In a smear no tubercle bacilli were seen.

Spleen.—Apparently normal. Portions were inoculated into 18 guinea-pigs, each receiving two gms. Two died prematurely; 16 were found free from tuberculosis when killed seven weeks after inoculation.

All other tissues.—Normal.

Summary.

Submaxillary lymphatic glands free from tubercle bacilli; one mesenteric gland tuberculous; two minute tubercles in the lungs. 22·5 gms. of the apparently normal tissue failing to infect 14 guinea-pigs; tubercle bacilli present in the liver apart from visible lesions; spleen normal, 32 gms. failing to infect 16 guinea pigs.

PIG 7.

Fed on October 31st, 1912, when four months old, with ·001 mg. of tubercle bacilli of bovine type.

Killed on January 23rd, 1913.

Duration of experiment, 84 days.

Post-mortem Results.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated. One died prematurely; the other two were found healthy when killed 61 days after inoculation.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated. One died prematurely; the other two were found free from tuberculosis when post-mortemed 29 and 47 days after inoculation.

All other tissues.—Normal.

Summary.

No visible tuberculosis. Submaxillary lymphatic glands failed to infect guinea-pigs.

PIG 8.

Fed on October 31st, 1912, when 4 months old, with ·001 mg. of culture of tubercle bacilli of bovine type.

Killed on January 23rd, 1913.

Duration of experiment—84 days.

Post-mortem Results.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated. One died prematurely; the other two were found healthy when killed 51 days after inoculation.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated, and were found free from tuberculosis when post-mortemed 34, 51, and 51 days after inoculation.

All other tissues.—Normal.

Summary.

No visible tuberculosis. Submaxillary lymphatic glands failed to infect guinea-pigs.

PIG 9.

Fed on October 31st, 1912, when 4 months old, with ·01 mg. of tubercle bacilli of bovine type.

Killed on January 23rd, 1913.

Duration of experiment—84 days.

Post-morten Results.

Left submaxillary lymphatic glands.—Two were normal. A third, the size of a pigeon's egg, was about two-thirds replaced by caseo-necrotic tissue with opaque gritty streaks; the remainder was translucent and beset with opaque caseous foci.

Right submaxillary lymphatic glands.—Two were normal. A third resembled the tuberculous gland on the other side, but was caseo-necrotic almost throughout. A fourth contained a small collection of caseous tubercles.

Mesenteric glands.—These contained caseo-necrotic nodules up to a robin's egg in size.

Lungs.—There were sparsely scattered minute, caseating tubercles.

Bronchial glands.—One showed a caseous focus.

Liver.—Similar to the lungs.

Portal glands.—There were a moderate number of minute caseous foci.

Spleen.—Normal.

Kidneys.—Normal.

Summary.

Disseminated tuberculosis.

PIG 10.

Fed on October 31st, 1912, when four months old, with ·01 mg. of tubercle bacilli of bovine type.

Killed on January 23rd, 1913.

Duration of experiment—84 days.

Post-mortem Results.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found free from tuberculosis when post-mortemed 6 weeks after inoculation.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated. One died prematurely; the other two were found free from tuberculosis when post-mortemed 30 and 46 days after inoculation.

Mesenteric glands.—Two small ileo-colie glands were partly caseous. A third showed two caseous foci. In a smear tubercle bacilli were moderately numerous.

Lungs.—Normal.

Bronchial glands.—Normal.

Liver.—In the substance were two minute tubercles.

Portal glands.—Caseous foci were found.

Spleen.—Normal.

Kidneys.—Normal.

Summary.

Disseminated tuberculosis.

PIG 11.

Fed on October 31st, 1912, when four months old, with ·1 mg. of tubercle bacilli of bovine type.
Killed on January 24th, 1913.
Duration of experiment—85 days.

Post-mortem Results.

Submaxillary and cervical lymphatic glands.—Normal.
Mesenteric glands.—The majority were entensively tuberculous, being enlarged and replaced by caseo-necrotic tissue.
Lungs.—There were scattered minute, caseating tubercles.
Bronchial glands.—Several showed small caseous patches.
Liver.—There were scattered minute, grey tubercles with caseous centres.
Portal glands.—Three showed caseous patches.
Spleen.—Normal.
Kidneys.—Two or three tubercles were seen in each.

Summary.

Disseminated tuberculosis.

PIG 12.

Fed on October 31st, 1912, when four months old, with ·1 mg. of tubercle bacilli of bovine type.
Killed on January 24th, 1913.
Duration of experiment—85 days.

Post-mortem Results.

Right submaxillary lymphatic glands.—There was a gland, the size of a pheasant's egg, composed of firm, translucent tissue beset with caseous, gritty masses.
Left submaxillary lymphatic glands.—There was a gland, the size of a partridge's egg, which resembled the tuberculous gland on the other side.
Mesenteric glands.—Many were enlarged and caseous.
Lungs.—There were scattered caseating tubercles up to a millet seed in size.
Bronchial glands.—These contained discrete caseous tubercles and patches.
Liver.—Similar to the lungs.
Portal glands.—Similar to the bronchial.
Spleen.—In the substance were two tubercles, one the size of a rape seed, the other of a millet seed.
Inguinal and cervical glands.—Normal.

Summary.

Disseminated tuberculosis.

PIG 13.

Fed on February 4th, 1913, when four months old, with 10 mg. of tubercle bacilli cultivated from Pig LXXV., a virus of human type.
Killed on May 1st, 1913.
Duration of experiment—86 days.

Post-mortem Results.

