Occurrence of Onchocerca in South Africa.

By G. DE KOCK, M.R.C.V.S., Dr.Med.Vet., Research Officer, Onderstepoort, and P. S. SNYMAN, B.V.Sc., Government Veterinary Officer, Durban.

Occurrence of Onchocerca in South Africa.

By G. de Kock, M.R.C.V.S., Dr.Med.Vet., Research Officer, Onderstepoort, and P. S. Snyman, B.V.Sc. (S.A.), Government Veterinary Officer, Durban.

The object of this paper is to determine the distribution of *Onchocerciasis* (Worm-nest nodules in cattle) in South Africa. James Chalmers, M.R.C.V.S., was the first to point out the existence of Onchocerciasis in Rhodesian cattle, at the close of the war in 1917, when South Africa participated in the beef export trade with the Imperial Government, and some of the specimens examined were collected by him.

The following observations were made at the abattoirs of Messrs. Sparks, Young, and Farmers' Meat Industries, Limited, Congella, Natal, where for the period 8th February to 3rd December, 1926, close on 67,000 head of cattle were slaughtered for export, from various parts of the Union, Rhodesia, and Bechuanaland Protectorate.

Geographical Distribution.—The occurrence of Onchocerca, the cause of worm nodules on the brisket of cattle seems to be more particularly confined to Southern Rhodesia than in any other part of South Africa, and particularly an area roughly bounded as follows: Que-Que in the north, Lala-Panzi in the east, West Nicholson on the south, and on the west by Bulawayo, thus including centres like Bala-Bala, Heany Junction and Gwelo. An occasional worm nodule has been detected on cattle from Bechuanaland and on cattle north of the Limpopo, entrained at Messina. Out of a lot of 384 cattle bought at a sale at Bloemfontein, O.F.S., only three old oxen showed small calcified nodules and about the same percentage of cattle bought at Matatiele and Mooi River in Natal had small calcified worm nodules.

From the position outlined above it may be assumed that the area described in Rhodesia serves as nucleus of the disease, and that it is steadily spreading outwards to the surrounding areas. Another factor which should also be kept in mind is the movement of cattle, as there seems to be a tremendous interchange and trade, not only amongst the natives and farmers themselves, but also between the natives and store-keepers. Snyman has counted no less than five different private brands on Bechuanaland cattle. This movement of cattle will therefore undoubtedly help to spread the disease.

As has already been mentioned, an occasional nodule is met with in Bechuanaland cattle, and in cattle from certain areas in the Union. It may be that the disease occurs primarily in Rhodesia.

Union cattle that arrived for slaughtering were from the whole of Natal, Eastern Free State, and Northern Transvaal. It is, however, unfortunate for this survey that cattle from more centres were not slaughtered, but the chief object has been gained, namely, to have been able to confirm the presence of Onchocerca in South Africa.

A point of considerable importance as regards the spreading of the disease is the fact that in the "Report on Texas Fever and Red

Water" by Gray and Robertson, in Rhodesia (1902), page 5, it is stated that in 1901 some 1,000 head of cattle were imported into Rhodesia from New South Wales, i.e., from a country where Onchocerciasis is very prevalent. These cattle unfortunately all died, some at the coast at Beira, and the balance (800) at Umtali, except three.

The question now arises, was the disease brought over from Australia, or was it enzootic in South Africa? Unfortunately, we have no record of the existence of the disease prior to 1917. Moreover, no cattle from Umtali were slaughtered to determine whether Onchocerciasis was present in that district.

Is it possible to believe that the short existence of the cattle and the three surviving ones were responsible for the spread of the disease in Rhodesia? In view of the recent literature [Blacklock (3)] it would appear that insects are probably responsible for the transmission, and accordingly a sojourn of only a few days may have been sufficient for flies to have become infected. Blacklock maintains in so far as experiments with wild flies can be accepted as evidence in the absence of actual transmission to man or animals, *S. damnosum* is a vector *of Onchocerca volvulus.*

The nodules produced by the parasite, their situation, and number.—It is interesting to note that the situation in the host agrees more or less with that described in Australia (Gilruth and Sweet, Ref. No. 1, p. 5), except that no nodules have been found on the external surface of the hind limb. The position on the brisket appears to be divided into three areas, as regards the frequency of occurrence—

(i) the most prevalent place is under the subcutaneous fascia, over the junctions of the 4th and 5th ribs to their respective costal cartilages, and very rarely close to the medial line;

(ii) the next area most frequently affected is situated cranially, more towards the medial line on the crest of the sternum, buried superficially in the sternal fat.

