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# **Preliminary Report on a South African Virus Disease amongst Pigs.**

**By D. G. STEYN, B.Sc., Dr.Med.Vet., Research Officer,  
Onderstepoort.**

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## INTRODUCTION.

MR. J. QUIN, of our Department, after a tour in the Koedoesrand Ward in August, 1926, reported a very serious disease amongst pigs in that area, and especially in the vicinity of Maasstroom. The farmers in that area informed him that it was impossible to raise pigs on account of this deadly disease, and that affected animals very seldom recovered. Deaths due to this disease were more prevalent amongst the pigs running free on the farm than amongst those kept in the styes.

Another point of importance is that the wart-hog (*potomochoerus*) occur in large numbers on these farms affected with the disease. The farmers have noticed that the wart-hogs searched the yards for food during night-time, and they thus maintain that the domestic pigs contract the disease from these wild pigs. Another peculiar fact is that this pig-disease and "snotsiekte" amongst cattle occur on the same farms. Furthermore, the following information was obtained from the farmers:—The disease affects pigs of all ages. The pigs are suddenly noticed to be ill—listless, breathing very heavily, grinding the teeth, and foam issuing from the mouth. Very often the animals die within twenty-four hours. Sometimes they remain sick for a few days, showing a swaying gait. Affected pigs very seldom recover, and are then apparently immune, although they sometimes have a second attack, which is never as severe as the first. The disease seems to be the most prevalent in spring. On post-mortem the farmers found the intestinal mucosa dark-reddish, showing sores in some cases.

On the Director's request a pig suffering from the above disease was forwarded to the Laboratory on the 17.9.26. It arrived here dead on the 18.9.26, and showed the following post-mortem lesions:—

- (1) Marked p.m. changes.
- (2) Hydropericardium.
- (3) Extensive epicardial and intramyocardial haemorrhages.
- (4) Subendocardial haemorrhages in left ventricle.
- (5) Fibrinous pleuritis—right lung.
- (6) Croupous pneumonia.
- (7) Haemorrhagic foci in right lung.
- (8) Haemorrhagic infiltration of all the lymph-glands.
- (9) Haemorrhagic infiltration of kidneys.
- (10) Croupous typhlitis.

Subsequent inoculations with heart-blood collected from the above pig proved the disease to be of an infectious nature. The pigs, inoculated with the blood collected from the above pig, were kept in a sty next to

pigs engaged in another experiment, and the infection spread to the last-named pigs. In the course of three months five available pigs also died from this disease, the infection having been carried by the boy attending to the pigs.

#### MODE OF INFECTION.

The experiments carried out during the last four months proved that the disease could be transmitted—

- (a) by subcutaneous injection of (1) blood from affected pigs showing fever temperatures, (2) blood from pigs which have died from this disease, (3) gall from pigs which have died from this disease ;
- (b) by placing available pigs in contact with pigs suffering from the disease ;
- (c) by feeding pigs with urine and faeces collected from affected pigs.
- (d) Furthermore, it was proved that the boy looking after the pigs carried the infection from one sty to the other, as two available pigs, which were kept in clean and uninfected styes, died from the disease. Three more available pigs succumbed to this disease, but whether they picked up the infection in the infected styes, or whether the boy carried the infection to them from affected pigs, is impossible to say.

Subsequently the following precautions were taken in order to avoid the infection being carried from one pig to the other, or to areas outside Onderstepoort. The boys looking after and temperating these animals were provided with rubber boots, which were disinfected in a carbolic dip solution as soon as the boys left a sty. Furthermore, each pig on temperature had its own thermometer.

#### ETIOLOGY.

Smears were made from the blood, liver, spleen, kidneys, and lymph-glands, and proved to be negative in all cases.

Anaerobic and aerobic cultures were made from the heart-blood, liver, affected parts of the lungs, glands, kidneys, and spleen. In all cases these were negative, except those from the affected parts of the lungs, which showed secondary infections with staphylococci and coli bacilli. These organisms proved to be nonpathogenic to pigs, rabbits, guinea-pigs, and white mice.

The cause of this disease was proved to be a filterable virus, the filter used being a Seitz.