Submaxillary lymphatic glands.—Two on each side were slightly enlarged and contained discrete, soft, yellow, caseous and slightly gritty nodules varying up to a small pea in size and easily shelling out. Tubercle bacilli were scanty. One or two glands on each side were small and appeared normal.

Mesenteric glands.—The majority contained discrete, yellow, caseous tubercles, easily shelling out.

Lungs.—There were three small, translucent tubercles, with caseous centres; no tubercle bacilli were seen in two smears. Twelve guinea-pigs were inoculated with apparently normal lung tissue, each receiving 2 gms. One died premature; eleven were killed in 42 days; ten of these were found healthy; in the remaining one there was early general tuberculosis.

Bronchial glands.—Normal.

Liver.—One minute, opaque tubercle and two grey nodules, up to small pea in size, were found. The nodules were inoculated into two guinea-pigs, which were found healthy when killed 42 days afterwards. Twelve guinea-pigs were inoculated with apparently normal liver tissue, six receiving 3 gms. each and six 3·5 gms. each. Two, which died in 28 and 33 days, were found free from tuberculosis; the remaining ten were found healthy when killed six weeks after inoculation.

Portal glands.—Normal.

Spleen.—Apparently normal. Sixteen guinea-pigs were inoculated, each receiving 2 gms. One, which died in 23 days, was found free from tuberculosis; the remaining 15 were found free from tuberculosis when killed six weeks after inoculation.

Summary.

Tuberculosis of the submaxillary and mesenteric glands. Three minute tubercles in the lungs; of 22 gms. of apparently normal lung tissue, 20 were free from tubercle bacilli but two were tuberculous. No tubercle bacilli in the liver, as shown by the inoculation of 39 gms. No tubercle bacilli in the spleen, as shown by the inoculation of 30 gms.

PIG 14.

Fed on February 4th, 1913, when 4 months old, with 50 mg. of tubercle bacilli cultivated from Pig LXXV., a virus of human type.

Killed on May 1st, 1913.

Duration of experiment—86 days.

Post-mortem Results.

Submaxillary lymphatic glands.—Two on each side were slightly enlarged and beset with small yellow, caseous and gritty patches and tubercles. Tubercle bacilli were very scanty.

Mesenteric glands.—Almost all were slightly enlarged, feeling a little firm, and beset with small, yellow, caseous and gritty patches and tubercles, not readily separated from the surrounding tissue. In a smear no tubercle bacilli were seen.

Lungs.—Apparently normal. 14 guinea-pigs were inoculated, each receiving 2 gms. Two died prematurely; of the remainder, killed

six weeks after inoculation, six were tuberculous and six were healthy.

Bronchial glands.—Normal.

Liver.—Four submiliary tubercles were seen beneath the surface and one in the substance. These were inoculated into two guinea-pigs and produced general tuberculosis.

Apparently normal liver tissue was inoculated into 20 guinea-pigs, each receiving 2·6 gms. Two died prematurely; of the remainder, killed six weeks after inoculation, two were tuberculous and 16 were healthy.

Portal glands.—Two indefinite opague foci, in which no tubercle bacilli could be found.

Spleen.—Apparently normal. 11 guinea-pigs were inoculated, each receiving 2·5 gms. One which died 31 days after inoculation was found free from tuberculosis. The remainder were found healthy when killed six weeks after inoculation.

Summary.

Tuberculosis of the submaxillary and mesenteric glands and four minute tubercles in the liver. Of 24 gms. of apparently normal lung, 12 were tuberculous and 12 were free tubercle bacilli. Of 46·8 gms. of apparently normal liver, 5·2 were tuberculous and 41·6 were free from tubercle bacilli. 27·5 gms. of apparently normal spleen were found free from tubercle bacilli.

PIG 15.

Fed on February 4th, 1913, when four months old, with ·005 mg. of tubercle bacilli of bovine type.

Killed on April 30th, 1913.

Duration of experiment—85 days.

Post-mortem Results.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated; one died prematurely; in the other two, which died in 35 and 37 days, no tuberculosis was found.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found healthy when killed six weeks afterwards.

Mesenteric glands.—Normal, except for one minute, indefinite, opaque focus in which no tubercle bacilli could be found.

Other organs.—Normal.

Summary.

The animal escaped infection.

PIG 16.

Fed on February 4th, 1913, when four months old, with ·005 mg. of tubercle bacilli of bovine type.

Killed on April 30th, 1913.

Duration of experiment—85 days.

Post-mortem Results.

Right submaxillary lymphatic glands. — Apparently normal. Three guinea-pigs were inoculated and were found free from tuberculosis when killed six weeks afterwards.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found free from tuberculosis when killed six weeks afterwards.

Other organs.—Normal.

Summary.

The animal escaped infection.

PIG 17.

Fed on February 4th, 1913, when four months old, with ·002 mg. of tubercle bacilli of bovine type.

Killed on April 29th, 1913.

Duration of experiment—84 days.

Post-mortem Results.

Submaxillary lymphatic glands.—Normal on both sides.

Mesenteric glands.—One, measuring $3{\cdot}7 \times 2 \times 1{\cdot}7$ cm., was three-fourths composed of grey tissue with a close, gritty, caseous network; the remaining fourth contained scattered caseous foci. The other glands were normal.

Lungs.—Apparently normal. Seventeen guinea-pigs were inoculated, each receiving 2 gms. General tuberculosis was produced in 11; the remaining six were found healthy when killed six weeks after inoculation.

Bronchial glands.—Normal.

