

In practice the danger to human beings or other large mammals is probably not great, owing to the timidity of most individuals of this species of snake, and to the peculiarities of the dentition and the poison gland, requiring the most favourable circumstances for the infliction of a fatal bite.

- (b) The venom of this species is comparatively slow in its action, and there may be a very long incubative period, during which the bitten animal appears to be quite normal.
- (c) The chief action of the venom is apparently exerted on the vascular endothelium, with the consequent causation of numerous small haemorrhages.

Haemorrhagic lesions may occur in practically any organ or part, but they are generally most pronounced in the subcutaneous connective tissue.

Only in one case was there a visible rupture of a vessel or highly vascular organ, and in this case rupture of Glisson's capsule, and profuse haemorrhage, led abruptly to death.

In the majority of cases there is progressive weakness, from the occurrence of numerous small haemorrhages, and death occurs eventually, apparently from exhaustion and anaemia.

- (d) The venom also exerts a distinct anti-coagulative action on the blood.

2. *Trimerorhinus rhombeatus*, and *T. tritaeniatus*, the so-called "Schaapstekers":—

- (a) These have been shown to possess a venom, and to be able to inflict bites fatal to such small animals as guinea-pigs and rabbits.

From one experiment it would appear that, given a favourable combination of circumstances, *T. rhombeatus* at least is capable of killing sheep also, but confirmation of this case is desirable.

- (b) The chief symptom shown was the occurrence of a rapid series of more or less general muscular contractions, these contractions being most probably due to the onset of asphyxia.

3. With *Leptodira hotamboeia*, a number of experiments all gave negative results, and it would appear that this species does not secrete a venom seriously inimical to such animals as guinea pigs, or, more probably, that it is unable to introduce beneath the skin of such animals a quantity of venom sufficient to cause noticeable disturbance of health.

4. Negative results were also obtained in a few experiments with *Tarbophis semiannulatus* and *Psammophis furcatus*.

It would therefore appear that *some* opisthoglypha, at least, must be regarded as distinctly venomous snakes, and that it is advisable thoroughly to test all members of this division.

The larger opisthoglypha especially should be considered as venomous, and treated with caution, until definitely proved by actual experiment to be harmless.

*Experiments with Proteroglypha.*

Of the fourteen species of *Proteroglypha* (excluding *Hydrus*) recognised as occurring in South Africa, only three species, *Naia haie* and *flava*, and *Sepedon haemochates*, have been available for experiments on these lines.

It is particularly to be regretted that there has been no opportunity of working with *Dendraspis angusticeps*, the much dreaded Mamba, and so little is known of the venomous powers of the members of the genera *Elapechis*, *Aspidelaps*, and *Homorelaps*, that definite data on this subject would be of great interest, and possibly of practical importance.

The venoms of *Naia nigricollis* and *Naia anchietae* will doubtless prove to be very similar in their effects to those of the two species of this genus which have already been tested, but there may be interesting variations in detail.

1. *Naia Haie, The Egyptian Cobra.*

This snake, which is apparently common in many parts of the Transvaal (including Onderstepoort and its vicinity), was tested on the following animals:—

Two horses. One horse died, and the other was only very slightly affected.

One donkey. This animal was bitten on two occasions, and recovered.

Four sheep. Of these, two sheep died, and one recovered, after exhibiting symptoms of serious general disturbance. The fourth sheep, which was not visibly affected, was bitten by a cobra immediately after the latter had inflicted the bite causing one of the fatalities (in sheep) recorded above.

One dog, which died.

Thus of the eight animals bitten, four died, three recovered, and one did not receive sufficient venom to cause any noticeable ill-health.

The following records of cases are given to illustrate the course of the intoxication, and the nature of the symptoms and lesions observed.

*Horse 6,520.*

19th December, 1911, 12.30 p.m. Temperature 99·6°F, pulse 42 beats a minute.

1 p.m. The horse was bitten on the right side of the neck by an Egyptian cobra.

1.3 p.m. The animal was feeding quietly in a stall.

1.14 p.m. Slightly restless, not feeding, and occasionally stretching the head to the ground. Pulse 37.

1.17 p.m. Occasional muscular tremors, especially in the hind legs.

1.20 p.m. Very restless, turning around, and stretching the head to the ground.

1.22 p.m. Turning and knocking the head gently against the stall partition.

1.25 p.m. Respirations 39 per minute. The horse was now standing quietly, with the head hanging, and had a dull appearance. Muscular tremors, sometimes local, and at other times more or less general, were noticeable.

1.30 p.m. The head was rested on the manger for a time, and was then held near the ground for some minutes, after which it was raised to the normal position.

At 1.40 p.m. the animal appeared to be rather better, and five minutes later it recommenced feeding, but this continued only for three minutes.

1.50 p.m. The horse was standing quietly with the head in the manger, eating a very little at intervals.

The pulse was 39, and the respirations 40 to the minute.

2 p.m. The head was pushed against the manger. The horse passed a moderate quantity of rather dark coloured urine, without protruding the penis.

2.10 p.m. The head was raised, but the animal was very quiet and dull.

At 3.30 p.m. the horse was very dull, and was resting the head against the wall.

3.45 p.m. The general condition was unchanged; there was noticeable salivation. Pulse 34, respiration 29.

3.50 p.m. The horse was swaying from side to side, and "boring" into the wall; urine was passed, but the penis was not protruded from the sheath.

The corneal reflex was easily obtained, and the animal switched at flies with the tail, but less actively than previously.

4.5 p.m. The horse was given a bucket of water, and, when the head was pushed into the water, it appeared to drink a little mechanically, but most of the water taken in by the mouth escaped through the nostrils.

The animal rested the head on the edge of the bucket until the latter was removed; the head was then rested on the manger, and against the wall.

4.15 p.m. There were occasional muscular tremors in the right foreleg.

4.35 p.m. The horse was swaying and boring more heavily into the wall, and there were muscular tremors in both forelegs.

4.39 p.m. The animal kicked several times with the left hind leg; the left foreleg was repeatedly raised, and the body rested on the right side against the manger.

4.45 p.m. The general condition improved slightly, but the horse was leaning forward against the manger.

6.30 p.m. The animal was dull, and leaning forward against the manger; the legs were moved occasionally.

7 p.m. The horse was leaning forward, with the head stretched out and resting on the front dividing wall of the stall. The hind legs were slightly "straddled."

There was much sweating and salivation, and the pulse was 32, fast and slightly intermittent.

The respirations were rather deep and hurried.

At 8 p.m. the horse was still leaning forward against the wall and stall division, the hind legs were "straddling" and the penis was hanging from the sheath. The corneal reflex was active.

At 8.30 p.m. the horse, which was in the same position, succeeded, after frequent attempts, in passing much urine, the flow being several times interrupted.