The pigs injected with culture-sterile and unfiltered heart-blood, collected from pigs which had died from the disease, all succumbed, whereas none of the four pigs injected with unhaemolysed and filtered blood died, three of them only showing fever reactions after the injection. This seemed a noteworthy fact, so that four available pigs were injected subcutaneously with haemolysed and filtered blood. These four pigs died, showing post-mortem symptoms typical of this disease. Apparently the virus is to a great extent attached to the red-blood cells, but further investigation is necessary before a definite opinion can be expressed on this point.

## SUSCEPTIBILITY.

The experiments at the Laboratory, as well as the information from Koedoesrand, have proved that all pigs are equally susceptible, irrespective of age, sex, or breed. Furthermore, horses, cattle, sheep, goats, dogs, cats, rabbits, guinea-pigs, doves, and white mice were injected with large quantities of culture-sterile unfiltered blood from pigs which had died from the disease, but none of these animals showed any local or fever reaction, except one very poor-conditioned horse, which showed a local swelling which disappeared within twenty-four hours after injection.

## SYMPTOMS.

The incubation period, after subcutaneous injection, varied from thirty-six hours to four days, being mostly two days; whereas in the three contacts which died from the disease the incubation period varied from four to seven days. The period from the time the animal started showing fever up to the point of death, varied from two to three days, and in one case lasted up to eleven days. The disease thus had a very acute character. The temperature curve is a very typical one. Two to four days after inoculation the temperature suddenly rises, sometimes to 108° F., remains between 105° F. and 107° F. for two to five days, then suddenly drops, in the course of two to three days, often to below normal temperature (96° F.), at which point the animals die.

The second or third day after the injection the animal shows a certain degree of dullness, which increases daily, until a day before death the animal is in a comatose state, lying on its side with stretched-out legs, closed eyes, and only feebly grunting when stirred. Complete inappetence is present. Very often a mucopurulent discharge from the nostrils is present. The lungs are affected in about 50 per cent. of the cases, mostly with bronchitis and less frequently with bronchopneumonia. The animals cough very seldom. The breathing is laboured, double, sometimes deep and slow, and at other times shallow and accelerated. The heart-action is tremendously accelerated (up to 180 beats per minute), very weak, and irregular. Not very seldom a marked diarrhoea, sometimes of an haemorrhagic nature, is present; in some cases, again, the faeces is very hard, whereas in other cases the same animal may sometimes show signs of diarrhoea, and at other times those of constipation. The affected pigs, when forced to rise, invariably show a staggering gait and walk with an arched back. The hindquarters appear to be stiff, and the animals seem to have lost control over them (paresis), as they try to sit down when chased about and drag the hind legs along the ground.

## POST-MORTEM APPEARANCES.

These were practically identical with those in the pig sent in from Koedoesrand. In all cases the animals were in very good condition, and on post-mortem the following lesions were found:—

- (a) Purulent conjunctivitis.
- (b) Hydroperitoneum.
- (c) Hydrothorax.
- (d) Hydropericardium.

- (e) In two out of twenty-five cases a serofibrinous pericarditis.
- (f) Numerous subepi- and subendocardial haemorrhages, the latter especially marked in the left ventricle.
- (g) Intramyocardial haemorrhages and degeneration of the myocard.
- (h) Bronchitis and fairly often bronchopneumonia.
- (i) Interlobular oedema of lungs.
- (j) Marked tumor splenis with hyperplasia of the malpighian bodies, the pulp scraping with difficulty.
- (k) Degeneration and congestion of the liver.
- (l) Numerous intra- and subcapsular and intracortical haemorrhages in the kidneys, rarely also in the medulla and pelvis. Sometimes the kidneys are markedly swollen.
- (m) The lymph-glands, especially the periportal, are markedly enlarged and haemorrhagic.
- (n) Gastro-enteritis, which varies from slight catarrhal to marked haemorrhagic, in one case even of a pronounced fibrinous nature, and showing necrotic foci in the mucosa of the rectum.
- (o) Subserosal haemorrhages in stomach and small intestine.

Invariably present on post-mortem were the subendocardial haemorrhages in the left ventricle, the marked tumor splenis, the haemorrhages in the kidneys, the haemorrhagic nature of all the lymph-glands, and especially that of the periportal glands, and the varying changes in the intestinal tract.