Liver.—Just beneath the surface were four uniformly grey translucent nodules, up to a millet seed in size. On section there were found six translucent nodules, some with minute opaque points, up to a millet seed in size, and two fibrous nodules, the size of hemp seed, with chalky centres. In a smear no tubercle bacilli were seen. The nodules were inoculated into two guinea-pigs, in which they produced general tuberculosis. Nineteen guinea-pigs were inoculated with apparently normal liver tissue, each receiving 2·5 gms. Tuberculosis was produced in nine; of the remaining ten, two, which died in 35 and 37 days, were found free from tuberculosis, and eight were found healthy when killed six weeks after inoculation.

Portal glands.—In the cortices of two were several small patches of minute, irregular, opaque, yellow foci, in one of which distinct grittiness was detected. In a smear one tubercle bacillus was seen.

Spleen.—No visible tuberculosis; Malpighian bodies prominent. Fifteen guinea-pigs were inoculated, each receiving 2 gms. One died prematurely; the remaining 14 were found healthy when killed six weeks after inoculation.

Summary.

Tuberculosis of a mesenteric gland. Of 34 grammes of apparently normal lung, 22 were found tuberculous and 12 free from tubercle bacilli. Of 47·5 grammes of apparently normal liver, 22·5 were found tuberculous, and 25 free from tubercle bacilli. 28 grammes of apparently normal spleen were found free from tubercle bacilli.

FIG. 18.

Fed on February 4th, 1913, when four months old, with ·002 mg. of tubercle bacilli of bovine type.

Killed on April 29th, 1913.

Duration of experiment.—84 days.

Post-mortem Results.

Left submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were found healthy when killed six weeks afterwards.

Right submaxillary lymphatic glands.—Apparently normal. Three guinea-pigs were inoculated and were killed six weeks afterwards; two were healthy; the third was affected with tuberculosis, which was obviously due to spontaneous infection.

Mesenteric glands.—Normal.

Lungs and bronchial glands.—Normal.

Liver.—A few scattered translucent nodules similar to those in Pig 17.

Portal glands.—Normal.

Spleen.—Normal.

Summary.

No evidence of tuberculosis.

TABLE XIII.—*Distribution of lesions in pigs fed with culture of mammalian tubercle bacilli.*

All the pigs except 13 and 14 were fed with virulent bovine cultures 10–14 days old on serum.

Number of pig and dose.	Duration of Experiment.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.
1. ·01 mg.; 88 days later, ·01 mg.	166 days	Nil visible; inoculation experiments negative.	Nil visible; inoculation experiments negative.	Nil	Nil	Nil	Nil	Nil
2. ·01 mg. ...	87 „	No visible lesions, but the left glands produced tuberculosis in guinea-pigs.	Nil	Nil	Nil	Nil	Nil	Nil
3. ·001 mg. ...	88 „	Nil	Nil	Nil	Nil	Nil	Nil	Nil
4. ·001 mg. ...	87 „	On both sides moderately enlarged and beset with discrete caseous nodules.	Nil	Two minute grey tubercles with opaque centres.	Nil	Three grey foci, of doubtful appearence, which failed to infect guinea-pigs.	Nil	Nil
5. ·0001 mg.; 88 days later, ·1 mg.	166 „	One gland contained three small caseo-calcareous tubercles.	A small caseo-calcareous nodule in one.	Nil	Nil	Nil	Nil	Nil
6. ·0001 mg.; 88 days later, ·1 mg.	167 „	Nil visible; inoculation experiments negative.	One completely caseous.	Two minute tubercles.	Nil	Two minute tubercles and T.B. found in apparently normal tissue.	One caseous focus.	Nil

7. ·001 mg. ...	84 „	Nil visible; inoculation experiments negative.	Nil	Nil	Nil	Nil	Nil	Nil
8. ·001 mg. ...	84 „	Nil visible; inoculation experiments negative.	Nil	Nil	Nil	Nil	Nil	Nil
9. ·01 mg. ...	84 „	On each side one was caseo-necrotic; a third contained a few tubercles.	Numerous large caseo - necrotic nodules.	Scanty minute, caseating tubercles.	One caseous focus.	Scanty minute, caseating tubercles.	Several minute caseous foci.	Nil
10. ·01 mg. ...	84 „	Nil visible; inoculation experiments negative.	Two small ileo-colic glands were partly caseous and there were caseous foci in a third.	Nil	Nil	Two minute tubercles.	Some caseous foci.	Nil
11. ·1 mg. ...	85 „	Nil	Enlarged and extensively tuberculous.	Scattered minute, caseating tubercles.	Several contained small caseous patches.	Scattered minute, caseating tubercles.	Caseous patches in three.	Nil
12. ·1 mg. ...	85 „	On each side one was enlarged and caseo-calcareous.	Many were enlarged and caseous.	Small scattered, caseating tubercles.	Discrete caseous tubercles and patches.	Small scattered, caseating tubercles.	Discrete caseous tubercles and patches.	Two small tubercles.
*13. 10 mg. (human).	86 „	On each side two were enlarged and contained caseous nodules.	The majority contained discrete caseous tubercles.	Three small translucent tubercles with caseous centres and T.B. found in apparently normal tissue.	Nil	One minute opaque tubercle and two small grey nodules which failed to infect guinea-pigs.	Nil	Nil

* These pigs were fed with culture of "human" (eugonic) bacilli 14 days old on serum.