The animal was sweating slightly, and the corneal reflex was not very active. The pulse was 38, and the respirations, which were shallow, were 30 to the minute.

At 11 p.m. the position was unchanged; there was much salivation.

20th December, 12.15 a.m. The position was unchanged. Salivation was very noticeable, the jaws were working, and the eyes appeared to be retracted.

6 a.m. The horse was lying on its side.

At 7 a.m. the horse was lying down, and was making frequent efforts to rise, and to roll over.

There was slight salivation, the respirations were very deep, the neck was arched, and the nostrils and jaws were working almost continuously.

At 8 a.m. the horse was lying with the head turned to the chest, the eyes were closed, and the respirations were very deep.

At 9 a.m. the animal was lying on the side, the eyes had a "sunken" appearance, and the respirations were deep and laboured. There were occasional kicking movements.

At 10 a.m. the horse was found dead, 21 hours after the bite.

*Post-mortem examination* performed two hours after death.

An aged bay gelding, condition poor, rigor mortis absent.

*Subcutaneous Connective Tissue.*—There was an area of infiltration on the right side of the neck over the jugular furrow, and extending on to the breast, on both sides, to the level of the elbow. This area showed the presence of much yellow liquid, and yellow gelatinous material, and the infiltration extended to the subjacent muscular tissue. There were also a few small subcutaneous haemorrhages.

*Peritoneal Cavity.*—Empty and normal.

*Pleural Cavities.*—Normal.

*Pericardial cavity* contained 50 c.c. dark straw-coloured liquid.

*Lungs.*—Collapsed normally. A few fibrous filaments were present on the pleura. The lungs contained several small cysts with yellow semi-liquid contents.

*Trachea and Bronchial Glands.*—Normal.

*Heart.*—Epicardium showed a few white fibrous patches.

The blood in the left ventricle was uncoagulated, but a small coagulum was present in the right ventricle. The endocardium in both ventricles showed yellow patches; there was an ecchymosis in the left ventricle.

*Liver.*—On section the parenchyma appeared greenish yellow in colour, with indistinct lobulation; it was softer than normal.

*Kidneys* appeared normal.

*Suprarenal Glands.*—Normal.

*Spleen.*—The pulp was dark, and appeared dry; trabeculae fairly distinct.

*Stomach.*—The organ was contracted, and contained a little food material. The mucous membrane appeared normal.

*Jejunum.*—The mucosa showed a few petechiae.

*Ileum.*—Normal.

*Caecum* contained a few *S. armatum*. Mucosa normal.

*Colon.*—Mucosa normal.

*Mesenteric Glands.*—Normal.

*Bladder* contained much brownish urine, with a few flocculi.

*Brain and spinal cord* appeared normal.

### *Donkey 6953.*

*10th January, 1912, 12.27 p.m.* The donkey was bitten on the left shoulder by an Egyptian cobra; the snake first lost some venom by biting at the stick used in the manipulations.

*12.35 p.m.* A small oedematous swelling was visible in the region of the bite.

*12.50.* Blood was slowly trickling from the punctures. The animal appeared rather dull and depressed. The pulse was 50.

*12.55.* The animal was distinctly dull and depressed, the head was hanging, at times almost to the ground, and the eyes were closed.

The left foreleg was frequently raised.

*1 p.m.* The condition had not changed.

At *1.45 p.m.* the donkey was standing quietly, with the eyes closed; it was very depressed, but quite conscious. The pulse was 50. The swelling had increased somewhat in size, and had extended downwards for several inches.

*2.15 p.m.* The animal was very dull, but there were occasional restless movements, and the head was sometimes stretched to the ground.

*2.55.* The animal was standing quietly, with the eyes closed.

From *3 to 4 p.m.* the donkey stood for periods quite motionless, with the eyes closed. Occasionally it would move about restlessly for a few minutes, and start feeding, but after about 5 minutes it would again become dull and quiet.

At *4 p.m.* the swelling was much larger, hard and painful, and it was extending downwards.

Throughout the evening the donkey was very dull and depressed, and the swelling increased much in size.

*11th January.* Throughout the day the animal was very depressed. The swelling was not very large, and formed a discrete pendulous mass under the breast.

*12th January.* There was general improvement, and the animal took a little food. The swelling was rather larger.

*13th January.* The animal was still rather dull and depressed, but was feeding well.

The swelling was still very large, but was softer; it was very pendulous, with sharply-defined edges, and a slight constriction or neck.

*14th January.* The general health had much improved, and the swelling was slightly reduced in size.

*15th January.* The animal's general health was apparently restored to the normal, and the swelling was distinctly smaller.

From the *16th to the 18th*, the swelling disappeared rapidly, and the general health remained unimpaired.

On the 23rd January the experiment was repeated, the donkey being bitten on the right side of the neck by an Egyptian cobra at 1 p.m.

At 2 p.m. there was slight oedematous swelling over the region of the bite, and this increased somewhat during the evening.

On the following day the swelling was hardly noticeable, and by the morning of the 25th January it had disappeared.

The general health was not visibly affected at all.

### *Sheep 3675.*

1st February, 1912, 3.45 p.m. The sheep was bitten in the left thigh by an Egyptian cobra (some venom was lost before biting).

4 p.m. The sheep was nervous and rather restless, and the respiration was rather hurried.

At 5 and 6 p.m. the animal appeared to be quite normal.

8 p.m. The sheep was found lying on the side. Respiration was noisy and laboured, the eyes were open, and the pupils were sensitive to light, but the corneal reflex was inelicitable.

No swelling nor discoloration of the skin was visible.

At 8.55 p.m. death occurred,  $5\frac{1}{4}$  hours after the bite was inflicted.

*Post-mortem examination*, made after 10 hours.

Merino hamel, four teeth, condition fair, rigor mortis present. Blood coagulated.

*Subcutaneous Tissue*.—There was an area of slight oedematous infiltration, not haemorrhagic, over the right thigh, and extending above on to the abdominal wall for about two inches.

*Peritoneal cavity* contained 20 c.c. blood-tinged liquid.

*Pleural cavities* contained each 5 c.c. blood-tinged liquid.

*Pericardial cavity* contained 20 c.c. clear liquid, and a large fibrinous coagulum.

*Lungs* not completely collapsed. Both lungs were affected with oedema, and the right lung contained one small cyst.

*Trachea* contained froth. Mucosa was hyperaemic.

*Bronchial glands* were hyperaemic.

*Heart*.—The epicardium showed small ecchymoses, and both endocardia presented the same lesions. The cavities contained coagulated blood.

The myocardium appeared pale, and was softer than normal.

*Liver*.—The parenchyma was pale yellow in colour, and soft.

The gall-bladder contained viscid yellow bile.

*Kidneys*.—The capsule was easily detached; on section, the parenchyma showed some post-mortem discoloration.

*Spleen*.—The pulp was pale and moist in appearance, and the trabeculae were indistinct.

