

Dr. Ballard's report, to the Local Government Board, on a series of cases of acute specific disease (similar to that observed in the Welbeck outbreak) following the eating of hot baked pork purchased at a shop in Nottingham / [Edward Ballard].

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Ballard, Edward, 1820-1897.
Great Britain. Local Government Board.

Publication/Creation

London : Eyre and Spottiswoode for H.M.S.O., 1881.

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Dr. Ballard's Report, to the Local Government Board, on a series of cases of Acute Specific Disease (similar to that observed in the Welbeck outbreak) following the eating of hot baked pork purchased at a shop in Nottingham.

GEORGE BUCHANAN,
Medical Department,
June 18, 1881.

On February 18, it became known to the Board through Dr. Seaton, the Medical Officer of Health, that a series of cases of illness, resembling in character the Welbeck series which I reported on last year, had occurred in Nottingham, apparently in consequence of the sufferers having partaken of hot baked pork supplied from a particular cook-shop in the town. One of the sufferers had died, and an inquest held upon this person had been adjourned in order that a post-mortem examination of the body might be made. I was accordingly instructed to investigate the circumstances of the alleged illnesses. I found that Dr. Seaton had already gathered a good deal of information about them, and I had the benefit of his able assistance in the further inquiry.

So far as could be discovered, it appears that 15 persons were taken ill after eating the pork; these persons were members of five different households. Of the 15 persons, 10 (members of four of these households) attributed their illness to pork fetched and eaten on the evening of Friday, February 11: four (members of two of these households) attributed their illnesses to pork fetched and eaten on Saturday, February 12, and one person attributed her illness to pork eaten both on the 11th and on the 12th. All these persons resided only a short distance from the shop whence the pork was purchased. The occurrence of the illnesses speedily became notorious, and I think it most probable that if many more than these 15 persons had been taken ill, we should have heard of them. It is certain that by far the largest proportion of persons who consumed the pork supplied from the shop on those two days must have escaped illness. I have notes of nine persons who thus ate of them and were not taken ill.

The following is a tabular statement of the members of the five households who were ascertained to have been taken ill:—

Households.	Persons Attacked.	Age.	Date and hour of Eating.	Date of Attack.	Severity of Illness.	Result.
1	James C. -	23	Friday, Feb. 11, 6 p.m.	Feb. 12, in course of forenoon.	Severe -	Died Feb. 15.
	Mrs. C. (his wife) -	19	" " "	" " "	Slight -	Recovered.
2	Mr. F. -	28	" " 8.15 p.m.	Feb. 12, 9 a.m.	Slight -	Recovered.
	Mrs. F. (his wife) -	28	" " "	" about noon	Sharp attack	Recovered.
3	Mrs. T. -	34	" " 9 p.m.	" 4 p.m.	"	Recovered.
	Herbert T. (her son) -	14	" " "	" 5 p.m.	"	Recovered.
	Jane T. (servant) -	19	" " "	" tea time	Severe -	Recovered.
	Mrs. T., senior -	64	" " "	" about 12 at night	Sharp attack	Recovered.
			also Saturday, Feb. 12, 11.30 p.m.			
	James T. (cousin) -	19	Saturday, Feb. 12, 11.30 p.m.	Feb. 13, tea time	Slight -	Recovered.
4	Mr. H. -	29	Friday, Feb. 11, 9.30 p.m.	" 8 a.m.	Moderately sharp attack.	Recovered.
	Mrs. H. (his wife) -	24	" " "	Feb. 12, 10 p.m.	Sharp attack	Recovered.
	Mr. H. (lodger) -	20	" " "	Feb. 13, on rising in morning.	"	Recovered.
5	Mr. H. -	23	Saturday, Feb. 12, 6 p.m.	Feb. 13, 8 p.m.	Slight -	Recovered.
	Mrs. H. (his wife) -	22	" " "	" forenoon	Severe -	Recovered.
	Annie K. (lodger) -	19	" " "	" 12 at night	Sharp attack	Recovered.

In some of these households there were members who did not partake of the pork and did not suffer illness, but in each of the five households every one who partook of the pork suffered more or less.