TABLE XIII.—*continued.*

Number of pig and dose.	Duration of Experiment.	Submaxillary lymphatic glands.	Mesenteric glands.	Lungs.	Bronchial glands.	Liver.	Portal glands.	Spleen.
*14. 50 mg. (human).	86 days	On each side two were slightly enlarged and contained caseous, gritty areas.	All slightly enlarged and contained discrete caseous and gritty areas.	Nil visible, but T.B. found in apparently normal tissue.	Nil	Five submiliary tubercles, and T.B. found in apparently normal tissue.	No definite tubercles.	Nil
15. ·005 mg. ...	85 „	Nil visible; inoculation experiments negative.	Nil definite	Nil	Nil	Nil	Nil	Nil
16. ·005 mg. ...	85 „	Nil visible; inoculation experiments negative.	Nil	Nil	Nil	Nil	Nil	Nil
17. ·002 mg. ...	84 „	Nil	One caseo-calcareous almost throughout.	Nil visible, but T.B. found in apparently normal tissue.	Nil	A few miliary tubercles and T.B. found in apparently normal tissue.	Several tuberculous foci.	Nil
18. ·002 mg. ...	84 „	Nil visible; inoculation experiments negative.	Nil	Nil	Nil	A few doubtful nodules.	Nil	Nil

* These pigs were fed with culture of "human" (eugonic) bacilli 14 days old on serum.

TABLE XIV.—*Intraperitoneal inoculation experiments on guinea-pigs with apparently normal tissues from pigs fed with cultures of mammalian tubercle bacilli.*

Number of pig.	Tissue inoculated.	Weight of portion inoculated.	Number of guinea-pigs inoculated.	Post-mortem results.	
				Guinea-pigs free from tuberculosis.	Guinea-pigs tuberculous.
		Gms.			
2	Submaxillary glands (right).	4	4	All killed in 44 days.	
	Submaxillary glands (left).	4	4		All developed general tuberculosis.
	Mesenteric glands ...	7	5	All killed in 44 days.	
4	Bronchial glands ...	2·1	3	All killed in 43 days.	
	*Lungs	22·5	11	All killed in 43 days.	
	Liver	42	15	Thirteen killed in 42 days; one died in 29 days, and one in 31 days.	
	Spleen	47·3	19	All killed in 42 days.	
5	Submaxillary glands (right).		3	All killed in 56 days.	
	*Submaxillary glands (left).		3	All killed in 42 days.	
	*Mesenteric glands ...		3	Two killed in 56 days; one died in 36 days.	
	Lungs	2·4	1	Killed in 56 days.	
	Liver	45·9	17	One died in 23 days; 16 killed in six to eight weeks.	
	Spleen	36	18	One died in 27 days; 17 were killed or died in six to eight weeks.	
6	Submaxillary glands (right).		3	All killed in 42 days.	
	Submaxillary glands (left).		3	Two killed in 42 days; one died in 29 days.	
	*Lungs	22·5	15	One died in 22 days; 14 were killed or died in six to eight weeks.	
	*Liver	26	13	Five killed in seven weeks.	Eight developed tuberculosis.
	Spleen	32	16	All killed in seven weeks.	
13	*Lungs	22	11	Ten killed in 42 days.	One developed tuberculosis.
	Liver	39	12	Two died in 28 and 33 days; 10 were killed in six weeks.	
	Spleen	30	15	All killed in six weeks.	

* The whole of the inoculated tissue, after careful dissection, was found free from visible lesions, but elsewhere in the same specimens scanty and minute foci of tuberculosis were seen.

TABLE XIV.—*continued.*

Number of pig.	Tissue inoculated.	Weight of portion inoculated.	Number of guinea-pigs inoculated.	Post-mortem results.	
				Guinea-pigs free from tuberculosis.	Guinea-pigs tuberculous.
		Gms.			
14	Lungs	24	12	Six killed in six weeks	Six developed tuberculosis.
	*Liver	46·8	18	Sixteen killed in six weeks.	Two developed tuberculosis.
	Spleen	27·5	11	One died in 31 days; 10 were killed in six weeks.	
17	Lungs	34	17	Six were killed in six weeks.	Eleven developed tuberculosis.
	*Liver	47·5	19	Two died in 35 and 37 days; eight were killed in six weeks.	Nine developed tuberculosis.
	Spleen	28	14	All killed in six weeks.	

* The whole of the inoculated tissue, after careful dissection, was found free from visible lesions, but elsewhere in the same specimens scanty and minute foci of tuberculosis were seen.

GENERAL RESULTS OF THE ENQUIRY.

Part I.

Source and Character of Material Investigated.

During this enquiry the tissues of 100 pigs obtained from the slaughter-house have been investigated in the laboratory.

Thirty-four of these cases were obtained from Birmingham during the course of the inspectors' routine work at various slaughter-houses between March 8th, 1911, and November 26th, 1912; they were all sent for examination as cases of localised tuberculosis, but no information is available as to the proportion of these to the total number which may have been localised. The remaining 66 were obtained from the Brighton Borough Abattoir. Between January 25th, 1911, and January 16th, 1913, every pig killed at this slaughter-house was specially examined with a view to ascertaining whether it was a suitable case for the present enquiry. During this period the total number of pigs killed was 24,144; of these, 209 were found by the inspector to be affected with generalised tuberculosis, 393 with slightly disseminated tuberculosis, and 59 with localised tuberculosis. All the last mentioned 59 cases were sent to the laboratory and were examined, together with seven of the cases of slight dissemination.

Of the 34 Birmingham pigs, the tuberculosis in nine has been proved by cultural and experimental investigation to be due to infection by the avian tubercle bacillus, and therefore caused in all probability by ingestion of the excreta of fowls affected with this disease. Twenty-two of the cases have been proved, culturally and by animal experiment, to be instances of infection with mammalian tubercle bacilli. These include one where there was a double infection,

the mesenteric glands yielding a pure culture of avian bacilli and the submaxillary glands a pure strain of mammalian bacilli. The 22 mammalian strains all exhibited the typical cultural characteristics of tubercle bacilli of bovine origin. And 21 of these were also identical with the bovine bacillus in their high pathogenicity for rabbits; it is therefore probable that these bacilli were introduced by the ingestion of milk, fæcal excreta, or other material derived from tuberculous cattle. The remaining virus, though identical in cultural characters with tubercle bacilli of bovine origin, exhibited relatively low virulence for rabbits. In two of the three remaining cases the lesions were anatomically typical of tuberculosis, but the type of bacillus was not identified, as no living tubercle bacilli could be recovered from the lesions. In the third the lesions produced general tuberculosis of mammalian type in guinea-pigs, but a culture was not obtained.

