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# **Some little known South African Poisonous Plants and their effects on Stock.**

**By H. H. CURSON, F.R.C.V.S., Dr. Med. Vet., Research Officer,  
Onderstepoort.**

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# Some little known South African Poisonous Plants and their effects on Stock.\*

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## INTRODUCTION.

In this paper are recorded certain observations concerning little known poisonous plants and their effects on stock at pasture. Most of the field data was obtained while serving in the Veterinary Division, but actual investigational work has been performed while in the Veterinary Research Division. †A complete list of plants tested by the writer and *definitely proved toxic*, along with certain remarks, is appended hereunder :—

Table I.

Plant.	Natural Order.	Remarks.
<i>Moraea polystachya</i> , Ker..	Iridaceae.....	Details of "tulp" poisoning well known. See Hutcheon (1900), and Stent and Curson (1922).
<i>Moraea spathacea</i> , Ker....	Iridaceae.....	Apparently first record of toxicity.
<i>Homeria pallida</i> , Baker...	Iridaceae.....	Apparently first record of toxicity. See Rindl (1924).
<i>Urginea burkei</i> , Baker.....	Liliaceae.....	"Transvaal slangkop" poisoning frequently described. See Dunphy (1906), Gunn (1921-1924), Stent and Curson (1922), and George (1925).
<i>Senecio latifolius</i> , D.C....	Compositae....	Poisonous effects well known. See Chase (1904b), Robertson (1906), Verney (1911), and Theiler (1919).
<i>Setaria sulcata</i> , Raddie....	Gramineae.....	Previous reference of toxicity not found. Experiments carried out only on small birds. ‡
<i>Cotyledon wallichii</i> , Harv..	Crassulaceae..}	First proved toxic by the writer in 1920. See Soga (1891), Hutcheon (1899), Henning (1926), and Kamerman (1926a).
<i>Cotyledon ecklonii</i> , Harv...	Crassulaceae..}	

\* Being part of a thesis accepted for diploma of F.R.C.V.S. (1926).

† During the period 1919-1921.

‡ A seeding sample of this grass (from Durban) was forwarded to the Director of Veterinary Research by the Chief, Division of Botany, the history being that certain cage birds which had been fed on it had died suddenly. Experiments were carried out on small wild birds with positive results.

Plant.	Natural Order.	Remarks.
<i>Dichapetalum cymosum</i> (Hook), Engl.	Dichapetalaceae	Position brought up to date by Steyn (in the press). See, however, Dunphy (1906).
<i>Equisetum ramossissimum</i> , Desf.	Equisetaceae . .	Apparently first record of toxicity.
<i>Acokanthera venenata</i> , G. Don	Apocynaceae . . .	Juritz (1904) recorded toxic effects in dog.
<i>Cynanchum africanum</i> , R. Br.	Asclepiadaceae.	Toxic action not yet recorded.
<i>Melianthus major</i> , Linn. . .	Meliantaceae . .	Toxic action not yet recorded.
<i>Ornithogalum tenellum</i> , Jacq.	Liliaceae . . . . .	Toxic action not yet recorded.
<i>Melothria punctata</i> , Cogn.ë	Cucurbitaceae . .	Toxic action not yet recorded.

The study of poisonous plants is already a most important section of tropical medicine; but in the African continent this subject has been somewhat neglected. This was clearly revealed during a discussion on the problem of plant poisons at the last Pan-African Veterinary Congress, Nairobi (1924). On that occasion, Montgomery, Veterinary adviser to the Governments of Uganda, Kenya, and Tanganyika, stated: "Many of the plants which Dr. Viljoen has referred to . . . as occurring in South Africa . . . occur also in these territories, if not actually the same species, they are of the same genus."\* Hornby added: "Our trouble lies in the ignorance concerning both the plants, and the symptoms and lesions they produce." Kennedy concluded with the admission: "We know very little of the poisonous plants of East Africa."

The ingestion of poisonous plants by the herbivora may arise from various causes as follows:—

- (a) Non-selective feeding on the vegetation, noticeable not only in stock imported from abroad, but also in animals introduced from a neighbouring pastoral area. Acclimatization may thus involve not only the acquiring of immunity to local diseases but also discrimination regarding herbage.
- (b) Great scarcity of grazing, especially of a succulent nature, e.g. in early spring the toxic plants appear first in many cases and are then more readily eaten.
- (c) Accidental consumption, e.g. in the hay cut from meadows containing poisonous plants such as *Ornithogalum* spp. and *Homeria* spp.