In this series of cases a period varying from 12 to about 34 hours elapsed, after partaking of the pork, before definite symptoms of illness occurred. In 10 of the

cases the illness commenced with abdominal pain, soon followed in some of them by headache, faintness, shivering or chilliness, or by purging; in one it commenced with headache, in one with headache and shivering, in two with purging, and in one with sickness, fainting, and rigors. The cases marked in the table above as "slight" were those in which the symptoms were limited to diarrhoea or to headache, with nausea and pain in the back and abdomen; or to headache and diarrhoea. But even these slight attacks, lasting for from one to four days, weakened the subjects of them considerably. The more severe cases exhibited in various degrees the following symptoms, one or more of which were, however, sometimes absent, viz., severe (sometimes described as "crampy") pains in the abdomen, diarrhoea, the discharges, where noted, being dark coloured, watery, and offensive, vomiting or sense of sickness, headache, sense of prostration, and faintness or fainting, shivering or sense of coldness early in the illness, and sense of heat and feverishness at a later period, coated tongue, and a loss of all appetite. These were the symptoms which were most constant. Other symptoms observed in some few of the cases were thirst, aching or shooting pains in the back or limbs, or a sense of general stiffness, and in one case muscular twitchings in the limbs. In one case there was cough with pain in the side, and in two cases an eruption like herpes appeared round the mouth. The illnesses lasted mostly several days, and resulted in much physical weakness. Some of the cases had not thoroughly recovered from the diarrhoea when I saw them eight or nine days after the commencement of illness.

The following are accounts of the two most severe cases, one of them resulting in death and the other in recovery:—

J. C., aged 23, a painter by trade, residing with his wife in a small house in a narrow street or court in Nottingham. Never, to his wife's recollection, had suffered from colic. He was not a powerful man, but he had habitually fair health. At about 6 p.m. on February 11 his wife purchased about 6 oz. of hot baked pork cut from a leg of pork in the shop of Mr. —, about 100 yards distant from their own residence, and carried it home on a plate, the pork being covered with a piece of whitey brown paper taken from a nail in the shop. J. C. and his wife ate the pork between them at tea, immediately on its arrival, J. C. eating more of it than his wife. He did not complain all night, ate his breakfast as usual, and went to his work at 8.30 a.m. When he came home to dinner at 2 p.m. he complained of feeling sick, but he ate his dinner (beef-steak), drank only water, and went back to work. When he returned about 5.30 p.m. he said he had been purged all day. He slept, however, on Saturday night, and did not rise to stool; but on the next day (Sunday) he could eat nothing, was repeatedly purged, and in the course of the day began to vomit, rejecting immediately whatever liquids he drank. The stools were dark coloured, watery, and very offensive. He lay in bed up to 5.30, and then, although with difficulty on account of feeling very weak, he came down stairs. He sat there close to the fire, complaining of feeling cold, but his wife says he did not shiver. He had been very thirsty all day, and repeatedly drank of cold water or milk. At 8 p.m. he had to be assisted upstairs again to bed. He passed a bad night, and on the Monday morning had severe abdominal pain, with headache and a continuance of the vomiting and diarrhoea. In the course of this morning he was seen by an assistant of Dr. Popham, of Nottingham, who states that, while complaining of feeling cold, his skin was burning, the pulse was too rapid to be counted with accuracy, the tongue was dry, the thirst was intense, the vomiting and purging very violent, the belly tender, and the arms and legs bent and twitching while the muscles were hard and rigid. Later in the day he was seen by Dr. Popham, who then noticed, in addition, that the face was swollen and eyelids puffy, the skin livid in patches and hot, and the pulse imperceptible; the legs and arms were constantly twitching, and he repeatedly and suddenly threw himself from side to side "as if electricity had been applied." In the course of the day he was delirious. On the Tuesday his stools were passed under him in bed, and looked green coloured on the bed sheet. He died this day at 2 p.m.