The 59 Brighton cases which were sent as localised were investigated in the same way as the Birmingham cases. Seventeen were found to be due to infection with the avian tubercle bacillus; from two of these 17 cases an acid-fast bacillus other than a tubercle bacillus was also isolated. Twenty-five of the cases have been proved, culturally and by animal experiment, to be instances of infection with mammalian tubercle bacilli. Twenty-three of these mammalian strains were in cultural characters identical with tubercle bacilli of bovine origin, and, with one exception, were also typical of bovine bacilli in their high virulence for rabbits. One of these virulent strains was obtained from a case of double infection; the lesions in the submaxillary glands yielded a pure culture of "bovine" bacilli, whilst from apparently normal liver tissue there was obtained, through the guinea-pig, a culture which was eugonic in growth and, like the common eugonic bacillus of human origin, of low virulence for rabbits. One virus, though identical in cultural characters with tubercle bacilli of bovine origin, exhibited relatively low virulence for rabbits. The remaining strain differed from the above 23 in that it resembled the eugonic bacillus of human origin, being of abundant cultural growth and low virulence for rabbits. In two instances the lesions produced general tuberculosis of mammalian type in guinea-pigs but cultures were not obtained. Of the remaining 15 cases, eight were found after investigation not to be of a tuberculous nature, the remaining seven were anatomically typical of tuberculosis, but either owing to the bacilli being dead (5) or from some accidental cause (2), the type of bacillus could not be identified. Of the seven Brighton cases which were sent as examples of slightly disseminated tuberculosis, one was found not to be a case of tuberculosis, and in one the disease was too extensive to fall within the scope of the present enquiry; the remaining five were all due to infection with mammalian tubercle bacilli exhibiting cultural and experimental characters identical with those of tubercle bacilli of bovine origin.

The results with the material obtained from Birmingham and from Brighton may now be considered collectively. Tubercle bacilli have been obtained in culture from 78 pigs. The disease was due to infection with the avian tubercle bacillus in 26 pigs, with the typical bovine bacillus in 47 pigs, and with the typical eugonic "human" bacillus in one pig. One pig was infected with a mixture of typical avian and bovine bacilli, and one with a mixture of typical bovine and "human" bacilli. In two pigs infection was due to mammalian tubercle bacilli of atypical nature; these two viruses combined the cultural characters of the bovine bacillus with the relatively low

virulence of the eugonic "human" type. In two cases an acid-fast bacillus other than a tubercle bacillus was obtained, on both occasions in association with the avian tubercle bacillus.

Distribution of Lesions in Avian and Mammalian Tuberculosis.

The following is a summary of the distribution of the disease observed on careful naked-eye inspection of the 26 cases of avian infection. In 18 cases the submaxillary lymphatic or mesenteric glands alone were visibly tuberculous. In the remaining eight, in addition to tuberculosis of the above-mentioned groups of glands, minute tubercles were seen in one or more of the following tissues:—the lungs, the bronchial glands, the liver, and the portal glands.

In the 50 cases, sent as localised, where infection was found to be due to the mammalian tubercle bacillus, the distribution of visible disease was briefly as follows. In 16 cases the submaxillary lymphatic or mesenteric glands alone were visibly tuberculous. In 14 cases, in addition to tuberculosis of the above-mentioned groups of glands, minute disseminated lesions were seen, similar in character and distribution to those found in the cases of avian infection. In the remaining 20 cases the amount of visible dissemination was greater* ; it varied in quantity, being sometimes only slightly more than in the last-mentioned group of nine cases, but in other instances extending to general tuberculosis of the lungs, the bronchial glands, the liver, the portal glands, the spleen, and occasionally the inguinal glands. In fact the amount of dissemination was in some instances quite as great as that found in the seven cases sent as examples of slight dissemination.

It will thus be observed on comparing, as regards presence or absence of visible dissemination, the cases of avian infection with those cases where infection was due to mammalian bacilli, that in 18 avian and 16 mammalian cases the disease was strictly limited to the submaxillary or mesenteric glands ; in 8 avian and in 14 mammalian cases there was slight visible dissemination beyond these regions ; none of the avian cases showed more than such slight dissemination ; in the remaining mammalian cases the amount of dissemination was greater than in any of the avian cases.

Comparison of Primary Lesions in Avian and Mammalian Tuberculosis.