#### MICROSCOPICAL PATHOLOGICAL DIAGNOSIS.

*Heart.*—Subendocardial, subepicardial, and intramyocardial haemorrhages. Hyperaemia and fatty degeneration of myocard.

*Liver.*—Small haemorrhages, hyperaemia, fatty degeneration, and infiltration with cells, more than half of which are eosinophiles.

*Kidneys.*—Necrotic foci in tubuli. Subcapsular haemorrhages, also in cortex and medulla. In one case haemorrhages were seen in all the glomeruli. Marked hyperaemia. Fatty degeneration of tubuli and glomeruli.

*Spleen.*—Haemorrhages and marked hyperaemia, the blood sinuses markedly distended with blood.

*Lymph-glands.*—Haemorrhagic, marked hyperaemia and eosinophile infiltration.

*Lungs.*—Bronchopneumonia and bronchitis.

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*Immunity.*—Immunity tests were carried out with five pigs. Four of these animals showed fever reactions after the first injection with filtered blood. Three, however, died within seven days after a subsequent injection with virulent blood. The other one, after a second injection with virulent blood, showed a very high fever reaction, but seems to be on the way to recovery.

The remaining pig showed no fever reaction after the first injection with filtered blood and died within eight days after the subsequent injection with unfiltered blood.

The period between the first injection and the immunity test varied from one to two months.

Judging from the above results, it seems as if the tendency to form an immunity is extremely small.

#### DISCUSSION.

Montgomery investigated a similar disease amongst pigs in East Africa and called it "East African Swine Fever" (*Journal of Comparative Pathology and Therapeutics*, Vol. XXXIV, p. 159, 1921). As regards the incubation period, the course of the disease, the symptoms and post-mortem lesions,\* and the immunity, there is a striking similarity between East African swine fever and the Koedoesrand disease.

Another point of similarity is the following:—Montgomery dispatched virulent blood to London, and in the report of the English Committee it was stated that the virus is by predilection attached to the red blood corpuscles. As was previously stated, all the pigs (ten in number) injected with culture-sterile unfiltered blood died from this disease, whereas out of four pigs, injected with unhaemolysed and filtered blood, none died, three of them only showing fever reactions and the fourth no reaction at all. On the other hand, the four pigs, injected with haemolysed and filtered blood, all died from the virus disease. This phenomenon seems to corroborate the opinion of the English Committee.

Montgomery established the facts, viz., that pigs immune to the European swine fever are still susceptible to the East African swine fever, and that the East African swine fever very seldom causes immunity.

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#### APPENDIX.

All the blood samples used in the undermentioned experiments were collected under aseptic conditions in a glycerine oxalate mixture to prevent coagulation of the blood and to act as preservative at the same time. Before the blood was injected agar-, bouillon-, and Hibler-cultures were made to ascertain whether the blood was infected, in which case it was filtered through a Seitz filter. If the blood after seventy-two hours' incubation proved to be culture-sterile, it was injected as such. The infected blood always proved to be culture-sterile after one filtration. As the oxalate-glycerine blood mixture filtered extremely slowly, it was diluted 1 : 5 with sterilized physiological saline solution before filtration.

In the experiments to ascertain whether the virus had a predilection for the red blood corpuscles, the blood was diluted 1 : 1 with sterilized distilled water and allowed to stand for one hour before filtration, so as to cause complete haemolysis.

The following experiments were carried out since September, 1926:—

*Pig 583.*—Injected subcutaneously on the 8.9.26 with 5 c.c. of blood collected from pig 591, which was sent in by Mr. Troye, Potgietersrust. *Pig 583*, however, contracted the Koedoesrand virus disease in the styes,

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\* E.g. numerous subcapsular haemorrhages in the kidneys, tumor splenis, and general haemorrhagic enlargement of the lymph-glands.

as it was placed in a sty next to pigs engaged in the Koedoesrand pig-disease experiment, and died from this disease on 20.9.26.

Post-mortem Appearances :

- (a) Hydroperitoneum.
- (b) Hydropericardium.
- (c) Numerous subendocardial haemorrhages in left ventricle.
- (d) Acute bronchopneumonia.
- (e) Hyperaemia and degeneration of liver.
- (f) Gelatinous infiltration of the periportal tissues.
- (g) Enlargement of all the lymph-glands.
- (h) Marked acute catarrhal gastro-enteritis with small haemorrhages.