The body was examined under order from the coroner by Dr. Truman (Public Analyst), of Nottingham, 106 hours after death. Post-mortem rigidity not passed away. Body fairly nourished. Patchy lividity of posterior parts of trunk and of arms, forearms, and hands. Brain and its membranes normal. Chest.—Pericardium contained a few drachms of reddish serous fluid. Heart healthy: right cavities contained a little loose coagulum slightly fibrinous. Pleuræ healthy and free from adhesions. Parts of all the lobes of both lungs failed to collapse when the chest was opened, and these parts were of a very dark colour and firm to the touch. This was the character of the whole lower lobe of both lungs (except quite their upper parts),



of the greater part of the middle lobe of the right lung, and of all but the upper half of the upper lobes of both lungs; and on section these portions were found deeply engorged and almost non-crepitant; very little liquid followed the knife on their section, but a little dark bloody fluid could be expressed by squeezing. The tissue in these parts was tough and did not break down on firm pressure; portions cut off floated in water, and could not be made to sink by squeezing them. The lower margin of both lower lobes was emphysematous. The bronchial mucous membrane was stained. *Abdomen.*—Peritoneum healthy. Mesenteric and mesocolic glands prominent, enlarged, and red on section. Stomach contained about 3 oz. of a brownish yellow gruelly-looking fluid. There was fine stellate redness of the mucous membrane in patches on the small curvature and posterior wall towards the pyloric half. The small intestines contained a considerable quantity of fluid similar to that found in the stomach. Mucous membrane of the jejunum slightly reddened, that of the ileum mostly pale, but towards the lower part reddened, with ramiform injection of vessels which extended to the borders of the agminated and solitary glands, but not beyond. These glands were white, thus contrasting strongly in colour with the surrounding membrane, and they were slightly but palpably raised above the general surface. There was some redness of the mucous membrane of cœcum and of most of the large intestine, but no obvious softening nor ulceration. Liver apparently healthy. Kidneys apparently healthy, and capsules stripped off readily and freely. Spleen small, shrivelled-looking, and flabby; it was dark coloured on section, and the tissue readily broke down on pressure. Bladder nearly empty.

Dr. Truman examined chemically the contents of the stomach and intestines for arsenic, antimony, lead, mercury, copper, and various irritant poisons, as also for strychnine, with a negative result. He also similarly examined with the same negative result portions of the coats of the stomach and intestines, and also portions of the liver and kidneys.

On the day succeeding the examination of the body, I forwarded to Dr. Klein, for microscopic examination and experiment, the following fluids and tissues, viz.:—Pericardial fluid, blood from the heart, part of the stomach and lower part of the ileum, the cœcum, and some mesocolic glands, and part of the mesentery, some engorged lung, and a portion of kidney, liver, and spleen. Dr. Klein's report upon the examinations, cultivations, and inoculations he made is given in full in the Appendix to this report. Briefly the results were as follows:—

1. Bacilli (similar to those discovered in the Welbeck inquiry) were found in varying numbers in the blood, pericardial fluid, juice expressed from the lung, in the air vesicles and in the blood vessels of the lung, in the tissues of the stomach and ileum, in the spleen within and around its large vessels, and in and around the vessels of the kidney and in the connective tissue between the tubuli of the renal cortex.
2. The capillary vessels of the glomeruli of many of the Malpighian corpuscles of the kidney were impervious, being degenerated into hyaline or fibrous bands, the nuclei of the glomeruli being increased ("glomerulo-nephritis"). Some of the tubuli contorti contained extravasated blood, others of them hyaline casts.
3. There was hæmorrhagic infarction of the lung tissue, and bacilli were found with or without spores amongst the blood, filling the air vesicles and in the blood vessels.
4. Inflammation of Peyers glands of the small intestine and a few bacilli in the submucous tissue.
5. In the liver slight interstitial hepatitis.

Guinea pigs and mice inoculated with the blood, pericardial exudation, and lung juice became diseased. Six, out of 10 animals inoculated, died spontaneously, and four were killed. In all ten, pneumonia, in two accompanied by pulmonary hæmorrhage, was found after death, and in eight of the ten was peritonitis, in four pleuritis also, and in two, in addition to pneumonia, there was enlargement of the liver and spleen. In two guinea pigs inoculated with the blood, a tumour containing purulent matter developed at the seat of inoculation.