A comparison of the macroscopic disease in the submaxillary or mesenteric glands, produced respectively by the avian and the mammalian tubercle bacillus, brings out the following features : When the infection was due to the typical bovine bacillus, the glands were commonly enlarged, often to a marked extent, and frequently the adjacent glands had become fused into a coherent mass. On section the gland substance was often found to be partly or completely replaced by fibro-caseous, gritty material embedded in a firm, translucent matrix. When the infection was due to the avian bacillus,

* For the purpose of the laboratory investigation, the inspectors were asked to refrain from freely incising the tissues; hence their opportunities for examination were restricted and they were unable to guarantee that a case was strictly localised, but limited themselves to the statement that no tuberculosis was discoverable in any particular pig except in the specimens sent to the laboratory.

the glands were often not enlarged, and when enlargement was present, it was usually slight or only moderate in amount. On section, the glands were found to contain a varying number of caseous and gritty or calcareous nodules, which were easily shelled out of the surrounding gland tissue and left behind smooth, fibrous-walled cavities. But there were several instances where the macroscopic appearances failed to give correct indication of the type of bacillus causing the infection. For example, in Pigs LVIII and LXVI, where infection was due to the avian bacillus, the glands were moderately enlarged and the lesions were not encapsuled; again, in Pigs XXXVI and LXV, where infection was due to mammalian bacilli of bovine type, the glands were not definitely enlarged and the lesions, which were small and discrete, shelled out readily. The number of bacilli found in smear preparations from the affected glands was often an important indication of the nature of the bacillus. In a gland which, macroscopically, suggested avian infection, the presence of numerous bacilli gave support to this suspicion, which was confirmed generally, though not invariably, by subsequent investigation; but scarcity of bacilli, though usually associated with mammalian cases, was found to be inconclusive, as this condition also occurred in some of the avian infections.

Evidence of Dissemination apart from Visible Lesions.

The following are the results obtained with experiments designed to determine the presence or absence of tubercle bacilli in the apparently normal tissues of the tuberculous pigs obtained from the slaughter-house by the described method of selection. Portions of one or more of such tissues were investigated, by inoculation of guinea-pigs, in 19 cases where the infection in the pig was due to the avian bacillus; in six of these pigs the presence of tubercle bacilli was demonstrated in one or more of three apparently normal organs (lungs, liver, and spleen) and in a seventh case in the muscle. This capacity of the avian tubercle bacillus to reside in the tissues without causing a reaction leading to the production of manifest lesions is a characteristic which has been demonstrated in guinea-pigs as well as in swine. In 21 cases where the visible lesions in the glands of the alimentary tract were due to mammalian tubercle bacilli with the cultural characters of bovine bacilli evidence was sought as to the presence or absence of tubercle bacilli in apparently normal tissues, by methods identical with those which gave positive results with cases of avian infection. The tissues investigated were spleen, liver, and lungs, where these organs appeared normal, and muscle, where there was some visible dissemination in these organs. In every instance except one the search for tubercle bacilli in these tissues yielded negative results, but it should be noted that in some cases the quantity of tissue tested was small. Equally small quantities of tissue had, however, given positive results in some of the cases of avian infection. A positive and unexpected result was obtained with Pig XCI, the submaxillary gland of which yielded a culture of typical bovine bacilli; an emulsion of apparently normal liver tissue treated with antiformin produced general tuberculosis in two guinea-pigs, and the cultures from both of these animals were eugonic and of low virulence for rabbits.

Significance of slight foci of Dissemination in cases of Mammalian Tuberculosis.

As will be seen from reference to the Table of Guinea-pig Inoculations (see pp. 85–88) minute foci of visible dissemination

have been proved in several instances to contain living tubercle bacilli. Furthermore in Pig XLVIII, where the visible tuberculosis in the lungs was limited to a single minute tubercle, the inoculation of apparently normal tissue from this organ produced general tuberculosis in one out of five guinea-pigs. Results similar to this were obtained in our feeding experiments (see Part II, p. 125). On the other hand it must also be pointed out that in these small foci of visible dissemination living tubercle bacilli cannot always be demonstrated. The bronchial glands of Pig XCIX contained small caseous, gritty nodules, and two tubercle bacilli were seen in a smear preparation, but inoculation of this material failed to produce tuberculosis in a guinea-pig.

The Frequency of Macroscopically Localised Tuberculosis.

The following is a summary of the evidence furnished by the present enquiry as to the frequency of localised tuberculosis in swine (*i.e.*, the occurrence at the time of slaughter of cases where visible tuberculosis had not extended beyond the glands in relation to the alimentary tract) and the type of bacillus causing the infection in such cases. Of the total 24,144 pigs killed at Brighton during the period of the enquiry, 661 were reported on inspection to be affected with tuberculosis (2·7 per cent.). Out of these 661 pigs disseminated lesions of tuberculosis were recognised at the slaughter-house in all but 59 (9 per cent. of 661 or ·2 per cent. of 24,144). The organs of all these 59 were submitted for full examination and dissection in the Board's Laboratory, with the result that only 24 were found to be strictly localised (3·6 per cent. of 661 or ·1 per cent. of 24,144). These 24 cases include four where the bacilli were probably dead; in twelve the lesions were proved to be due to the avian tubercle bacillus; in the remaining eight they were due to mammalian tubercle bacilli (seven cases of local infection with typical "bovine" bacilli, including one where eugonic bacilli of "human" type were recovered from the apparently normal liver; and one case of infection with typical eugonic "human" bacilli). It is impossible to give equally complete statistics for the Birmingham pigs. Thirty-four cases were sent as apparently localised, subject to further examination for macroscopic disease in the laboratory, the result of which showed that only 15 were strictly localised. These 15 include one where the bacilli were apparently dead; in six the lesions were proved to be due to the avian tubercle bacillus; in the remaining eight they were due to mammalian tubercle bacilli (seven cases of infection with typical bovine bacilli, including one where avian bacilli were also present, and one case of infection with dysgonic bacilli of low virulence for rabbits).

Part II.

The following results have been obtained in feeding experiments performed upon 18 pigs with cultures of mammalian tubercle bacilli.

Experiments with Dysgonic Bacilli of High Virulence for Rabbits.