*Abomasum* contained normal food material mixed with some blood.

The mucosa showed a few small haemorrhagic patches.

*Omasum*.—There were a few haemorrhagic streaks on the leaves.

*Jejunum*.—The mucosa was slightly yellow in colour.

*Ileum*.—The mucosa was normal; in the submucosa were a number of parasitic nodules.

*Caecum* as the Ileum.

*Colon* as the Ileum.

*Sheep 3622.*

On the 1st February, 1912, this sheep was bitten on the left thigh by an Egyptian cobra, immediately after the latter had bitten Sheep 3675. There were no noticeable symptoms of disturbance of health.

On the 8th of February the experiment was repeated, the sheep being bitten in the left thigh, and the udder, at 3.56 p.m.

At 4.5 p.m. the sheep was lame, and when not moving around the box, it would sway slightly from side to side, and move the bitten leg restlessly.

At 4.11 p.m. the animal was standing in a corner of the box, swaying slightly, and with the head turned around to the left side.

At 4.16 p.m. the sheep was limping around the box, staggering slightly, and at 4.17 p.m. it lay down; the respiration was hurried.

Two minutes later the animal rose and backed into a corner; the head was hanging, and the respiration was hurried.

At 4.25 p.m. the animal was distinctly better, and several times started rather listlessly to eat.

The improvement continued, and at 5 p.m. the animal was feeding quietly, and showed no signs whatever of general disturbance; lameness was still present.

The sheep was kept under observation until midnight, but no further symptoms were manifested.

The following day, at 7 a.m., the animal was found dead; it had succumbed between 8 and 15 hours after the infliction of the bite.

*Post-mortem examination* performed within 7 hours of death.

Merino Hamel, 6 tooth, condition fair, rigor mortis absent. Blood coagulated.

*Subcutaneous Tissue.*—On the inner aspect of the left hindleg there was an oedematous, non-haemorrhagic infiltration, extending from the stifle joint to the hock. There were also two small areas of a similar nature in the pubic region.

*Peritoneal cavity* empty, normal.

*Pleural cavities* empty, normal.

*Pericardial cavity* empty, normal.

*Lungs* only slightly collapsed. Both lungs showed oedema, and well-marked congestion.

*Trachea* contained froth. Mucosa was hyperaemic.

*Bronchial glands* normal.

*Heart.*—The epicardium and endocardium were normal. The cavities contained coagulated blood.

*Liver.*—On section the parenchyma was pale, with indistinct lobulation, and rather soft in consistency.

The gall-bladder contained thin yellow bile.

*Kidneys* were quite normal in appearance.

*Spleen.*—The pulp was pale and moist in appearance, and the trabeculae were indistinct.

*Abomasum.*—Normal.

*Omasum.*—Normal.

*Jejunum.*—Mucosa pale.

*Ileum.*—Mucosa pale.

*Caecum.*—The mucosa showed a few petechiae.

*Colon.*—There were a few parasitic nodules (*Oesophagostomum*) in the sub-mucosa; the mucosa was normal.

*Sheep 2803.*

4th January, 1912. 12.55 p.m. The sheep was bitten in the right thigh by an Egyptian cobra; the snake managed first to bite the pole used in the manipulations.

1 p.m. Respiration was hurried.

1.10 p.m. There were occasional restless movements of the legs, and especially of the right hind leg.

1.15 p.m. The respirations were somewhat less frequent, but were noticeably fast, and there were occasional movements of deglutition. The right hind leg was drawn back.

1.18 p.m. The respiration varied somewhat, being more frequent during some short periods than at other times.

The animal advanced to the side of the box, and licked the wall for about one minute. The head was then withdrawn a few inches from the wall, and the animal stood dully, with the right hind leg drawn well back.

1.20 p.m. The animal was standing in the same place, resting the nose against the wall, and it coughed several times.

It appeared to be very dull and depressed, but was quite conscious of its surroundings.

The sheep lay down, with the head turned around to the right flank. The jaws were working, and occasionally the animal bit at the air. Respiration was very hurried.

Two minutes later the animal rose, and stood with the head hanging, the back arched, and the hind legs "straddled." The jaws were no longer working.

1.30 p.m. The animal was standing in the same position as before, with the eyes closed. Respiration was hurried, and there were occasional movements of deglutition.

The sheep began suddenly to rub the head from side to side against the wall, licking the plaster, and working the jaws.

The head was then rested on the ground for a minute, and for another minute the licking was resumed.

The animal was quite conscious of any movement, or of the approach of an attendant.

1.36 p.m. The animal walked a few steps, grinding the teeth occasionally, and then stood in a normal position; respiration was hurried.

1.39 p.m. The animal was restless for two minutes, and then stood for several minutes pushing into the wall; the head was hanging, and the back was arched.

The sheep remained fairly still for some minutes, showing only occasional restless movements of the legs or head, and occasionally grinding the teeth. It was dull and depressed, but quite conscious, and fled when approached, showing a slight degree of lameness.

At 2 p.m. it was quiet and dull, standing near the wall, and resting the head against it.

At 2.30 p.m. the animal was lying down, but it rose when approached, and tried to escape; it was now very lame.

At 3 p.m. it was standing in a normal position, and the respiration was quiet, regular, but somewhat fast.



At 5 p.m. the general health had improved markedly, but the animal was very lame and there was a soft swelling on the inner aspect of the right hind leg, extending halfway down the tibial region.

At 9 p.m. the general health appeared to be excellent, but the swelling had increased in size, and the leg was carried.

*January 5th.* The general health was good, and the animal was feeding well, and ruminating.

The leg, however, was much swollen down to the hock joint, on both the inner and the outer aspects, and the swelling was hot, tense, and painful.

The sheep was lying down during the greater part of the day, and, when forced to rise, it carried the right hind leg.

After this time the general health remained unimpaired, and the swelling subsided very slowly, the lameness rapidly decreasing.

There were no signs of local suppuration, and by the 20th of January the swelling had entirely disappeared, and recovery was complete.

(N.B.—This sheep succumbed, three days later, to the effects of the bite of a Cape cobra, *Naia flava*).

*Dog 1209.* March 18th, 1912.

3.58 p.m. The dog, a large mongrel terrier, was bitten three times in the abdomen by a young Egyptian cobra, only one foot in length.

It was kept under observation until 6.15 p.m., and during this period the animal appeared to be quite normal in all respects.

At 8 p.m. the dog was found dead, and rigor mortis had commenced.

The dog was lying on the abdomen, with the hind legs widely abducted; the head was turned to one side, and much froth was exuding from the mouth and nostrils.

The animal had defaecated and micturated very freely, and there were signs of much struggling.

In this case death had occurred less than four hours after the bite, and no symptoms were shown during the first  $2\frac{1}{4}$  hours (and possibly considerably longer) of this period.