(iii) caudally to the first position mentioned and adjoining it, extending to a point slightly caudal to the xyphoid cartilage, but in this case more frequently further away from the medial line.

The whole position of occurrence on the brisket may roughly be said to be in the form of a V, with the point on the crest of the sternum and limbs extending caudally to a point about two inches past the xyphoid cartilage, showing the most selected positions on the middle of the limbs of the V, then on the point, and thirdly on the extremities of the arms. The line of demarcation is, however, only arbitrary, as one position merges into the other.

It is interesting to note that the nodules under description only occur on those parts of the animal in contact with the ground when lying down, i.e. the V-formation on the brisket. Moreover, the numbers found on an animal in this country are small in comparison to that found in Australia, both as regards number of cattle infected and number of nodules present in an infected animal. Whereas in Australia, according to Gilruth, up to 50 per cent. of cattle in certain districts in Queensland may be infected, and as many as fifty nodules

found on one animal, in the cases from Rhodesia infection occurs in about .5 to 3 per cent. of cattle, and the nodules usually occur singly, seldom in twos and threes, and very rarely one or two more are found.

Macroscopic appearances.—For descriptive purposes the " worm-nodules " may be divided into two groups according to the position in the subcutaneous connective tissue. In case of some it can hardly be said that they are situated in the subcutaneous tissue as they are very superficially placed and appear as flat ovoid tumours situated on the surface like buttons, which can be easily removed with a knife leaving no impression on the underlying tissues. (See plate I.)

The second group are those which appear as swellings in the subcutaenous connective tissue, revealing their presence by a slight bulging of the tissue. The extent of the swelling depends on the size of the nodule, and as to whether it is deeply or more superficially seated. Such nodules can only be removed by cutting the nodule out of the surrounding tissue. Occasionally a nodule is detected, situated in the intra-muscular connective tissue of the deep pectoral muscle. These nodules are very difficult to detect, as they are sometimes completely buried in the muscle, but more generally they protrude about one quarter of their size beyond the edge of the muscle.

The shape and size of the " worm nodules " vary according to their situation. The superficial button-like nodule, oval discoid in shape, is seldom more than 7 mm. thick, but may measure anything from 1 cm. to 3 cm. in diameter. Although the shape is usually more rounded, measuring 2 mm. in depth by 1.5 cm. in diameter others are slightly elongated, and are 7 mm. in depth and 3 cm. in diameter.

The deeper seated nodules are more spherical, only slightly compressed at the poles, or may be large flattened bodies.

The following measurements should give some idea of size and shape :—

1.5 cm. in depth by 2 cm. in diameter, 2×6 cm., 1.5×3.2 cm.; 8×2.5 cm., etc.

The intramuscularly situated nodules are usually spherical, and smaller than those mentioned above, measuring 5 mm. and occasionally 9 mm. in diameter.

The nodules are very tough and fibrous, and pressure with the fingers show firm elasticity, whereas others are completely hardened. On section the superficial button-like nodule shows a thin fibrous capsule enclosing a well-defined irregular " nucleus " or " worm nest " proper. This capsule is comparatively thin, measuring up to 2 m.m., but in greater majority is only 1 mm. in thickness.

The deep-seated tumours have a different touch on pressure. The tumour is elastic on the outside, but a hard firm centre can be felt, thus giving the impression that the firmness increases in the tumour from without inwards. On section it is found that such a tumour has a much thicker fibrous capsule, which encloses a well-defined worm-nest.