Similar results followed the inoculation of material obtained by cultivation of the blood and lung juice in the incubator.

Bacilli were found in the blood and exudations of some of the above inoculated animals as well as in the purulent matter of the tumours found in two of them as above described at the seat of inoculation.

The following are my notes of a severe case which recovered:—

J. T., aged 19, a female servant, was sent by her mistress on Friday evening, February 11, to fetch hot baked pork from the same shop at about 9 p.m. She brought home

about $\frac{3}{4}$ lb. of it in a clean basin. The basin was covered immediately with some whitey brown paper from a nail in the shop, and over this she laid a blue cloth such as she generally used for this purpose. The paper did not touch the pork. On arrival with the pork she, together with others in the house, partook of it for supper. Her mistress says that this girl had more of it than the rest. The girl says it tasted all right. She remained well on Saturday up to tea time (about 5 p.m.), but after tea felt sick and faint and shivered a good deal. In the course of the evening her hands became swollen, principally the left hand, which was so swollen and painful that she was unable to bend it. Nevertheless, she was that evening sent out to fetch more pork for the supper of other members of the household. She began to vomit on Saturday night. On the Sunday morning the swelling of the hands had subsided, but there were aching pains and muscular twitchings of the extremities. Purging commenced on Sunday morning, and all that day she was vomiting and purging and had severe griping pain in the belly. On the Monday she was greatly prostrated and was seen by the medical man who had been sent for to attend her mistress and others who were ill in the house. On this day she began to suffer pain in the left side, and had cough, but without expectoration. On the Tuesday, being still in the same condition, she was sent away to her home at Calverton, a distance of $7\frac{1}{2}$ miles, the first 4 miles of which she travelled in an omnibus, and the remaining $3\frac{1}{2}$ miles in a cart. She suffered intensely during this journey, and, it is said, appeared almost dead on reaching her home. The purging and other urgent symptoms became abated under medical treatment on Wednesday night. She describes the discharges from the bowels as "dark-coloured, like treacle, and very offensive." On Thursday (17th) pimples with watery heads broke out around her mouth, and she says similar pimples appeared within the mouth. When I saw her on 24th she was convalescent, but very weak, and had lost flesh considerably. She was not quite free from cough, but no dulness, nor abnormality of respiratory murmur were discoverable on thoracic exploration.

The similarity of these cases to those observed in the Welbeck outbreak last year must strike any person who has read my report to the Board upon that outbreak. There was a period of incubation of similar length intervening between the eating of the suspected food and the occurrence of the primary symptoms of illness; morbid phenomena of a similar character were observed during life, and similar phenomena were observed in the body examined after death, so far as the details of the Welbeck post-mortem examinations are available for comparison. Moreover, in the fluids and tissues of the patient who died microscopic organisms were discovered similar to those which were discovered in the kidney of one of the fatal cases at Welbeck, and in the hams which were shown to have caused the illnesses in that instance. The results of experiment at the hands of Dr. Klein were also similar. Unfortunately in this case none of the material suspected of producing the illnesses was obtainable; but it is impossible to entertain a doubt that the illnesses were consequent upon the ingestion of the suspected food, and due to a morbid element in it, similar to that which produced like illness in the Welbeck series.

The following account embraces all I have been able to learn about the pork:—

The shop at which the hot baked pork was purchased is what is commonly known as a "cook-shop" at which cold cooked articles of food are also sold, such as corned beef (tinned meat), potted meat, home made pastry, &c. The hot pork is mostly sold in the evenings, the largest sale of the week being on Friday and Saturday evenings. This hot pork customarily stands in the window of the shop upon a tinned iron dish having a well for gravy, which dish again rests upon a metal vessel containing water kept boiling by a gas arrangement beneath it. The shop is a very small one, with a still smaller sitting room behind it, and it communicates at the back part by means of a trap door in the floor (habitually open) with a cellar in the foundation, the ceiling of which is a little above the level of the footpath and roadway outside. The door of the shop is always open during business hours, and there is also an opening in the upper part of the shop window for the escape of steam, &c. The cellar below has constantly an open communication with the footway by means of a barred opening. At the time of my visit to the premises, which was unexpected, I found the shop scrupulously clean in every part, some newspaper cut into sizes lay upon the counter, and some similarly cut new whitey brown paper hung on a nail in the shop, both kinds of paper being used for covering food sold in the business. The condition of the cellar contrasted greatly with that of the shop; it was dirty, the walls having sooty cobwebs upon them, and it contained various kinds of rubbish as well as emptied meat tins, old ginger beer bottles, old ginger beer corks, &c., a selection from which was forwarded to Dr. Klein for investigation. Various processes of the trade were, I found, habitually carried on in this place; for example, tinned beef was manufactured into "potted