In the final stage there had evidently been respiratory distress, and more or less general convulsions.

*Naia Flava, the Cape or Yellow Cobra.*

Living snakes of this species, which is confined to Cape Colony and German South-West Africa, were procured through the kindness of Mr. F. W. Fitz Simons, of the Port Elizabeth Museum.

They were allowed to bite a horse, a mule, and two sheep, and in every instance the case terminated fatally.

The records of the cases are as follows:—

*Horse 4389.*

*9th February, 1912, 11.50 a.m.* The horse was bitten twice on the right side of the neck by a Cape cobra.

The animal was kept under observation until midnight, and during this period there were no symptoms of general disturbance.

At 2 p.m. a small oedematous swelling was noticeable in the region of the bite, and at 4 p.m. this had become an oedematous plaque as broad as the hand.

The swelling continued to increase in size, and extended down the neck towards the breast.

*10th February*, 7 a.m. The animal appeared rather dull, and there was a large soft pendulous swelling under the breast.

At 9 a.m. the horse was very restless, and the jaws worked incessantly, as in mastication.

The restlessness increased, the horse walking around the box with a progressive unsteadiness of gait.

The lips were not under complete control, the lower lip hanging considerably, and the jaws and lips were continually working, but although the head was frequently pushed into the manger, and attempts to eat were made, no food was taken properly into the mouth, or swallowed.

At times the animal was very restless, frequently stretching the head forward and knocking the food out of the manger by lateral movements; sometimes it was dull, and the head was rested.

The corneal reflex was active, and the horse was quite conscious of any movement or approach.

The pulse was full and regular, and the respirations were not noticeably hurried, nor altered in character.

At 1 p.m. the jugular blood was tested for coagulation, and for the presence of pigment in the plasma; it was found to be quite normal.

During the afternoon the depression increased, and at 5 p.m. the horse was lying on the side, with the tongue paralysed and hanging from the mouth, and the lips falling away from the incisor teeth, which were thus exposed.

The pulse was weak and infrequent, and the respirations were infrequent, spasmodic and stertorous.

There were occasional spasmodic movements of the legs and the head.

*11th February*, 12.15 a.m. The condition was similar, but the animal was noticeably weaker.

At 7 a.m. the horse was found dead, about 43 hours after the bite.

*Post-mortem examination*, made at 7 a.m., *11th February*.

An aged chestnut gelding, condition fair.

Rigor mortis present, blood coagulated.

*Sub-cutaneous tissue*.—Over the breast there was an area of oedematous, and in parts haemorrhagic, infiltration extending from the position of the bite, between the forelegs, to the level of the elbow.

*Pleural cavities*.—Empty and normal.

*Peritoneal cavity*.—Empty and normal.

*Pericardial cavity* contained 40 c.c. blood-tinged liquid.

*Lungs*.—Not completely collapsed. On section, the lung tissue exhibited some oedema and congestion.

*Trachea*, Normal.—*Bronchial glands* slightly oedematous.

*Mediastinal gland*.—Slightly oedematous.

*Heart.*—The epicardium showed ecchymoses, and the endocardium and myocardium appeared normal.

Large blood coagula were present in the auricles and ventricles.

*Liver.*—On section, the parenchyma generally was pale, with a mottled appearance; it was softer in consistency than the normal.

*Kidneys.*—The capsule was easily stripped. On section, there was congestion of all three zones, and the consistency was soft.

*Suprarenal glands.*—Normal.

*Spleen.*—The pulp appeared rather pale and moist; the trabeculae were very distinct.

*Stomach* contained much liquid. There were a number of *Gastrophilus equi* larvae present, and at the fundus was one small *Spiroptera* tumour.

The mucosa, at the fundus, showed small hyperaemic patches.

*Jejunum.*—The mucosa exhibited well-marked patches of hyperaemia, and small haemorrhagic areas.

*Ileum.*—Normal.

*Caecum* contained a few *S. armatum*. The mucosa showed a few petechiae.

*Colon.*—The mucosa showed a few small hyperaemic areas.

*Mule 6806.*

*10th January, 1912, 12.33 p.m.* The mule was bitten twice on the left side of the breast, and once at the base of the neck, by a Cape cobra.

12.40 p.m. Very slight swelling was noticeable over the two bites on the breast.

12.50. The animal was feeding quietly.

1.45. The animal was feeding quietly, but the swelling was slightly larger, and it was rather painful.

The pulse was 60 to the minute, and this was probably due to excitement, the animal resenting any handling.

At 2 p.m. the mule was rather restless, and occasionally worked the jaws for one or several minutes.

From this time until 4.30 p.m., the mule would stand for five or ten minutes with the head hanging; it would then raise the head and recommence feeding, but within two or three minutes it would drop the head again, and stand quietly as before.

At 4.15 p.m. the swellings (two in number) had increased much in size, and were extending downwards from the positions of the bites. These swellings were warm, hard, and painful when touched; and were now more or less confluent.

At 5 p.m. the animal was found staggering from side to side, working the jaws continually, with the head hanging, and the mouth open. The pulse was frequent and fast, and the respiration was hurried.

At 5.30 p.m. the mule was staggering around the box, with marked twitching of all the muscles of the body, occurring in spasms. The pulse was frequent, and slightly intermittent, and the respiration was hurried and deep.

The head was hanging, the mouth was open, and the jaws were occasionally working. The visible mucous membranes appeared normal. The condition rapidly became worse, and at 5.35 p.m. the

mule went down on the breast, with the neck arched, and the head was several times knocked fiercely against the ground.

At 5.36 the animal rolled on to the side, with the forelegs drawn up to the body, and the hind legs kicking violently.

There was twitching of all the surface muscles, and this was well-marked in the laryngeal muscles.

Respiration was now very jerky, both inspiration and expiration being cut very short; the pulse was irregular, and very frequent. The jaws were working, and there was slight salivation.

5.40. Respiration ceased.

5.43. The heart stopped, 5 hours and 10 minutes after the infliction of the bite.

*Post-mortem examination*, made 45 minutes after death.

An aged bay mule, female, in good condition.

Rigor mortis absent. Blood not coagulated.

*Sub-cutaneous tissue*. At and below the position of the bites, on the left side of the breast, there was an area of oedematous infiltration (not haemorrhagic), about 5 inches in diameter.

The subjacent muscular tissue was not infiltrated.

*Pericardial cavity* contained 30 c.c. of clear liquid.

*Lungs*.—Normal.

*Trachea*.—Normal.

*Bronchial and Mediastinal glands*.—Normal.

*Heart*.—The cavities contained uncoagulated blood.

*Epicardium*.—Normal.

*Endocardium*.—Paler than normal.

*Myocardium*.—Soft, and rather flabby in consistency.

*Liver*.—Enlarged. On the capsule were a few fibrous filaments.

The parenchyma was pale in colour, with distinct lobulation, and was of soft consistency.