Out of 16 pigs fed with small doses of the tubercle bacillus of typical bovine characteristics, which is the organism commonly causing natural tuberculosis in swine, seven completely resisted infection, one showed no macroscopic evidence of infection but tubercle bacilli were demonstrated by guinea-pig inoculation in the

submaxillary lymphatic glands of one side of the neck only, and in eight there were visible tuberculous lesions. All these eight pigs developed tuberculosis of the submaxillary or mesenteric glands or both. In one of them there was no extension of visible disease beyond these glands; in the remaining seven foci of visible dissemination in varying amount were present in the organs.

Experiments with Eugonic Bacilli of Low Virulence for Rabbits.

Two pigs were fed with eugonic bacilli of "human" type which were obtained from a case of slight tuberculosis in a pig received from the slaughter-house. Both developed tuberculosis of the submaxillary and mesenteric glands and also exhibited a slight amount of visible dissemination in the organs.

Evidence of Dissemination apart from Visible Lesions.

Attention may first be called to the difficulty of producing strictly localised macroscopic tuberculosis in young pigs by experimental feeding (see Table XIII, p. 122), as the doses there specified usually either failed to infect or produced some degree of disseminated disease. Out of the 10 pigs in which macroscopic tuberculosis was found, in only one were the lesions strictly confined to the glands draining the alimentary tract. This was a pig which gave a negative result to the tuberculin test three months after the first dose; it was fed again and was therefore three months older than the majority of the other pigs at the time of slaughter.

In this last experiment (Pig 5), where there was an entire absence of visible dissemination, no tubercle bacilli could be found, by guinea-pig inoculations, in the liver, spleen and lungs (see Table XIV, p. 125). Similarly in Pig 4, though a few minute lesions were present in the lungs, the inoculation experiments with the spleen, liver, and apparently normal lung tissue were negative. In two experiments, Pigs 6 and 13, where there were minute lesions in the lungs and liver, apparently normal portions of these same organs produced tuberculosis in guinea-pigs. Furthermore, in Pigs 14 and 17, where minute foci of dissemination were seen only in each liver, apparently normal tissue not only from these organs but also from the lungs in each case produced tuberculosis in guinea-pigs. In those tissues of the last four pigs which yielded positive results the numbers of tubercle bacilli were not large, since only a proportion of the guinea-pigs inoculated in each case developed tuberculosis. The spleens of the same four swine exhibited no lesions, and the inoculation of large quantities of spleen tissue was negative in every instance.

The above results show that tubercle bacilli of bovine and human types may be present, in small numbers in the apparently normal tissues of a tuberculous pig in which there are visible foci of dissemination, however minute in size; but they afford no evidence that such bacilli may be present, in sufficient number to be capable of demonstration, in apparently normal tissues of pigs which, on being subjected to naked-eye examination of a minute character, manifest no macroscopic dissemination of disease beyond the glands draining the alimentary tract.

Plate I.

CULTURES ON GLYCERIN-AGAR OF TUBERCLE BACILLI FROM PIGS.

These reproductions illustrate the maximum growth obtainable in four months, and are the actual size of the originals. They show the different amounts of growth yielded by viruses possessing mammalian cultural characters.

1. Direct culture from liver of Pig XXI., 3rd generation ; of high virulence for rabbits.

2. Direct culture from spleen of Pig XXXV., 6th generation ; of high virulence for rabbits.

3. Direct culture from submaxillary gland of Pig XLVII., 7th generation ; of high virulence for rabbits.

4. Direct culture from submaxillary gland of Pig LXXVII., 10th generation ; of relatively low virulence for rabbits compared with other viruses of similar cultural characters.

5. Culture (through guinea-pig) from submaxillary gland of Pig LXXXV. ; of high virulence for rabbits.

6. Direct culture from submaxillary gland of Pig XCIII., 7th generation ; of high virulence for rabbits.

7. Culture (through guinea-pig) from liver of Pig XCI., 3rd generation ; of low virulence for rabbits.

8. Direct culture from submaxillary gland of Pig LXIX., 11th generation ; the peculiarity of this culture is that, though it grows in dry, mammalian fashion, it behaves like the avian bacillus in experiments on guinea-pigs and rabbits.