These post-mortem lesions as well as subsequent inoculations with blood collected from the above pig, proved that the animal succumbed to the Koedoesrand virus disease.

Smears : All negative, except those taken from the affected parts of the lungs, which showed staphylococci and coli bacilli.

Cultures : All negative, except those made from the affected parts of the lungs, which showed the presence of staphylococci, coli bacilli, and bacillus *lanceolatus*.

*Pig 593.*—Forwarded to the Laboratory by Mr. Troye, Potgietersrust, on the 16.9.26. It was placed in the piggeries and died from the Koedoesrand virus disease on the 25.9.26, which it contracted from pigs engaged in that experiment.

Post-mortem Appearances :

- (a) Hydrothorax.
- (b) Subacute bronchopneumonia.
- (c) Enlarged and haemorrhagic lymph-glands.
- (d) Spleen enlarged.
- (e) Numerous subcapsular haemorrhages in kidneys.
- (f) Slight catarrhal enteritis.

Smears : All negative, except those taken from affected parts of lungs, which showed streptococci and staphylococci.

Cultures : Same results as in smears.

(a) *Unfiltered Culture-sterile Blood Injections.*

*Pig 596.*—Injected on the 22.9.26 with 5 c.c. blood from pig 583. The reaction started forty-eight hours after injection, lasted for three days, after which period the temperature dropped to 96° F. in the course of twenty-four hours. The animal died six days after injection.

Temperature : 106° to 107° F.

Pulse : 180 per minute.

Respiration : 120 per minute.

Post-mortem Appearances :

- (a) Hydropericardium.
- (b) Marked acute haemorrhagic and fibrinous gastro-enteritis.

Smears : Negative.

Cultures : Negative.

*Pig 598.*—Injected on the 27.9.26 with 5 c.c. blood from pig 593. Reaction commenced thirty-six hours after injection, and on the 8th day

the animal died, showing post-mortem lesions typical of the Koedoesrand virus disease. Twelve hours before death the temperature fell from 107° to 100° F.

Temperature: 107·8° C.

Pulse: 160 to 176 per minute.

Respiration: 98 to 108 per minute.

Post-mortem Lesions:

- (a) Marked hydropericardium.
- (b) Acute fibrinous pericarditis.
- (c) Subepi- and subendocardial haemorrhages.
- (d) Tumor splenis with hyperplasia of the malpighian bodies.
- (e) Enlargement and haemorrhagic infiltration of all lymph-glands.
- (f) Degeneration of liver.
- (g) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (h) Marked acute catarrhal gastro-enteritis with haemorrhages.
- (i) Subserosal haemorrhages in small intestine.
- (j) *Ascaris suis* in caecum.

Smears and Cultures: Negative.

*Pig 599.*—Injected subcutaneously on the 13.10.26 with 2 c.c. blood from pig 536. Reaction commenced twenty-four hours after injection and died on the 11th day from the Koedoesrand virus disease.

Temperature: 104° to 107° F.

Pulse: 160 per minute.

Respiration: 100 per minute.

Post-mortem Appearances:

- (a) Marked hydropericardium.
- (b) Acute fibrinous pericarditis.
- (c) Subepi- and subendocardial and intramyocardial haemorrhages.
- (d) Tumor splenis with hyperplasia and haemorrhagic condition of all the lymph-glands.
- (f) Degeneration of liver.
- (g) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (h) Marked acute catarrhal gastro-enteritis with haemorrhages and a few necrotic foci in rectum.
- (i) Subserosal haemorrhages in small intestine.

Smears and Cultures: Negative.

*Pig 601.*—Injected subcutaneously on the 16.10.26 with 3 c.c. blood from pig 597. The reaction commenced forty-eight hours after injection, the animal dying from the Koedoesrand virus disease on the 21.10.26, with a fall in temperature of 7° within the last thirty-six hours before death.

Temperature: 107° F.

Pulse: 180 per minute.

Respiration: 108 per minute.