*Suprarenal glands*.—Normal.

*Kidneys*.—On section, the cortex was rather pale in colour.

*Spleen*.—The pulp was slightly pale and dry in appearance.

*Stomach* contained normal ingesta. The mucosa showed hyperaemic patches.

*Jejunum*.—The mucosa showed some slight diffuse hyperaemia.

*Ileum*.—As the jejunum, with thickening and hyperaemia of Peyer's patches.

*Caecum* contained normal ingesta, and a few *S. armatum*.

The mucosa exhibited a few small petechiae.

*Colon*.—The mucosa was slightly thickened and oedematous.

*Sheep 2803*. 23rd January, 1912.

12.54 p.m. The sheep was bitten in the right thigh by a Cape cobra. It was kept under observation until 1.15 p.m. and during this time there was no sign of general nor local disturbance.

2 p.m. The animal was found dead, 1 hour and 6 minutes after the bite.

*Post-mortem examination*, made within an hour of death.

An aged merino hamel, in good condition.

Rigor mortis absent. Blood not coagulated.

*Skin*.—On the inner aspect of the right thigh were two livid areas, 3-4 centimetres in diameter.

*Sub-cutaneous tissue*.—On the inner aspect of the right thigh there was some oedematous infiltration, not haemorrhagic.

*Pericardial cavity* contained 10 c.c. clear liquid.

*Lungs* were only half collapsed, and there was a swelling in the middle lobe of the right lung, caused by a cyst with a fibrous wall enclosing some yellow amorphous material. Similar cysts of small size were scattered in both lungs, and the lung tissue exhibited some oedema.

*Trachea* contained froth. The mucosa showed injection of vessels.

*Bronchial glands* showed slight hyperaemia.

*Heart*.—The cavities contained uncoagulated blood.

A few petechiae were observed under the epicardium and the right endocardium.

*Liver*.—The parenchyma was rather pale, with indistinct lobulation, and the tissue was friable.

The gall-bladder contained thin yellow bile.

*Kidneys*.—There was slight hyperaemia of the cortex and medulla.

*Spleen*.—This was slightly enlarged (14 x 9.5 centimetres). The pulp was swollen and moist in appearance, and the trabeculae were indistinct.

*Abomasum*.—Normal.

*Omasum*.—Normal.

*Jejunum*.—Normal.

*Ileum*.—A few parasitic nodules in the sub-mucosa.

*Caecum*.—A few parasitic nodules in the sub-mucosa.

*Colon*.—A few parasitic nodules. The mucosa showed patches of slight hyperaemia.

*Sheep 3711.* 16th April, 1912.

2.27 p.m. The sheep was bitten once on the inner aspect of the right thigh by a Cape cobra.

2.40 p.m. The weight was being thrown on to the left hind leg.

2.57 p.m. The right hind hoof was raised from the ground, and the sheep was blowing slightly.

3.14 p.m. The animal commenced to struggle and fell, lying stretched out on the side.

3.26 p.m. Respirations were 43 to the minute, and rather shallow.

3.28 p.m. The heart beats were 50 to the minute, and the temperature was 104.2°F. There were occasional spasmodic contractions of the muscles of the trunk, legs, and tail, and a small quantity of faeces was passed.

The corneal reflex was not obtained, and the animal was unconscious of sound, movement, etc.

3.29 p.m. The jaws were working, and there was froth in the mouth. Respiration was accompanied by gurgling sounds in the throat, and râles could be heard on auscultation of the chest.

The nostrils were dilating slightly with inspiration.

3.30 p.m. Respiration was very slow and superficial, and ceased at 3.31 p.m. The heart beats were becoming progressively less frequent and weaker.

3.33 p.m. The heart stopped, 1 hour and 6 minutes after the bite. *Post-mortem examination*, made 40 minutes after death.

A Merino Hamel, 6 tooth, in fair condition.

Rigor mortis absent. Blood not coagulated.

*Sub-cutaneous tissue*.—There was no local lesion.

*Peritoneal and pleural cavities*.—Empty.

*Pericardial cavity* contained 10 c.c. clear liquid.

*Lungs* had not collapsed. A few sub-pleural haemorrhages were present. The lung tissue was oedematous.

*Trachea* contained food material and froth. The mucosa showed hyperaemic patches.

*Bronchial glands*.—Enlarged and slightly hyperaemic.

*Heart*.—The epicardium and endocardium appeared normal; the myocardium was somewhat softer than normal in consistency. The cavities contained a little uncoagulated blood (heart in systole).

*Liver*.—On section the parenchyma was pale in colour, with indistinct lobulation, and it was distinctly friable.

The gall-bladder contained thin green bile.

*Kidneys*.—On section, the cortex appeared rather paler than normal.

*Spleen*.—Normal in size. The pulp was soft and moist, and the trabeculae and malpighian bodies were not distinct to the eye.

*Abomasum* contained normal semi-fluid ingesta, and a few *H. contortus*.

The mucosa presented hyperaemic patches.

*Omasum, Rumen, Reticulum*.—Normal.

*Jejunum*.—The mucosa showed hyperaemic patches.

*Ileum*.—A few hyperaemic streaks were noticeable.

*Caecum*.—The mucosa showed a few small hyperaemic patches.

*Colon*.—There was well-marked diffuse hyperaemia of the mucosa.

#### *Sepedon Haemachates, the Ringhals.*

The species has a wide distribution in South Africa, and it is found in all four provinces of the Union, but I was able to procure only one living ringhals for experiment, the specimen in question being forwarded from the Cape Province by Mr. F. W. Fitz Simons.

This snake was allowed to bite:—

Two horses, which recovered after exhibiting some degree of disturbance, chiefly of a local character, and one sheep, which succumbed.

While in our possession, the snake gave birth to young, ten in number, but the young snakes could not be fed suitably, and only two of them attained the age of two months.

Before they died, however, some of these young ringhals, of which the ages varied in different experiments from a few hours to two months, were allowed to bite the following animals:—

One horse, which showed slight local swelling, but which developed no symptoms of general disturbance. A sheep, a dog, and a rabbit all of which succumbed, and three guinea pigs, of which two died and the third was not visibly affected.

The clinical and post-mortem records of the various cases are as follows:—

*Horse 5202.* 9th February, 1912. (*Vide* Plate 60.)

11.45 a.m. The horse was bitten near the base of the neck, on the right side, by a ringhals. The snake bit well, but much venom was deposited on the skin around the wound.

At 1 p.m. the animal was feeding quietly, but there was slight oedematous swelling in the region of the bite.

The swelling increased in size, at first very slowly, but until midnight, when the last observation was made, the general health was not affected.

*10th February.*—The general health was unimpaired, but there was a large swelling, very tense but not very sensitive, extending over the sternal region, and this swelling increased gradually in size throughout the day.