meat," and ginger beer was made by the ordinary process with brewer's yeast. On the floor of the cellar, close to one of the walls, and within reach of dust, &c. that might enter by the cellar opening, there were pans containing potted meat and a wooden pail containing meat jelly obtained in the process of manufacturing the potted meat.

The process of preparing the hot pork for sale is said to be always the same, and it was pursued in the case of the hot pork to which the illnesses in question were attributed. The leg of pork is boned and is then laid upon a clean tin with a little water at the bottom, and after the shop-keepers' dinner (*i.e.*, about 2 p.m.) is sent to a bakehouse close by to be baked. The baking is continued for $2\frac{1}{2}$ or 3 hours. On returning from the bakehouse it is transferred to the dish in the window and some gravy is put into the dish with it. This gravy has as its basis the sort of jelly which I saw in the pail in the cellar. On a Monday, "stock" or jelly is made for the week by boiling pork bones, pigs' feet, ends of knuckles of pork, &c., and by adding to the gelatinous liquor which results such liquor as is obtained from the manufacture of potted meat. When gravy is first required, a portion of this jelly (about 1 pint) is brought in a jug from the cellar into the shop, and as much as is necessary is warmed up over a fire in the back room or over a small gas-stove in the cellar, with some water and liquor from the dish in which the pork has been baked. Such jelly as is not then used stands in the jug on a shelf beneath the shop counter. When the dish in the window requires replenishing with gravy, either fresh gravy is made in the above manner, or some jelly from the jug is put into the dish, which is hot enough to melt it. On one occasion Dr. Seaton took the temperature of the gravy in the dish and found it 144° Fahr. The shop-keeper tells me that his constant practice is this: *viz.*, on a Saturday night after closing the shop all the gravy left in the window dish is thrown away, but on other nights any that remains is poured into a jug, which stands for the night either in the shop or (in summer) in the cellar, and is used for the leg of pork which is cut the next day, more gravy being also made as required. When two hot legs of pork are used in succession on the same evening (which is always the case on Fridays) the second is sent to the bakehouse while the first is in cut, and on its return is simply transferred to the same dish as the first had stood upon, and any gravy in use with the first leg is used also with the second leg. But after the shop is closed each evening any pork left over is sold cold the next day, and the dish is thoroughly cleaned with hot water and wiped dry for reception of the next leg of pork. The iron dish in which the pork is baked is also similarly cleaned. On my unexpected visit to the shop I saw this vessel and it was scrupulously clean.

The pork is cut off in slices for sale, the slicing commencing with the narrow or knuckle end, and continuing until the pork is finished at the thick end. When a dish or other vessel is brought by a purchaser, some of the gravy is habitually added and a piece of the whitey brown paper from the nail in the shop is laid over the vessel.

The pork sold on the 11th and 12th of February was purchased by the shop-keeper from one of the largest pork butchers in Nottingham, with whom he habitually dealt, and who says that the shop-keeper always purchases the primest pork for which he always pays the extreme price. The pigs slaughtered by this pork-butcher ordinarily come to him from Liverpool (probably being Irish pigs) or out of Lincolnshire. They are kept for a few days in sties near the slaughter-house and are killed as required. From 80 to 100 such pigs are slaughtered weekly. The slaughter-house was clean, and the pigs were being cleanly kept on straw and fed on good barley meal. But in a dirty cart shed adjoining there were standing two carts, one of which (called a "float") being used to bring live pigs from the railway, and the other being used to convey the dead meat to the pork butcher's shop. The former was very dirty and contained filthy straw, but the latter was fairly clean, having only a little straw and dust on the floor of it. In conveying the carcasses thither they are covered either with straw or with empty meal bags.