Post-mortem Appearances:

- (a) Hydropericardium.
- (b) Subepi- and subendocardial haemorrhages especially marked in left ventricle.
- (c) Subcapsular and intracortical haemorrhages in kidneys, with degenerative changes.

(d) Tumor splenis.

(e) Marked acute haemorrhagic gastro-enteritis with subserosal haemorrhages in small intestine.

Smears: Negative.

Cultures: All negative, except those from the heart-blood and liver, which showed Gr. bacilli.

*Pig 622.*—Injected subcutaneously on the 19.11.26 with 2 c.c. blood from pig 598. Reaction commenced seventy-two hours after injection, the animal dying from the Koedoesrand virus disease on the 24.11.26.

Post-mortem Appearances:

(a) Hydropericardium.

(b) Marked tumor splenis with hyperplasia of malpighian bodies.

(c) Numerous subendocardial and intracortical haemorrhages in kidneys.

(d) Slight catarrhal bronchitis.

(e) Acute haemorrhagic typhlitis and colitis.

(f) Enlargement and haemorrhagic condition of all lymph-glands.

*Pig 624.*—Injected subcutaneously on the 19.11.26 with 2 c.c. blood from pig 597. Reaction commenced thirty-six hours after injection. On the 29.11.26 the animal was killed *in extremis*.

Temperature: 106.2° C.

Post-mortem Appearances:

(a) Hydropericardium.

(b) Subendo- and subepicardial haemorrhages.

(c) Atelectatic foci in both lungs.

(d) Degeneration of liver.

(e) Tumor splenis with hyperplasia of malpighian bodies.

(f) Enlargement and haemorrhagic infiltration of all lymph-glands.  
Smears and Cultures: Negative.

(b) *Unhaemolysed and Filtered Blood Injections.*

*Pig 605.*—Injected subcutaneously on the 16.10.26 with filtered blood from pig 597. Reaction started on the 3rd day after injection, but the animal recovered. On the 9.12.26 the pig took ill again (Temperature: 107.4° F.), and was killed *in extremis* on the 13.12.26. The boy attending the pigs must have carried the infection, as the pig in question took ill seven weeks after the injection.

Temperature: 107.4° F.

Pulse: 108 per minute.

Respiration: 76 per minute.

Post-mortem appearances:

(a) Purulent conjunctivitis.

(b) Hydropericardium.

(c) Mucopurulent bronchitis.

(d) Degeneration and hyperaemia of liver.

(e) Marked tumor splenis with hyperplasia of malpighian bodies.

(f) Enlargement and haemorrhagic infiltration of all lymph-glands.

(g) Marked haemorrhagic gastro-enteritis.

(h) Catarrha' oesophagitis.

- (i) Numerous subcapsular and intracortical haemorrhages and degeneration in kidneys.

Smears and Cultures: Negative.

Pigs 600, 602, 613, and 614 injected with unhaemolysed and filtered blood and discussed under the immunity tests.

(c) *Haemolysed and Filtered Blood Injections.*

*Pig 607.*—After having been fed with different bacterial cultures and having shown no reaction, this pig was injected subcutaneously with 2 c.c. blood from pig 605 on the 14.12.26. Reaction commenced four days after injection and lasted until death from the Koedoesrand virus disease on the 26.12.26.

Temperature: 108.1° F.

Pulse: 160 per minute.

Respiration: 88 per minute.

Post-mortem Appearances:

(a) Marked decomposition.

(b) Numerous subcapsular and intracortical haemorrhages in kidneys.

(c) Marked haemorrhagic enteritis.

(d) *Ascaris suis* frequent in small intestine.

No smears and cultures made on account of decomposition.

*Pig 619.*—Injected subcutaneously on the 19.11.26 with 2 c.c. blood from pig 598. Reaction commenced forty-eight hours after injection, the animal dying from the Koedoesrand virus disease on the 25.11.26.

Temperature: 106.7° F.

Pulse and Respiration: Not observed during my absence from Onderstepoort.

Post-mortem Appearances:

(a) Hydropericardium.

(b) Subendocardial haemorrhages in left ventricle.

(c) Slight catarrhal bronchitis.

(d) Marked tumor splenis.

(e) Numerous subcapsular and intracortical haemorrhages in kidneys with degeneration.