On measurement it was found that although the deep-seated tumours are very much larger than the superficial ones, they do not enclose a larger nucleus or " worm-nest " ; some measurements are as follows: a tumour 3 cm. in diameter has a worm area of only

.9 cm. in diameter, while on one side the capsule was 1.3 cm. and the other 1.7 cm. thick. Others again show the capsule thinner .5 cm. with a worm-nest of practically the same size.

The intra-muscular seated nodules on section show generally the same structure as the other classes. The "worm-nest" enclosed in a thin capsule presses the muscular fibres away for room.

From the foregoing it will be seen that the fibrous capsule surrounding the "worm-nest" largely depends on the situation, and that the size of the worm nest has no relation to the amount of fibrous capsule formed. The shape of the tumour, however, is largely influenced by the position; the flat button-like tumour is flat owing to its superficial position and on account of pressure when the animal is lying down. The deeper situated nodules are more spherical on account of being allowed more play and less pressure.

The worm-nest proper.—The nucleus or worm-nest in all cases represent more or less the same structure. This portion of the tumour is well circumscribed but irregular in outline corresponding to the covering capsule. Consistence although firm is not quite that of the capsule immediately surrounding it, and is brittle and not elastic.

This worm-nest, although well defined, is difficult to enucleate owing to small irregular trabeculae passing from the capsule into the worm-nest, and giving off short pointed branches, representing an irregular dove-tail joint, and vice versa small tongue-like projections from the worm-nest project into the capsule lying in between the trabeculae, or sometimes deeper into small cavities.

The worm-nest on section shows a white greyish matrix in which are numerous tunnels of pin-point size, cut through in different ways, some transversely, others diagonally and longitudinally. The latter show up as small contorted furrows. These tunnels and furrows give the same appearance as an entangled ball of twine would give on cross section.

These tunnels and furrows are occupied by the very much contorted Onchocerca, surrounded by the matrix. According to Gilruth and Sweet (1), page 9, the female worm attains a length up to 140-3 cm., and nodules appear to contain most generally one female only, or less often, one male and one female in a complicated coiled up fashion.

Very often the worm centres are calcified, especially is this the case in old animals. The cut surface then has the same appearance as described above, only instead of tunnels and furrows the spaces are filled up with a yellowish white, gritty substance, which comes away in form of small solid cylinders, when the surface is scraped. In older nodules nothing can be distinguished as calcification is too far advanced.

Microscopical appearance.—Microscopically all worm tumours are formed on the same general basis.

The Capsule.—The line of division between the normal connective tissue is indistinct from the outside. Inwards there is a steady increase of spindle shape fibroblasts, up to a line close to the margin of the worm nucleus, where they are very densely packed.

Blood vessels in this area are fairly numerous, with their walls thickened, and in some instances with their lumen obliterated. Round

the blood vessels, looking like scattered islands, is an infiltration of polymorph nuclear leucocytes with oesinophiles in preponderance. There are also round cells present.

Towards the centre amongst the densely packed fibroblasts are scattered eosinophiles increasing in number towards the centre, also neutrophiles and round cells. The zone of closely packed fibroblasts is rather well defined on the inside, breaking off sharply with a few scattered fibroblasts still extending centre-wards. From this zone the polynuclear and round cells increase rapidly in number, and this marks the line of demarcation between the capsule and the " worm-nest."

The " Worm Nucleus."—From the line of demarcation, the worm-nest, except for a few spindle-shaped fibroblasts, is completely built up of polymorph nuclear leucocytes, of which a fairly large number are eosinophiles, and other round cells, forming the matrix, in which the worm lies coiled up.

Near the border there is practically no loss of structure in the cells, but extending a short distance inwards, the cells show necrobiosis, and the matrix is finally built up completely of such altered cells with a few fibroblasts.

The matrix shows the numerous openings (described above) in which the worm lies.

Onchocerca on Section (plates II and III).

The body-wall shows a slight indistinct striation. Enclosed in the body cavity appear the intestinal tract to one side, and a double uterus, containing eggs. In different sections of the uteri various stages in the development of the embryos can be made out. The complete development of the embryo may be studied in one nodule, from a cell with a single nucleus, to the morula stage with numerous nuclei and to small larvae lying curled up in the uteri.