*11th February.* The swelling was the same, in size and character, as on the previous day.

Several times during the day the horse showed marked restlessness, wandering around the box with the jaws working; towards night the animal became quiet, but it was not visibly depressed.

*12th February.* The general health was excellent, and the swelling was softer, and slightly reduced in size.

After this time the general health remained unimpaired, and the swelling disappeared rapidly.

*16th February.* The animal was normal in all respects.

*Horse 5334.* 29th February, 1912. (*Vide* Plate 61.)

11.35 a.m. The horse was bitten on the right shoulder by a ringhals.

4 p.m. A small oedematous swelling was visible over the punctures, but the animal was feeding quietly, and the pulse and respiration were normal.

9 p.m. The animal appeared rather dull, but the pulse and respiration were unaffected. The swelling was increasing in size, and extending downwards towards the breast.

*1st March.* The horse was rather dull throughout the day, but was feeding, and the pulse was normal. The respirations were rather slow and infrequent, but they were quite regular, and there were no signs of respiratory distress.

The swelling had increased much in size, and it was tense and prominent, but not painful.

*2nd March.* The general health was good; the swelling had increased somewhat in size, but it was less prominent, owing to gravitation between the forelegs, down to the sternal region.

*3rd March.* No symptoms of general disturbance appeared. There were two small openings through the skin over the swelling, and some serous liquid escaped, but there were no signs of suppuration.

Within a few days the swelling had entirely disappeared, and the animal was completely restored to the normal.

*Sheep 3647.* 6th February, 1912.

3.50 p.m. The sheep was bitten three times on the right thigh by a ringhals.

3.55 p.m. The animal was lying down. When raised, it carried the right hind-leg, and staggered to the wall of the box. It then remained for a minute, leaning to the left side against the wall, with the head hanging, the back much arched, and the right hindleg raised from the ground.

The animal then commenced blowing, and became rather restless. This condition continued, the animal occasionally limping across the box, and then leaning to the left side against the wall, or leaning back against the walls in the corner of the box, and occasionally stamping with one foreleg.

At 4.10 p.m. the back was less arched, and the right hindleg was resting on the toe, with the fetlock flexed.

The respiration was hurried, and some muscular tremors were noted.

5 p.m. The animal was dull, but quite conscious; it was standing straighter, but was very lame. Respiration was less hurried.

At 6.55 p.m. the sheep was found dead; it was still warm, *rigor mortis* had not set in, and the blood had not coagulated.

Death occurred about three hours after the bite was inflicted.

*Post-mortem examination* performed at 8 p.m., about 75 minutes after death.

A merino hamel, young (four teeth), in fair condition. *Rigor mortis* absent.

*Skin.*—Over the right thigh there was a livid patch 8 x 5 centimetres. On section, the skin showed an area of intradermal hæmorrhagic infiltration, extending inferiorly as far as 10 centimetres below the femoro-tibial joint, on the anterior aspect of the leg, and superiorly over the thigh and groin, and 20 centimetres up the right hypogastric region.

There was hæmorrhagic infiltration of the subcutaneous areolar tissue over the same area.

*Peritoneal cavity* contained 10 c.c. clear liquid.

*Pleural cavities* empty.

*Pericardial cavity* contained 3 c.c. clear liquid.

*Lungs* collapsed normally, except the inferior half of the middle lobe of the right lung, where there were several abscesses with fibrous capsules enclosing a thick creamy pus, and varying in size up to twice that of a hen's egg. At this point both the pulmonary and the costal pleura was thickened and fibrous, but no adhesion had occurred. Otherwise the pleura and the lung tissue were normal.

*Trachea* normal. *Bronchial glands* normal.

*Heart.*—The right ventricle contained one soft black coagulum, and all the cavities contained uncoagulated blood.

The left endocardium showed one hyperæmic streak; the right endocardium, the epicardium, and the myocardium appeared normal.

*Liver.*—The parenchyma was pale, with fairly distinct lobulation; the consistency was soft.



The gall-bladder contained much thin brownish-yellow bile.

*Left kidney.*—The medulla was slightly hyperæmic in parts.

*Right kidney.*—The medulla was slightly hyperæmic in parts, and the boundary zone was markedly congested.

*Spleen.*—The pulp was swollen, pale, soft, and moist; the trabeculæ were indistinctly seen.

*Alimentary canal.*—The mucosa was normal throughout.

There were a few wire-worms (*H. contortus*) in the abomasum, and in the caecum and colon there were a few parasitic nodules due to *O. columbianum*.

*Sheep 3717.* 12th April, 1912.

3.30 p.m. The sheep was bitten on the left thigh by a ringhals aged two months.

4 p.m. Respiration was hurried.

4.30 p.m. The animal was standing with the hindlegs widely separated, the back arched, and the head depressed. A yellow mucous liquid, containing flocculi, was running from the nostrils and mouth, and the head was occasionally shaken violently.

Small quantities of urine and faeces were frequently passed, and there were occasional spasmodic contractions of the abdominal muscles.

4.34 p.m. Temperature 103° F. Violent retching commenced, and much liquid was passed from the nostrils and the mouth. The back was much arched, and the abdominal muscles were quivering.

The animal began kicking violently with one foreleg, and then, for a few seconds, with all four legs. It then staggered and fell, remaining recumbent, and resting on the sternum.

There were again a few retching movements.

The respiration was rather frequent, and the respiratory movements were quick and abrupt.

The animal was conscious of sound and movement, and the corneal reflex was readily obtained.

4.40 p.m. There was very violent retching, with gurgling sounds in the abdomen and throat, and some semi-fluid material was discharged by the mouth.

4.42 p.m. There was much mucus and froth around the nostrils and mouth and pronounced râles were heard on auscultation of the chest.

There were hurried convulsive contractions of the muscles of the thorax and abdomen, the head was stretched forward, and the nostrils dilated with each inspiration.

4.45 p.m. The respirations were less frequent (50 to the minute), and râles were not so noticeable.

4.47 p.m. There were convulsive heaving inspirations, and laboured expirations. The legs were working, the head was swaying from side to side, and the tail was violently agitated.

The sheep sank gradually on to the right side, and remained motionless.

4.49 p.m. Definite respiratory movements ceased, the pulse showing at that time 74 beats to the minute.

After this there were a few spasmodic contractions of the trunk and tail muscles generally, producing some inspirations.

The pulse was very frequent, and was intermittent; the frequency increased very markedly with each of these general spasmodic movements.

The heart gradually slowed, becoming weaker and more irregular, and it stopped at 4.55 p.m.

Shortly before death occurred, the pupil became widely dilated. The conjunctival reflex persisted, although feeble and activated only by actual contact, until 4.54 p.m.

Death occurred 1 hour and 25 minutes after the bite.

*Post-mortem examination*, made three hours after death.

A merino hamel, aged, in fair condition. *Rigor mortis* absent.