A striking fact in connexion with the study of toxic plants is the lack of knowledge concerning their distribution. (See Map, Figure 8.)

ë *Ampelopsis hederacea* (Virginia creeper) was also found to be toxic, but being a foreign plant and cultivated it is not intended to describe it here.

\* As is well known, there is a definite relationship between the flora of Tropical Africa and that of South Africa. Bews (1922) has dealt fully with this phenomenon of plant migration.

## HISTORICAL SURVEY OF STUDY OF POISONOUS PLANTS.

From a purely veterinary aspect the date 1890 is important since it was in that year a plant, *Cotyledon ventricosa*, was for the first time proved toxic to stock in South Africa.\* In former years there were records of plants being suspected of causing mortality; but it was not until 1890 that *definite experimental evidence* was forthcoming. Some later discoveries are shown in the tabulated summary below; but among the names of other observers † who have contributed to the study of South African poisonous plants may be mentioned Pappe (1850), Smith (1888), Marloth (1913*a*), Rindl (1918), and Gunn (1921).

Table II.

Plant.	Natural Order.	First Reference.
<i>Cotyledon ventricosa</i> , Burm.....	Crassulaceae.....	Soga (1891).
<i>Cynanchum capense</i> , Thurnb.†.....	Asclepiadaceae...	Henning (1894).
<i>Moraea polystachya</i> , Ker.....	Iridaceae.....	Hutcheon (1900).
<i>Acokanthera venenata</i> , G. Don.....	Apocynaceae.....	Juritz (1904).
<i>Ornithogalum thyrsoides</i> , Jacq.....	Liliaceae.....	Hutcheon 1904b).
<i>Senecio latifolius</i> , D.C.....	Compositae.....	Chase (1904b).
<i>Dichapetalum cymosum</i> (Hook), Engl.	Dichapetalaceae..	Dunphy (1906).
<i>Urginea burkei</i> , Baker.....	Liliaceae.....	Dunphy (1906).
<i>Crotalaria burkeana</i> , Benth.....	Leguminosae.....	Theiler (1911).
<i>Cotyledon orbiculata</i> , L.....	Crassulaceae.....	Kehoe (1913).
<i>Urginea macrocentra</i> , Baker.....	Liliaceae.....	Wood (1914).
<i>Melianthus comosus</i> , Vahl.....	Meliantaceae.....	Juritz (1915).
<i>Tribulus terrestris</i> , L.....	Zygophyllaceae..	Theiler (1920a).
<i>Crotalaria dura</i> , Wood and Evans..	Leguminosae.....	Theiler (1920b).
<i>Pachystigma pygmaea</i> (Schltr), Phillips	Rubiaceae.....	Theiler, Du Toit, and Mitchell (1924).
<i>Matricaria nigellaefolia</i> , D.C.....	Compositae.....	Andrews (1924).
<i>Adenia digitata</i> (Harv.), Harms....	Passifloraceae...	Green and Andrews (1924).
<i>Geigeria passerinoides</i> (L'Herit), Harv.	Compositae.....	Du Toit (in the press).
<i>Cotyledon panniculata</i> , L.f.....	Crassulaceae.....	Kamerman (1926a).
<i>Cotyledon decussata</i> , Sims.....	Crassulaceae.....	Kamerman (1926a).
<i>Erythrophloeum lasianthum</i> , C.....	Leguminosae.....	Kamerman (1926b).

On comparing Tables I and II it will be noted that no definite record has been found in the literature regarding the toxicity of the following species (i.e. for herbivora): *Moraea spathacea*, *Homeria pallida*, § *Setaria sulcata*, *Cotyledon wallichii*, *Cotyledon ecklonii*, *Equisetum ran.ossi simum*, *Acokanthera venenata*, *Cynanchum africanum*, *Melianthus major*, *Ornithogalum tenellum*, and *Melothria punctata*. On account of their being less well known, the last five are recorded in more detail.

\* According to Soga (1891), Mr. P. Weyer, of "De Toekomst," Somerset East, actually proved the toxicity of *C. ventricosa* first. Soga's work was therefore of a confirmatory nature.

† As far back as 1690 the officials of the Dutch East India Company at the Cape were instructed to collect and despatch medicinal plants to Holland (Leibbrandt).