(f) Acute haemorrhagic typhlitis and colitis.

(g) Enlargement and haemorrhagic infiltration of all lymph-glands.

Smears: All negative, except those made from bronchial exudate, which showed staphylococci and coli bacilli.

Cultures: As smears.

*Pig 621.*—Injected subcutaneously on the 19.11.26 with 2 c.c. filtered blood from pig 597. Reaction commenced forty-eight hours after injection and lasted until the death from the virus disease on the 26.11.26.

Temperature: 106.7° C.

Post-mortem Appearances:

(a) Hydropericardium.

(b) Subendocardial haemorrhages left ventricle.

(c) Slight catarrhal bronchitis.

(d) Numerous subcapsular and intracortical haemorrhages in kidneys, with degeneration.

- (e) Enlargement and haemorrhagic infiltration of all lymph-glands.
  - (f) Acute haemorrhagic typhlitis and colitis.
  - (g) Degeneration of the liver.
- Cultures : Negative.

#### *Immunity Tests.*

*Pig 600.*—Injected subcutaneously on the 5.10.26 with 2 c.c. filtered blood from pig 596. Fever reaction ( $107.8^{\circ}$  F.) started twenty-four hours after injection and lasted two days, the animal being quite normal again after five days. On the 29.10.26, it received subcutaneously another 3 c.c. filtered blood from pig 596; no reaction. The immunity test with unfiltered culture-sterile blood from pig 596 was carried out on 5.11.26. The reaction commenced forty-eight hours after injection, the animal dying on the 12.11.26.

Temperature :  $107.0^{\circ}$  F.

Pulse : 156 per minute.

Respiration : 80 per minute.

Post-mortem Appearances :

(a) Marked post-mortem changes.

(b) Numerous subcapsular and intracortical haemorrhages in kidneys, with degeneration.

(c) Catarrhal enteritis with haemorrhages.

No smears and cultures made on account of decomposition.

*Pig 602.*—Injected subcutaneously on the 7.10.26 with 3 c.c. filtered blood from pig 598; no reaction ensued. The above injection was repeated on the 9.11.26, this time causing a fever reaction, which lasted nine days. On the 14.12.26 this animal was again injected with 2 c.c. unfiltered culture-sterile blood from pig 598. This injection only caused high fever ( $108^{\circ}$  F.), the animal recovering after eight days.

*Pig 603.*—Injected subcutaneously on the 12.10.26 with 2 c.c. filtered blood from pig 536. A fever reaction started forty-eight hours after injection and lasted eighteen days, after which period the animal recovered. When the immunity test was carried out on the 14.12.26, the animal succumbed to the virus disease seven days after subcutaneous injection with 2 c.c. of haemolysed and filtered blood collected at a temperature of  $107^{\circ}$  F. from pig 599.

Temperature :  $106.8$  F.

No cultures and smears were made during my absence from the Laboratory.

Post-mortem Appearances :

(a) Hydropericardium.

(b) Hydroperitoneum.

(c) Hydrothorax.

(d) Subendocardial haemorrhages in left ventricle.

(e) Marked oedema of the lungs.

(f) Congestion of the liver.

(g) Tumor splenis.

(h) Congestion of the kidneys with numerous subcapsular and intracortical haemorrhages.

(i) Marked hyperaemia of stomach.

*Pig 613.*—Injected subcutaneously on the 22.10.26 with 2.5 c.c. filtered blood from pig 596. No reaction resulted within the following fifty-two days, and on the 14.12.26 the animal was injected subcutaneously with 2 c.c. unfiltered blood from pig 605. A reaction ensued twenty-four hours after injection and continued until death from the virus disease on the 20.12.26.

Temperature : 107.6° F.

Pulse : 120 per minute.

Respiration : 84 per minute.

Post-mortem Appearances :

- (a) Hydroperitoneum.
- (b) Hydropericardium.
- (c) Hydrothorax.
- (d) Degeneration of myocard.
- (e) Tumor splenis.
- (f) Degeneration and congestion of kidneys and liver.
- (g) Marked hyperaemia of stomach.

Cultures and smears not made.