*Subcutaneous tissue*.—There was no visible local lesion.

*Peritoneal cavity* contained about 10 c.c. blood-stained liquid.

*Pleural cavities*, both contained blood-stained liquid.

*Pericardial cavity* contained 5 c.c. clear liquid, with a few flocculi.

*Lungs* only slightly collapsed, and on section showed marked œdema.

*Posterior Mediastinum*.—A large caseous abscess, the size of a turkey's egg.

*Trachea* contained much froth. Mucosa showed petechiæ.

*Bronchi* contained much froth. Mucosa showed petechiæ.

*Larynx* contained froth. Hyperæmic patches of the mucosa.

*Heart*.—The epicardium and myocardium appeared normal.

The left ventricle and auricle contained a little uncoagulated blood; the endocardium was normal. The right ventricle and auricle contained some partly coagulated blood; the endocardium showed ecchymosis in the auricle.

*Liver* was enlarged. The parenchyma appeared pale and bloodless, with indistinct lobulation; it was very soft and friable.

The gall-bladder contained much very thin light-yellow bile.

*Kidneys*.—Capsule easily stripped. The cortex was rather pale, with well-marked radial red streaks. The consistency was soft.

*Spleen*.—Normal in size. The pulp was rather pale in colour, and very soft; the trabeculæ were indistinct.

*Oesophagus* empty. Mucosa normal.

*Rumen*.—Very tympanitic. The mucosa was normal.

*Reticulum and Omasum* normal.

*Abomasum*.—Liquid contents, with fairly numerous H. contortus. The mucosa was normal.

*Duodenum*.—The mucosa showed a few petechiæ.

*Jejunum* was normal for the greater part of its length. The terminal portion showed diffuse hyperæmia of the mucosa, with hyperæmia and thickening of two Peyer's patches.

*Ileum* normal.

*Caecum*.—A few *O. columbianum* nodules.

*Colon*.—A few *O. columbianum* nodules.

*Dog 1208*. 12th March, 1912.

3 p.m. The dog was bitten on the right thigh by a ringhals aged one month (and less than six inches in length).

3.30 p.m. The dog was restless; salivation was noticeable.

3.35 p.m. The animal began to utter spasmodic cries, the respiration becoming deep and irregular, with sudden contractions producing spasmodic inspirations, accompanied by a shrill whistling sound.

The legs were struggling, and the tail was agitated; salivation was well-marked. The conjunctival reflex was lost soon after the struggling started.

3.40 p.m. The animal struggled occasionally, and there were occasional movements of inspiration.

3.43 p.m. Respiration ceased. During the next four minutes the heart continued to beat; the frequency decreased to 28 beats per minute, and the action then became very irregular, finally stopping at 3.47 p.m. During the following three minutes there were occasional spasmodic contractions of various muscles, especially those of the jaws and neck, and the abdominal muscles were quivering.

Death occurred less than 50 minutes after the infliction of the bite.

*Post-mortem examination* made within half-an-hour of death.

A large mongrel Irish terrier bitch, in good condition.

*Rigor mortis* was absent. The blood had not coagulated.

*Subcutaneous tissue*.—Slight œdema around the punctures.

*Serous cavities* empty and normal.

*Lungs* normal.

*Bronchial glands* normal.

*Heart*.—In diastole. The cavities contained uncoagulated blood. The epicardium, endocardium, and myocardium appeared normal.

*Liver*.—On section the parenchyma appeared hyperæmic, with fairly distinct lobulation; it was noticeably friable.

The gall-bladder contained viscid reddish bile.

*Kidneys* were normal in appearance.

*Spleen*.—The pulp was pale, and the trabeculæ showed up distinctly.

*Stomach*.—The mucosa showed slight diffuse hyperæmia.

*Jejunum*.—The mucosa presented hyperæmic patches.

*Ileum*.—The mucosa presented hyperæmic patches.

*Cæcum* normal.

*Colon* normal.

*Rabbit 2.* 24th February, 1912.

3.50 p.m. The rabbit was bitten in the abdomen by two young ringhals, aged 12 days.

4.5 p.m. The muscles of the limbs and jaws began suddenly to contract, producing a rapid series of jerking movements of the parts affected. This continued for a minute, and the rabbit then became quieter; the contractions of the pharyngeal muscles and the muscles of mastication continued, but there was only an occasional spasmodic jerk of a limb.

The corneal reflex was elicited only when the eye was actually touched.

A few seconds later, the muscular contractions increased again in frequency and violence, and the rabbit was staggering about, with dilated pupil, shaking from head to foot.

Finally the spasms involved the spinal muscles, and the rabbit rolled on to its side with general convulsions.

After some seconds the convulsions ceased, and the rabbit lay quietly on the side, with the hind limbs occasionally jerking for a few seconds.

4.8 p.m. Death occurred, 18 minutes after the bite.

*Guinea pigs 1, 2, and 3.* 13th February, 1912.

Each guinea pig was bitten in the abdomen by a ringhals, aged less than 24 hours.

*No. 1* showed violent muscular spasms, followed by paralysis, loss of consciousness, and death, which occurred 40 minutes after the bite.

*No. 2* presented the same symptoms, and died one hour after the bite was inflicted.

*No. 3* was not visibly affected.

*Post-mortem:* The rabbit and the two guinea pigs showed congestion of the liver and kidneys; there was no local lesion visible to the naked eye.

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## SUMMARY OF THE SYMPTOMS FOLLOWING BITES INFLICTED BY PROTEROGLYPHA.

The clinical symptoms observed in the cases recorded may be divided into several groups:—

### (1) *Local Symptoms.*

In some cases a local swelling is present, and subcutaneous, or intra-dermal, hæmorrhage may be noticeable.

The swellings vary greatly in size and extent, and in the length of time during which they are visible, and there are also considerable differences in their characters. In some cases the swelling is very soft and insensitive, and in such cases it is frequently pendulous; in other cases it may be hard or tense, warm to the touch, and very sensitive to manipulation.

It is important, in connection with the therapeutic treatment of snake bite, to note that these swellings show a great tendency to gravitation, and that such a swelling, when first seen, may therefore be most prominent in a region situated at some considerable distance from the actual position of the bite.

Of the seven animals bitten by *N. haie*, the four animals succumbing to the effects of the bite presented no swelling noticeable during life, but such lesions were noticeable in the three animals which recovered. In two of these cases (a donkey and a sheep) the swelling was hard and painful, and it attained large dimensions; in the third case (that of a horse) the animal was very slightly affected generally, and the swelling was small, soft, and insensitive.

The four animals bitten by *N. flava* all died. No swellings were shown by the two sheep, both of which succumbed after about an hour. The mule, which died five hours after the infliction of the bite, developed fairly small, but hard and painful, swellings, and the horse, which survived 43 hours, showed a large but soft and insensitive swelling.