‡ In Mr. J. W. Crowhurst's Ann. Rpt. for 1895 (G. 41-'96), p. 67 (C. of G.H.), he states he experimentally produced "Pisgoed" poisoning, but does not give name of plant. Presumably it was *Euphorbia genistoides*. Again in Mr. William Robertson's Ann. Rpt. for 1905, p. 63 (Ann. Rpt. C.V.S., C. of G.H.), he states: "Arthrosolen or January Bush, another denizen of the Karroo, has been proved toxic to oxen, producing death with lesions of acute gastritis." The species was probably *A. polycephalus*.

§ This was established in October, 1921. (See Expt. 1103.) Rindl (1924) refers to the toxicity of the material he worked with.

In addition to the plants listed as definitely proved toxic, there are dozens of species not only suspected of being poisonous to stock, but which, *on field evidence*, are decidedly dangerous. Some of these are:—

- (a) *Ornithoglossum glaucum* (Dixon, 1894).
- (b) *Nicotiana glauca* (Hutcheon, 1895).
- (c) *Melica* sp. (Hutcheon, 1895).
- (d) *Datura stramonium* (Sinclair, 1898).
- (e) *Cestrum* sp. (Chase 1904a).
- (f) *Agave americana* (Curson, 1920).
- (g) *Dimorphotheca cuneata* (Curson, 1921).

Closely associated with this problem is variability of toxicity with species, locality, and season, about which comparatively little is known as yet.

During the past dozen years the elucidation of the various plant poisons has made comparatively rapid progress, and with the facilities now available in the Divisions of Veterinary Research and Chemistry, progress should be more satisfactory in the future. For the present state of knowledge concerning toxic plants, thanks are due to Hutcheon and Theiler, both of whom have realized the importance of the subject to the live stock industry. This was recognized by the delegates at the last Pan-African Congress, who passed the following resolution: "This Conference records its appreciation of the work in South Africa upon poisonous plants, and considers that a Pan-African inquiry should be instituted into the distribution and effects of plants shown elsewhere to possess toxic properties."

#### ACOKANTHERA POISONING. (ACOKANTHEROSIS.)

Plant responsible:—*Acokanthera venenata*, G. Don.

Natural order—Apocynaceae.

According to Stapf (1909) there are two species of *Acokanthera* in South Africa, namely *A. venenata* and *A. spectabilis*, but Sim (1907) considers the latter as "the eastern coast form" of *A. venenata* into which it merges gradually "in accordance with surroundings." The question of nomenclature being still uncertain, it is considered advisable in this paper to use only the term *A. venenata*.

*Other Names of Plants*\*.—Old botanical terms were *Toxicophloea thurnbergii* and *Acokanthera thurnbergii*. The local names are "Hottentot's poison bush," "Kafir poison bush," or simply "Poison bush." To the Dutch the plant is known as "Gift boom," and to the natives as "Inhlungunyembe," or "Ubunhlungu benyoka," "Ubuhlungu bengorombe," or "Ubuhlungu benamba." In Zululand the first name is invariably employed.

*Description of Plant*.—A shrub or a gnarled tree, up to 14 ft. high, glabrous (except sometimes the inflorescence); young branches compressed or ancipitous, smooth; leaves mostly ovate or elliptic, sometimes oblong, rarely lanceolate, acute and usually mucronulate, rarely

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\* From the synonyms a good example is obtained illustrating the confusion which may arise through the use of local terms, e.g. "Gift boom" is the name also given to *Toxicodendron capense*, the "Wolve gift" of the North-West Cape Province; and "Ubuhlungu benamba" is a native (Xosa) term for *Melianthus* spp.

obtuse, acute at the base,  $\frac{1}{4}$ –4 in. long,  $\frac{3}{4}$ –2 in. broad, pale or olive-green when dry, somewhat shining above or on both sides; secondary nerves 6–10 on each side, often with similar interposed tertiary nerves, oblique, parallel, prominent on both sides; veins distinct or obscure; petiole stout, 1–2 lin. long; clusters glabrous or puberulous, sessile or subsessile, usually many-flowered; bracts ovate, brown or the upper pinkish; calyx glabrous or puberulous, 1 lin. long; sepals ovate to ovate-lanceolate, acute to subacuminate, distinctly to very obscurely ciliolate; corolla white to pink, sweet-scented; tube  $3\frac{1}{2}$ –5 lin. long, puberulous or glabrous without, hairy within; lobes broad-ovate, acute or shortly acuminate, somewhat over 1 lin. long; anthers  $\frac{1}{2}$ – $\frac{3}{4}$  lin. long; stigma short, obtuse, conic; berry globose, 1 in. in diameter, purplish-black; seeds semi-globose or semi-ellipsoid 4–6 lin. long. ("Flora Capensis." Vol. IV. Sect. I, p. 500.)