Between the worm and the matrix is a thin layer of haemogeneous substance, viz., the fluid in which the worm lies. With van Gieson it stains yellowish and with haemalum-eosin pink.

Conclusion.—Onchocerciasis is at present of no great economical value in South Africa, but the danger lies in its spreading. It may eventually become of equal economical importance as in Australia to-day, where as many as 50 nodules are found in one animal (Ref. No. 2, page 6), thus rendering the brisket in many instances unmarketable.

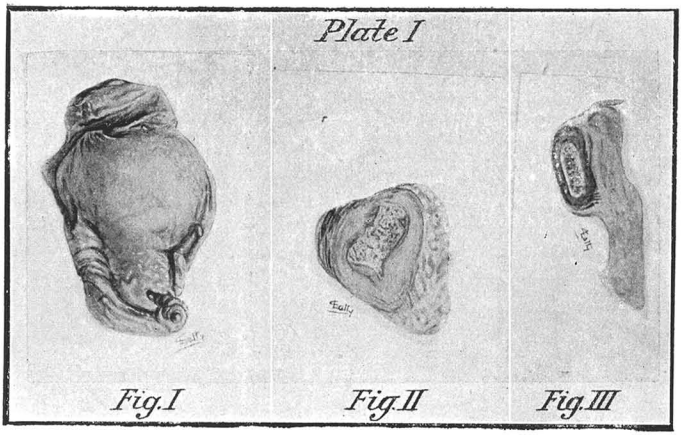
It will, therefore, be important, that, while our beef export trade is still in its infancy, the mode of transmission be determined in order to develop a line of defence. Furthermore, it would be interesting to determine whether antelopes, like the wildebeest, koodoo, and eland, are carriers of the disease.

REFERENCES.

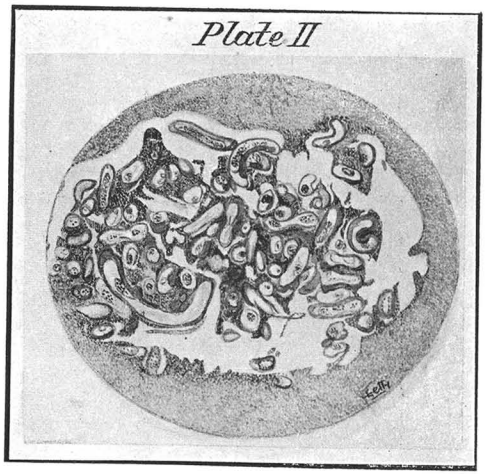
(1) " Report on *Texas Fever* or *Redwater* in Rhodesia." By Charles Gray and William Robertson. 1902.

(2) *Onchocerca gibsoni.* " The cause of ' Worm Nodules ' in Australian Cattle." By J. A. Gilruth and Georgina Sweet. Published by Direction of the Minister of Trade and Customs, New South Wales, Australia, 1911.

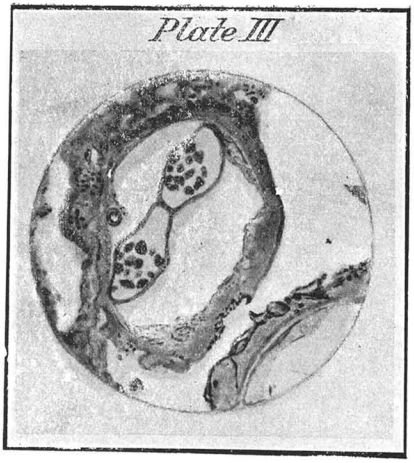
(3) Blacklock: " Development of *Onchocerca volvulus* in *Simulium damnosum*, Annuals of Tropical Medicine and Parasitology, Vol. 20, Nos. 1 and 2.



Half size. Onchocerca nodules. Cut surfaces of two nodules show worm nests.



Section of worm nest. Onchocerca nodule.



Higher magnification of part of worm nest observed in Plate II.

Onchocerca.] [*De Kock & Snyman.*