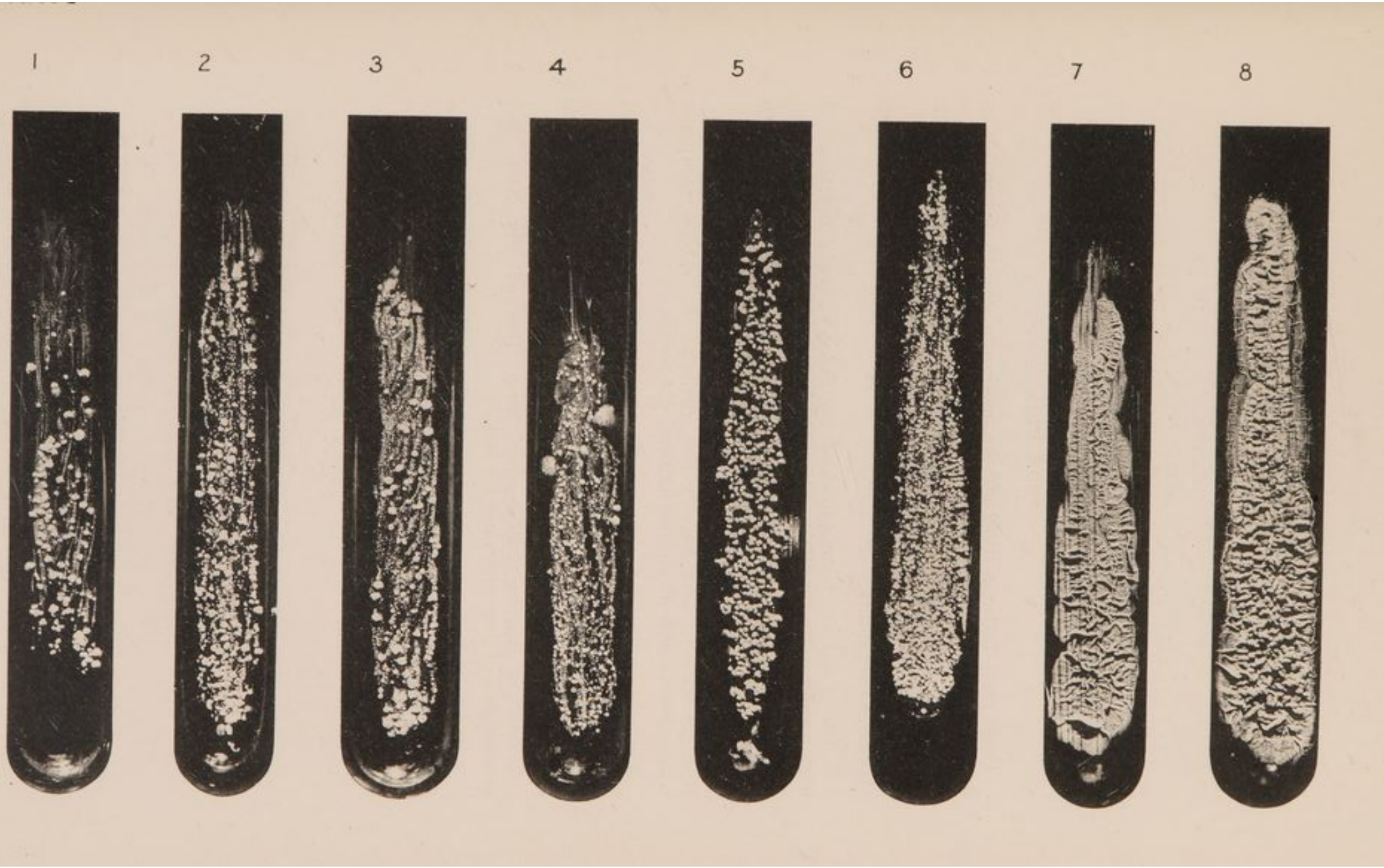
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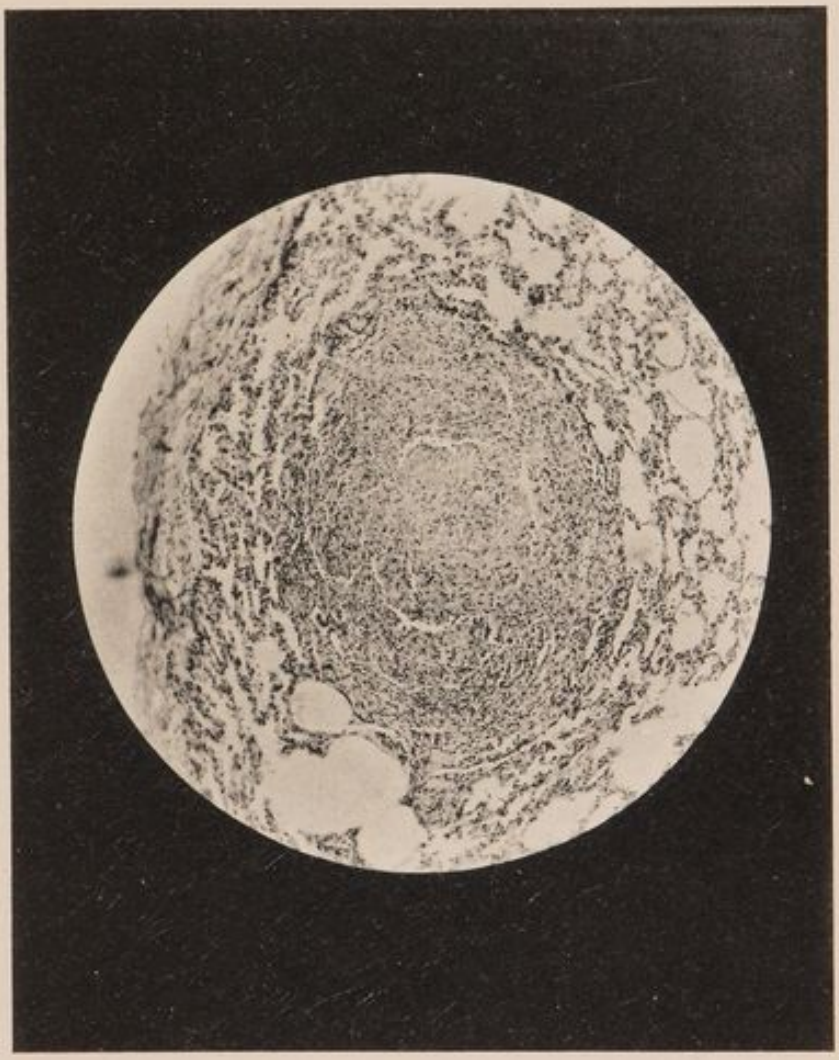
Plate II

1._ *Direct culture from submaxillary gland of Pig* XCVII *a virus of avian type, bacilli from primary colony 105 days old on egg, showing long and branched forms which retain the stain with different degrees of intensity. Stain -carbol-fuchsin, decolourised by 25 per cent* H_2SO_4, *without counterstain. ×1000.*

2._ *From same preparation as above. × 1500.*

3._ *From serum culture, 9 days old, of acid-fast bacillus obtained from Pig* LXVI *stained as above. ×1500.*

Plate III



Microphotograph (× 60) of section through sub-pleural tubercle from lung of Pig XLI

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