The tree is not deciduous and for that reason is so great a temptation to starving stock, especially cattle, during the winter or dry season. The shape and character of the foliage varies considerably, but it is essential that the general appearance be well known for it is that portion of the plant that is usually responsible for the death of stock. The leaves, although bitter, are frequently attacked by insects. The flowers usually appear in December and January, and the fruit when ripe resembles a small plum. The tree trunk has a dark brown to dark grey colour, and in poisoning of man the bark is probably more frequently used. Smith (1888) states that the Bushmen obtained poison for their arrow heads by treating the powdered wood.

*Distribution of Plant.*—*Acokanthera* is essentially a tropical genus, only *A. spectabilis* of Stapf's three species being confined to the temperate parts of South-eastern Africa, namely the Eastern Province and Natal. *A. venenata* is reported to occur in Kenya Colony, Tanganyika Territory, Nyasaland, Rhodesia, Zululand, Natal, Transvaal, Cape Province, and probably South-West Africa Protectorate. *A. schimperi*, the third species, seems to be chiefly confined to the tropics, but has also been recorded from South-western Arabia.

*A. venenata* in South Africa is chiefly to be found along the coastal belt, but its distribution inland, especially along the large river valleys, is far more general than one would expect from the records of locality at the various herbaria, such as indicated in the attached map (Figure 8).

*Literature.*—Smith (1888), in addition to his statement with regard to the use of *Acokanthera* as an arrow poison, described the plant as a native snake-bite cure of very doubtful efficacy, and erroneously regarded the active principle as brucine\*. Juritz (1903, 1904) referred to the use of the drug in human poisoning and added, "the poison appears to act in a twofold manner: (a) By producing very violent vomiting resulting in fatal exhaustion, and (b) by causing paralysis of the heart in systole." Both these actions he produced in the laboratory by experimentation on the dog and mouse respectively. Later (1907), he summarized (a) the experiences of other authors regarding the use of the various species of *Acokanthera* as arrow poisons in Tropical Africa; (b) the state of know-

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\* This was rectified in Smith's Third Edition of 1895.

ledge concerning the chemical determination of the *Acokanthera* poisons, emphasizing that there existed "no recorded tests," but that it was obvious that brucine was not present; and (c) the results of his investigations which would "enable the poison to be identified in most cases that may hereafter occur." Six years later, Marloth (1913*a*), in his presidential address to the Cape Chemical Society, referred to *Acokanthera venenata* as containing "a glucoside which appears to be different from ouabain and also a principle named Acokantherin." Previous to this, however, the Director of Agriculture, Transvaal, had forwarded a small quantity of the bark to the Imperial Institute, London, and with this, preliminary chemical and physiological investigations were undertaken. It was concluded (1915) that the amorphous product obtained was probably identical with the crude acokantherin described by others. It was found that the effect of this product resembled that of digitalis, there being "a primary slowing and strengthening effect on the heart which quickly passes into a toxic effect, leaving the heart quiescent in systole. . . . It appears to have a contractile effect on all plain muscle." It was further remarked that as "the poisonous substance is so ill-defined . . . a chemical examination would be of little value and reliance would have to be placed chiefly on observation of the character of the toxic symptoms." Since the drug is only one-tenth as active as the common digitalis, its use in medicine is not likely to become popular. A few months previous to the publication of the Report of the Imperial Institute, Juritz (1915) described further cases of poisoning in man due to *Acokanthera venenata* and again determined the poison by his characteristic colour test following the use of concentrated sulphuric acid on the residue extracted from the organs. Nevertheless, this information, furnished as far back as 1907 by Juritz, was apparently unknown to the workers at the Imperial Institute, for in a summary of work on poisonous plants published in 1916, no mention is made of Juritz's colour test and it is stated that "the isolation of the active constituent . . . of *A. venenata* still remains to be accomplished." Recently (1924) the subject has again been taken up by Morrison,\* Moir (1924), and Moir and Lewis (1925).