It appears that the cook-shop keeper purchased four legs of pork at the beginning of the week ending February 12, and on February 10, three more legs of pork. They were selected from the legs hanging in the pork butcher's shop at the time, and as nearly as possible of the same size. It is not possible to say whether any two legs purchased on February 10 were from the same pig. The four legs purchased at the commencement of the week having been consumed, two of the legs purchased on the 10th were baked (in the usual way) on the Friday for that evening's sale, and the third leg was baked on the Saturday for that evening's sale. The precise hour at which the second leg was begun to be cut on Friday (11th) is not discoverable, but it was probably a little after 9.30 p.m., since at that time one of those taken ill had

her pork cut from the thick end of a nearly finished leg, and says she saw another hot uncut leg standing in the shop ready to be cut. Only one leg was cut on Saturday (12th). Some of those taken ill, who ate of the pork on the Friday and the Saturday, say that it was very thoroughly cooked, and, indeed, complained that it was over cooked.

Looking at the time at which the pork was fetched by those who were taken ill after eating it on the Friday, and the accounts given me by those who fetched the pork of the condition of the leg from which each portion was cut, of which I have consecutive statements, almost hour by hour, it is quite obvious that such persons as were taken ill had partaken of the *first* leg cut that evening. Such as were taken ill after eating pork on the Saturday had also partaken of the first (in this case the only) leg cut that evening. It is worthy of remark that no one was taken ill after eating of the second leg of pork cut on the Friday, nor of the hot pork sold at the beginning of the next week. It is also to be remarked that there is no hint of any one having been taken ill from eating cold pork or other cold provisions sold out of the same shop about the same time. Whatever the material (presumably a morbid bacillus) may have been which produced the illness, it was present either in the pork or in the gravy dispensed with it, and only in the pork or gravy *first* used on the Friday and on the Saturday. Neither does it appear to have been present in every portion of pork cut from the same legs, or of the gravy dispensed with it on those evenings. It is curious, and probably important, to notice in this connexion that not only did individuals escape illness, but whole households who partook of the portions dispensed to them escaped, whereas in every instance where a single member of a household eating the pork became attacked, every individual of the household who ate of it was also attacked. Family proclivity will not account for this, since the persons in some of the households attacked were members of different families. This fact is calculated to raise the suspicion that after all the morbid element might not have been present originally either in the pork or in the gravy, but that it might have been introduced into the portions which did mischief, either in the act of dispensing and weighing or by the agency of the paper laid over the several portions. Possibly there may have been something personal to the woman who dispensed the food, and who on some occasions may have touched the food with her fingers. She was a woman somewhat advanced in years, and in apparently good health. She and her husband had themselves (they say) eaten of the same pork without suffering from any ill effects.

It is scarcely credible that bacilli, if originally present in the pork, should have retained potency for evil after such a prolonged baking as sufficed to disorganise the meat tissue, besides which the escape of other customers after eating of other portions of pork purchased at the same time from the same pork butcher makes any harmful quality of the joint itself extremely difficult to understand. Suspicion of the gravy is not so readily disposed of, having regard to the habitual proceedings at the cook-shop with reference to making and storing of the gravy or jelly, which was its basis. It is clear that jelly made several days previously and stored or kept as it was in this instance had the opportunity of accidental infection, and, unlike the pork, some of it thus accidentally infected might not have been exposed to the destructive operations of a sufficiently prolonged boiling. But then again, Dr. Klein could find nothing unusual or morbid in the various articles of rubbish, &c., which I sent him from the cellar where the jelly was kept, nor about a sample of the paper with which the portions of pork dispensed were habitually covered.

Future and further experience and investigation must be awaited before all the facts collected as to this series of cases can be satisfactorily interpreted.

EDWARD BALLARD.

June 6, 1881.

APPENDIX.