*Pig 614.*—Injected subcutaneously on the 27.10.26 with 2 c.c. unhaemolysed and filtered blood from pig 599. No reaction resulted within the next forty-six days. Injected subcutaneously on the 14.12.26 with 2 c.c. unfiltered blood from pig 599. Reaction commenced seventy-two hours after injection and lasted until death from the virus disease on the 22.12.26.

Post-mortem Appearances :

- (a) Hydrothorax.
- (b) Hydropericardium.
- (c) Subendocardial haemorrhages in left ventricle.
- (d) Oedema lungs.
- (e) Haemorrhagic enlargement of all lymph-glands.
- (f) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (g) Acute catarrhal gastro-enteritis with superficial necrotic foci in pyloric portion.

#### *Feeding of the Cultures.*

*Pig 607.*—Fed, mixed with food, the following cultures obtained from different organs and from the blood of pigs which have died from this virus disease :—

- (a) On the 16.10.26, 100 c.c. 24-hour bouillon cultures of coli and staphylococci.
- (b) On the 19.10.26, same as on 16.10.26.
- (c) On the 22.10.26, the above cultures plus Gr. — bacilli obtained from the heart-blood and liver of pig 601.
- (d) On the 26.10.26, 100 c.c. of the culture given on the 22.10.26.
- (e) On the 27.10.26, same as on 26.10.26.
- (f) On the 30.10.26, same as on 26.10.26.
- (g) On the 3.11.26, same as on 26.10.26.

Until the 13.12.26 the animal showed no reaction. On the 14.12.26 it was injected subcutaneously with 2 c.c. haemolysed and filtered blood from pig 605 and died from virus disease on the 26.12.26.

*Injection of Bacterial Cultures.*

*Pig 597.*—Injected subcutaneously on the 25.9.26 with 24-hour broth culture of Gr. + bac. *lanceolatus* obtained from the lungs of pig 583. On the 12th day after injection the reaction started, the animal dying from the virus disease on the 20th day.

The boy attending the pigs carried the infection from affected pigs, as it was subsequently proved that this bacillus *lanceolatus* had nothing to do with the cause of the disease, and that it was only a secondary infection.

Post-mortem Appearances :

- (a) Marked hydropericardium.
- (b) Intramyocardial, subepi- and subendocardial haemorrhages.
- (c) Tumor splenis with hyperplasia of malpighian bodies.
- (d) Haemorrhagic enlargement of all lymph-glands.
- (e) Degeneration of liver.
- (f) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (g) Marked acute catarrhal gastro-enteritis with haemorrhages.
- (h) Subserosal haemorrhages in small intestine.
- (i) *Ascaris suis* in caecum.
- (j) A few necrotic foci in rectum.

*Contact Experiments.*

*Pig 604.*—Placed in contact with pig 600, but no reaction resulted within the following two months.

*Sow 618* with six sucking pigs (619 to 624) were placed in a clean sty. 619, 621, 622, and 624 were injected with filtered and unfiltered blood on the 19.11.26, as described previously, and succumbed to this virus disease. 618, 620, and 623 were left as contacts and also died from this disease.

*Pig 618.*—The mother of the sucking pigs died from the virus disease on the 2.12.26.

Post-mortem Appearances :

- (a) Hydroperitoneum.
- (b) Hydropericardium and hydrothorax.
- (c) Subendocardial haemorrhages in left ventricle.
- (d) Congestion of liver.
- (e) Subcapsular and intracortical haemorrhages in kidneys.
- (f) Haemorrhagic enlargement of all lymph-glands.
- (g) Acute catarrhal gastritis.

*Pig 620.*—Died with symptoms typical of the virus disease on the 3.12.26.

Post-mortem Appearances :

- (a) Hydropericardium.
- (b) Subendocardial haemorrhages in left ventricle.
- (c) Atelectasis lungs.
- (d) Tumor splenis.
- (e) Subcapsular and intracortical haemorrhages in kidneys.
- (f) Haemorrhagic enlargement of all the lymph-glands.

*Pig 623.*—Died from the virus disease on the 4.12.26.

Post-mortem Appearances :

- (a) Hydropericardium.
- (b) Subendocardial haemorrhages in left ventricle.
- (c) Oedema of lungs.
- (d) Marked tumor splenis.
- (e) Haemorrhagic enlargement of all lymph-glands.
- (f) Subcapsular and intracortical haemorrhages in kidneys.
- (g) Catarrhal gastro-enteritis.