*Conditions under which Poisoning Occurs.*—Under natural conditions it is chiefly cattle that succumb to *Acokanthera* poisoning, for apart from goats, other species of domesticated animals are not largely reared in the type of country where the plant flourishes. Mortality among goats, however, and donkeys has been reported, and even ostriches are stated to have been killed, probably by the ingestion of the attractive fruit. Most cases observed personally occurred during the severe drought of 1920, when the writer was stationed at Grahamstown. Deaths suspicious of *Acokanthera* poisoning were, however, encountered in Zululand during the period 1921–2 when the writer was located in the Lower Umfolosi District. Cattle moved from grassveld to bushveld, especially during the winter when succulent herbage is scanty, are the principal sufferers. *Acokanthera*, on account of the structure of its leaves, appears to resist drought conditions more satisfactorily than many of the plants associated with it. It was a matter of surprise to note that *Acokanthera* is not

\* Morrison worked at Capetown with *A. spectabilis*. Report not yet published.

mentioned by Bryant (1909) in his work on "Zulu Medicines and Medicine Men," for the plant is well known to the Zulus of the Lower Umfolosi District. Malicious poisoning of stock undoubtedly occurs more frequently than is supposed, the poisonous material in such cases being administered as a drench.

*Symptoms.*—These vary according to the manner and channel of administration, and in cattle kept under ranching conditions are seldom observed. In cases where ingestion of the leaves had occurred the beast is noticed to be "off colour," and disinclined to move or graze. There may be slight salivation, the appearance is one of extreme anxiety, and there is a loss of appetite. Soon after there are indications of abdominal pain and the sufferer gazes repeatedly towards the flanks, swishes the tail frequently, and grinds the teeth. During this period there are usually important changes in the character of the pulse.\* There is at first a decrease in rate followed by increased force of ventricular action which is associated with a rise of blood pressure. The pulse becomes fuller and firmer and these alterations may be compared to the beneficial results following the use of a drug such as digitalis. As the absorption of Acokanthera poison remains unchecked so are marked changes to be noted in connexion with the circulatory system. The heart beat is reduced to as low as fifteen contractions a minute and is now associated with a lowered blood pressure. As more of the toxic material is taken into the system, the pulse becomes fast, feeble, soft, and small. Eventually the pulsation is irregular and so feeble that it is imperceptible. The cardiac changes being known, the systemic symptoms can more readily be understood, for with the exception of increased passage of fluid faeces, indeed often a dysentery, all the clinical manifestations are closely connected with changes in the frequency and force of the pulse. Urination is frequent, salivation is profuse, the ears and extremities become cold, jugular pulse marked, respiration becomes increasingly difficult, being stertorous, hurried, and shallow, and eventually froth may issue from the nostrils. Accompanying these symptoms is often a bloody diarrhoea, increased weakness, cyanosis of the mucosa, collapse, and struggling. Finally, in consequence of heart derangement and exhaustion, death brings all suffering to an end.

*Post-mortem Appearances.*—In cattle kept under ranching conditions, especially in the dense dwarf bushveld of the coastal districts of the Cape Province, it is often impossible to conduct a satisfactory post-mortem examination owing to the interval which has elapsed between the death of a beast and the discovery of its body. Under favourable conditions, however, one would find that there was tympanites, the degree depending on the amount of succulent vegetation eaten, or the interval since death had occurred. There may be blood-stained faeces, and the hinder parts of the body, e.g. buttocks, tail, and hocks, may be covered with liquid excreta sometimes containing shreds of mucosa. Around, there would probably be signs of struggling before death, such as abrasions of the body surface or disturbance of the vegetation within reach of the limbs. There might be the presence of froth in the nostrils following the dyspnoea and congestion of the lungs, and there would probably be signs of salivation

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\* Based on "feel" of pulse.



and urination. Internally, cyanosis of the mucosa is invariably present, the subcutaneous veins are engorged with blood, which in a few cases did not clot normally. There is also engorgement of the vessels of the mesentery and intestines, especially the small intestines. On opening the rumen and reticulum, portions of the masticated leaves are often to be found. Small diffuse patches of congestion along the alimentary tract may be present, but hyperaemia of the abomasum invariably occurs. The urinary bladder is generally empty and the remaining abdominal organs, liver, spleen, and kidneys are, as a rule, congested. The respiratory system usually contains white froth, but at times it is bloodstained. Congestion of the lungs is a frequent condition, but invariably associated with it is emphysema of the anterior lobes. The heart is more frequently in a state of systole, and both epicard and endocardium usually show ecchymoses. The myocardium is usually the seat of numerous haemorrhages.