With *Sepedon hæmachates* the three horses, which recovered from the effects of the bite, all developed a local swelling; in two cases the lesion attained considerable dimensions, but it was not painful. The sheep, the dog, and the smaller animals bitten, all died without developing any noticeable swelling.

In these cases the period elapsing from the time of the infliction of the bite, until the swelling was first noticeable, varied from five minutes to several hours.

In one case, that of a horse bitten by a ringhals, there was some serous discharge from the swelling through two cutaneous orifices, but in all other cases of general recovery, there was complete resolution locally, without cutaneous rupture or complication of any kind.

As far as one can judge from such a number of cases, it would appear that the formation of a large swelling, subsequent to the bite of a proteroglyphous colubrine, is usually a sign of a subacute case which will probably end in recovery.

The cause of the variation in the sensibility associated with the swelling in different cases was not apparent; the degree of local pain was certainly not proportional to the size of the lesion, and the anatomical situation varied but little in the different cases.

Any discoloration of the skin is generally difficult to distinguish in domesticated animals, on account of the hair or wool, and of the pigment normally present.

Livid areas were noticed in the vicinity of the fang punctures in two sheep, subjected to the bites of a *N. flava* and a *Sepedon hæmachates* respectively; in both cases the position was favourable to such observations, the bite having been inflicted on the skin covering the inner aspect of the thigh, which is comparatively free from wool or hair.

## (2) *Symptoms Directly Due to the Position of the Bite.*

These symptoms are naturally of a varied character. In the majority of our experiments the bite was inflicted on the neck, shoulder, or thigh of the experimental subject.

In cases in which the neck is primarily affected, there are usually no symptoms of this character beyond stretching the neck occasionally, unless an extensive local œdema follows, involving the forelimb by gravitation, and producing lameness.

A bite on a limb may produce lameness from pain, or from mechanical interference with the movement of a joint by swelling, and from either of these causes an animal may go down, and remain in a recumbent position for a considerable period.

If local pain is present, the affected limb may be moved restlessly, or the animal may assume some peculiar posture designed to relieve the affected region of all strain or weight-bearing.

The severity of these symptoms is naturally proportional to the degree of local pain or swelling.

(3) *Symptoms Due to Pain.*

The presence of local pain may be shown by a variety of symptoms.

If a limb is affected, there may be frequent jerky movements of that particular limb, it may be abducted or partially flexed, the weight being thrown on to the corresponding limb of the other side, or it may be carried.

The animal is probably lame, and it may assume some abnormal position, in which the affected part is rested as far as possible.

There are also general symptoms of pain, such as extreme restlessness, lying down and rising again repeatedly, sweating, hurried respiration, and a frequent hard pulse.

Such symptoms were noticeable in a donkey and three sheep bitten by *Naja haie*, in one sheep bitten by *Naja flava*, and in a sheep bitten by *Sepedon hæmachates*.

(4) *Nervous Symptoms.*

Excluding signs of pain, to which reference has already been made, there are two classes of nervous symptoms, indicating excitation and depression respectively.

In both cases the symptoms observed may be secondary in character, and not directly due to the action of the venom on the particular organ affected, nor on the nervous mechanism regulating the activity of such an organ.

Symptoms of nervous excitation include restless movements of the head, jaws, limbs and tail, and restless wandering about the box.

Quivering of muscles, or even strong spasmodic contractions, may be shown, and in each case the process may be local, or more or less general. In the final stage of asphyxia there may be general convulsions.

Grinding of the teeth may be noticeable, and salivation may be observed in an animal showing general symptoms of nervous excitation; frequent movements of deglutition have also been noticed, and copious defæcation and micturition.

Animals may also show such signs of cerebral disturbance as licking walls, biting the air, and knocking the head against the wall or manger.

Other symptoms of nervous excitation shown are frequent deep respirations and a frequent fast pulse.

It should be noted that some of the above-mentioned symptoms may be manifestations of pain, and in some cases it is difficult to determine whether pain is causing the symptoms or not.

The symptoms of nervous depression vary from slight dulness to paresis, either local or more or less general, and finally paralysis.

In the dull stage the animal is inclined to remain for long periods in one position; the head hangs, the ears droop, and frequently the eyes are closed.

Later, the animal may go down, or it may rest against a wall or manger, and give the appearance of "boring." Co-ordination of movement may become impaired, resulting in a staggering gait, and control over particular parts may be lost to a varying degree.

Thus the lips may hang away from the teeth, and be unable to close on any food, the anus may be relaxed, and the animal may be unable to protrude the penis, or to retract it when protruded.

Animals in a state of general depression sometimes show marked salivation.

The respiration and pulse may reflect the general state of depression, the corneal reflex may be slow or absent, and the animal may be weak, and unable to stand.

Finally, the animal may be comatose, and in that case death generally supervenes.

In our experiments, some at least of the above-mentioned symptoms of excitation were exhibited by the experimental subjects, with only two exceptions; in these two cases the animals (horses) were only slightly affected in general health.

In a number of cases local pain was apparently the cause of the majority, if not all, of such manifestations, and it is probable that the convulsive muscular contractions, noticeable particularly in the smaller animals, and especially as a result of the bite of *Sepedon haemachates*, were chiefly, if not entirely, due to respiratory distress and asphyxia.

Symptoms of cerebral disturbance, such as licking walls, and knocking the head against objects, were noticeable especially in a sheep bitten by *Naia haie*; they were also observed in a horse bitten by *Naia haie*, and a horse and mule bitten by *Naia flava*.

Signs of excitement, and in some cases pain, were usually (but not always) visible within 5 to 25 minutes of the bite.

Convulsive muscular contractions appeared, in those cases in which they were observed, within a comparatively short time of death.

Symptoms of depression were present in all cases, except in one horse, which recovered from the effects of a *ringhals* bite without exhibiting any general symptoms beyond slight restlessness.

In animals succumbing within a few hours, the period of depression was short, and frequently no well-marked symptoms of depression were noticeable until the animal was on the point of death, after making severe convulsive struggles.

Depression was better shown in animals surviving for longer periods, and in cases of recovery.

General dullness and weakness was most marked in a horse and a sheep bitten by *Naia haie*; progressive paresis and inco-ordination of movement was well-marked only in one horse, which succumbed to the effects of a *Naia flava* bite after 43 hours.

The general course of the intoxication with the venom of a proteroglyphous colubrine may be summarised thus:—

(1) In the majority of cases, there is a period of excitement and restlessness, appearing, as a rule, within half-an-hour.

(2) The preliminary excitement may be succeeded by a period during which the animal appears normal.

(3) Within an hour (or in larger animals within a few hours) of the bite, the animal may show convulsive muscular contractions, and it may then die, within a short period, of asphyxia.

This is observed more especially in sheep, dogs, and smaller animals, but it may occur in equines (*vide* Mule 6806).