DR. KLEIN'S REPORT on the EXAMINATION of the BLOOD and TISSUES of J. C., and of various articles forwarded by Dr. Ballard from Nottingham.

A.—*As respects the Straw, Cobweb, Dirt, Dust, Paper, Jelly, &c.*

Nothing unusual was found in any of these articles on microscopic examination of them, and only negative results followed experiments with them by inoculation of animals.

B.—*As to the Blood and Tissues of J. C.*

Microscopic Examination.

1. Blood from the heart. Bacilli were present in small numbers, but plenty were visible in every field of the microscope.
2. The juice obtained from the engorged hæmorrhagic lung tissue contained a great many bacilli, some of them thicker than others; the thicker ones had spores in their interior.
3. The pericardial fluid contained a good many bacilli similar to those in the lung juice.
4. In the kidney the bacilli were very numerous, both in and around the blood vessels, and in the connective tissue between the tubuli of the cortex. The capillary vessels of the glomeruli of many Malpighian corpuscles were imperious, being degenerated into hyaline or fibrous bands, the nuclei of the glomeruli being increased (glomerulo-nephritis). Some of the tubuli contorti contained extravasated blood, others of them hyaline casts.
5. In the spleen a few bacilli were seen in and around the large blood-vessels.
6. In the mesenteric glands, the same.
7. Liver, slight interstitial hepatitis.
8. In the hæmorrhagic lung tissue there were bacilli (with or without spores) amongst the blood filling the air vesicles; bacilli also within the blood vessels.
9. The stomach contained very numerous bacilli in the mucosa between the gastric glands, and in the blood-vessels next the muscularis mucosæ.
10. In the ileum, slight inflammation; a few bacilli in the submucosa.
11. Inflammation of Peyer's glands; a few bacilli in the submucosa.

Inoculation Experiments.

Experiment 1.—With the blood from the heart, there were inoculated—

- a. On February 19, two guinea pigs.
- b. On February 21, two mice.

Result.—All these four animals became diseased; the mice died spontaneously; the guinea pigs were killed. In all animals there were signs of pneumonia and slight peritonitis. In the two guinea pigs a tumour containing purulent matter had developed at the seat of inoculation.

Experiment 2.—With the lung juice, there were inoculated—

- a. On February 19, two guinea pigs.
- b. On February 21, two mice.

Result.—All four animals died spontaneously, and showed signs of pneumonia, pleuritis, and peritonitis.

Experiment 3.—With the pericardial exudation, there were inoculated—

Two guinea pigs.

Result.—These animals did not show much alteration during life. When killed, after six days, there were found in both enlargement of the liver and spleen; and in the lungs of both of them were pneumonic patches and hæmorrhages.

Cultivation and Inoculation Experiments.

Experiment 4.—Blood from the heart was cultivated in the incubator for 36 hours, and then on—

February 25, was inoculated into two guinea pigs.

Result.—One of these animals died after 24 hours, and after death there were found signs of severe peritonitis and of slight pneumonia. The other animal was killed on March 2. The liver was found enlarged, there was patchy pneumonia, and there were a few hæmorrhages in the lungs. At the seat of inoculation was a tumour filled with purulent matter.

Experiment 5.—Lung juice was cultivated for 36 hours in the incubator, and then on—

February 25, inoculated into two mice.

Result.—One died after four days, the other after five days. In both cases there was distinct pneumonia in both lungs. In one of the animals there was peritonitis and slight inflammation of the liver.

Organisms found.

- a.* In the purulent matter of each of the tumours developed in Experiment 1, and Experiment 4 at the seat of inoculation, there were a great many bacilli with and without spores.
- b.* The blood of the guinea pigs of Experiment 2 contained a few bacilli.
- c.* The pericardial exudation of one of these same guinea pigs contained minute rods.
- d.* In the first guinea pig of Experiment 4 the peritoneal exudation was filled with minute rods.
- e.* In the mice of Experiment 5 there were a few minute rods.

E. KLEIN.

LONDON:

Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,

Printers to the Queen's most Excellent Majesty.

For Her Majesty's Stationery Office.

[2906.—100.—6/81.]