*Diagnosis.*—One is guided by the following :—

- (a) History of the mortality, e.g. where stock was grazing, possibility of poison being maliciously administered, time of year, and whether drought conditions prevail.
- (b) Symptoms.—These are often unobserved and at any rate seldom seen by a veterinarian.
- (c) Post-mortem examination, including blood-smear examination. Fragments of leaves may be found in the first two compartments of the stomach of cattle, but the lesions observed are not characteristic of *Acokanthera* poisoning alone. Blood-smear examination is negative. The chemical colour test described\* by Juritz has distinct possibilities, but as far as is known it has never been applied to cases of stock poisoning.

*Differential Diagnosis.*—Being essentially an acute affection and possessing symptoms common to other diseases it is necessary that something should be stated with regard to differential diagnosis. The maladies with which *Acokanthera* poisoning is liable to be confused by the farmer are—

- (a) anthrax ;
- (b) heartwater ;
- (c) acute lamsiekte ;
- (d) redwater ;
- (e) acute arsenical poisoning.

(a) Anthrax most closely resembles *Acokanthera* poisoning and furthermore is exceedingly prevalent in the Border and Transkeian districts of the Cape Province, where *Acokanthera* poisoning is best known. For this reason the special regulations (see Government Notice No. 1750 of 23/10/23) concerning the notification by owners of all cases of sudden death of stock should be borne in mind. In addition, the owner must take a blood-smear from the ear and dispose of the carcass by burning or burial. With regard to the diagnosis of anthrax, microscopic examination of the blood is sufficient in the vast majority of cases to enable a veterinary surgeon to detect the organisms of the disease.

\* It is possible that this may be due not to *Acokantherin* but to associated impurities.

(b) Heartwater is also, exceedingly common along the coastal districts and becomes more severe the more tropical the vegetation becomes. Again, heartwater is particularly prevalent in the lowlying bush country where *Acokanthera* is most luxuriant in its growth. In heartwater the symptoms are more nervous and less abdominal, but post-mortem examination is the surest guide, for in this disease there is usually hydropericardium, hydrothorax, and oedema of the lungs. Assistance would probably be gained by a careful examination of the stomach contents, the importance of which has already been emphasized.

(c) Lamsiekte is another disease which should be differentiated from *Acokanthera* poisoning, especially the acute form, the so called "imipunga" of the Eastern Cape Province coastal districts. This malady does not actually occur in the bushveld areas, for in these, pica is rarely seen and craving for putrid material exceptional. It is on the confines of bushveld where lamsiekte exists, and the difficulty is increased owing to the fact that blood-smear examination microscopically is negative. Lesions of the alimentary tract such as acute enteritis, however, are not seen, and examination of the stomach contents would, of course, show no trace of *Acokanthera* leaves.

(d) Redwater may sometimes be mistaken for *Acokanthera* poisoning, since both affections occur frequently in the tick-infested bushveld of the coastal districts. Post-mortem examination, especially blood-smear examination, would be sufficient to differentiate on account of haemoglobinuria and the presence of *B. bigemina* in the former malady.

(e) Arsenical poisoning being an acute condition has been mistaken for *Acokanthera* poisoning. Apart from the fact that the history might assist, chemical examination of the stomach contents or liver would show the presence of arsenic in the former case.

*Treatment.*—(See page 220).

#### CYNANCHUM POISONING. (CYNANCHOSIS.)

Plant responsible: *Cynanchum africanum*, R. Br.

Natural order: Asclepiadaceae.

*Other Names of Plant.*—The commonest local name is "Klimop" which in Dutch signifies any climbing plant. "Baviaan's touw" is another well-known name. By some it is referred to as "Davidjes," and by others as "Excelsior" (Hutcheon). The condition set up by this plant is referred to by farmers as klimop poisoning, krimpsiekte, or krampsiekte. The term krimpsiekte is also used for another nervous affection due also to a plant, but belonging to a very different order, viz. *Cotyledon* spp. Work in South Africa has been performed in connexion with six species of that genus, *wallichii*, *ventricosa*, *ecklonii*, *γ. anniculata*, *decussata* and *orbiculata*, but other species are no doubt responsible. The distribution of these two nervous disorders of plant origin is quite different, *Cynanchosis* being confined to the South Western coastal area, whereas *Cotyledonosis* is prevalent throughout the arid Karoo. Although both are nervous diseases, the course is dissimilar, the former being usually acute while the latter is subacute or chronic.