*Excretions.*

*Pig 606.*—On the 16th, 18th, 19th, 21st, 22nd, and 25th October, 1926, this animal was given, mixed with the food, faeces and urine collected from pig 600, which suffered from the virus disease. A fever reaction (107° F.) started on the 25th October and lasted nineteen days, after which period the animal recovered.

*Availables.*

The following available pigs died from the virus disease :—

*Pig 536 :* Died 8.9.26.

Post-mortem Appearances :

- (a) Hydroperitoneum.
- (b) Hydropericardium.
- (c) Subepicardial and subendocardial haemorrhages.
- (d) Oedema of lungs with localized bronchopneumonia.
- (e) Marked congestion of liver with haemorrhagic enlargement of the periportal lymph-glands.
- (f) Subcapsular and intracortical haemorrhages in kidneys.
- (g) Acute catarrhal gastro-enteritis with haemorrhages.

*Pig 594 :* Died 7.12.26.

Post-mortem Appearances :

- (a) Hydropericardium.
- (b) Subepicardial and subendocardial haemorrhages.
- (c) Oedema of lungs.
- (d) Tumor splenis.
- (e) Haemorrhagic enlargement of all lymph-glands.
- (f) Subcapsular and intracortical haemorrhages in kidneys.
- (g) Degeneration of liver.
- (h) Hyperaemia of stomach and small intestine.
- (i) Ascaris worms in small intestine.

*Pig 608 :* Died 31.12.26.

Post-mortem Appearances :

- (a) Mucopurulent conjunctivitis.
- (b) Hydropericardium.
- (c) Mucopurulent bronchitis.
- (d) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (e) Haemorrhagic enlargement of all lymph-glands.
- (f) Tumor splenis.
- (g) Marked catarrhal gastro-enteritis.

*Pig 609*: Died 3.1.27.

Post-mortem Appearances:

- (a) Marked decomposition.
- (b) Mucopurulent conjunctivitis.
- (c) Hydrothorax and hydropericardium.
- (d) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (e) Haemorrhagic enteritis.

*Pig 610*: Died 24.12.26.

Post-mortem Appearances:

- (a) Hydroperitoneum.
- (b) Hydrothorax and hydropericardium.
- (c) Subendocardial haemorrhages in left ventricle.
- (d) Degeneration of myocard.
- (e) Marked oedema of lungs.
- (f) Congestion of liver.
- (g) Tumor splenis.
- (h) Numerous subcapsular and intracortical haemorrhages in kidneys.
- (i) Marked hyperaemia of stomach.

*Susceptibility of other Domestic Animals.*

The following animals were injected subcutaneously with unfiltered and culture-sterile virulent blood from pigs which have died from the disease:—

Horse 17449.....	40 c.c.	blood from pig 600.
„ 18271.....	20 c.c.	„ „
Bovine 1776.....	50 c.c.	blood from pig 598.
Sheep 15253.....	10 c.c.	blood from pig 605.
„ 15299.....	20 c.c.	„ „
Goat 15203.....	10 c.c.	„ „
„ 14479.....	20 c.c.	„ „
Dog 479.....	10 c.c.	„ „
„ 480.....	20 c.c.	„ „
Cat (plain).....	5 c.c.	blood from pig 600.
„ (blue).....	10 c.c.	„ „
1 Rabbit (plain).....	·5 c.c.	blood from pig 605.
1 „ (blue).....	1·0 c.c.	„ „
1 „ (red).....	2·0 c.c.	„ „
1 „ (violet).....	3·0 c.c.	„ „
1 Guinea-pig (plain).....	·25 c.c.	„ „
1 „ (red).....	·5 c.c.	„ „
1 „ (red).....	1·0 c.c.	„ „
1 „ (violet).....	1·5 c.c.	„ „
1 Dove (plain).....	·1 c.c.	„ „
1 „ (red).....	·3 c.c.	„ „
1 „ (blue).....	·8 c.c.	„ „
1 „ (violet).....	1·0 c.c.	„ „

All these animals showed no symptoms of ill-health except one very poor-conditioned horse, which showed a local swelling at the point of injection.