*Description of Plant.*—Plant branching from the base into several twining stems, thinly or densely covered with a soft spreading pubescence; leaves thinly coriaceous or rather thick and probably somewhat fleshy, more or less pubescent on both sides or glabrous; petiole 1–3 lin. long; blade  $\frac{1}{3}$ –1 in. long,  $\frac{1}{4}$ – $\frac{3}{4}$  in. broad, suborbicular, ovate, elliptic-oblong or oblong, acute or obtuse, apiculate, rounded to subcordate at the base; umbels lateral at the nodes, 5–7 flowered; peduncles  $\frac{1}{4}$ – $1\frac{1}{4}$  ins. long, pubescent to nearly glabrous; bracts about 1 lin. long, ovate or deltoid-ovate, acute; pedicels 1–5 lin. long, pubescent; sepals 1– $1\frac{1}{4}$  lin. long,  $\frac{2}{3}$ – $\frac{3}{4}$  lin. broad, ovate, acute, pubescent to nearly glabrous; corolla-tube  $\frac{1}{2}$ – $\frac{3}{4}$  lin. long; lobes 3–4 lin. long, 1 lin. broad, oblong-linear, obtuse, recurving or twisted and suberect, glabrous on both sides or slightly pubescent on the back, dark purple-brown; corona  $2\frac{1}{2}$ – $4\frac{1}{2}$  lin. long, tubular, usually irregularly about 10-toothed, but sometimes with 5 entire or bifid teeth  $\frac{1}{2}$ –1 lin. long at the top, glabrous, white; staminal column  $2\frac{1}{4}$ – $3\frac{1}{2}$  lin. long, terete, suddenly contracted under the anthers into a slender stipe  $1\frac{3}{8}$ – $2\frac{3}{4}$  lin. long; anther-appendages lanceolate, acute, connivent over the shortly conical minutely 2-lobed style-apex; follicles about  $2\frac{1}{2}$  ins. long and 4– $4\frac{1}{2}$  lin. thick, narrowly lanceolate, tapering into a long slender acute beak, puberulous; seeds  $2\frac{1}{4}$ – $2\frac{3}{4}$  lin. long, ovate, concave on one side, convex on the other, minutely tuberculate-rugose, light brown. (“*Flora Capensis*.” Vol. IV. Sect. I, p. 748.)

The plant is frequently found associated with *Melothria* spp. climbing over shrubs and trees forming a dense canopy of foliage. The flowers are found during the months of September to November and occasionally as late as April. The stem, leaves, and fruit contain a milky juice which has a slightly bitter taste.

*Distribution of Plant.*—The genus *Cynanchum* is widely distributed throughout Africa, most of the 100 or so species occurring in the Tropics or Sub-tropics. The species *C. africanum*, has not been tested before, since Henning’s (1894) work was carried out with *C. capense*. *C. africanum*, like *A. venenata*, is chiefly to be found along the coastal belt but is also common in the inland districts. For more detailed information regarding occurrence, see map. (Figure 8.)

*Literature.*—As shown on page 207 *Cynanchum capense* was proved as early as 1893 to be toxic, Henning giving an excellent report of his investigations. In 1904 a Mr. M. Walsh of Caledon District wrote to the Editor, “*Cape Agricultural Journal*,” asking for advice in cases where cattle had contracted “*Kraam Ziekte*,” and Hutcheon (1904a) in reply, after referring to Henning’s observations, suggested an active purgative to remove the plant, followed by an anodyne such as chloral hydrate. He, however, emphasised the importance of preventive treatment, such as “*extirpation of the plant*.” The same year (1904c) Hutcheon reproduced in extenso Henning’s account of 1894, since mortality of obscure origin, but apparently due to *Cynanchum*, had been reported in Caledon District. Actually Henning was the only individual who had investigated the toxic properties of *Cynanchum* prior to the work now to be recorded. Walsh (1909) states that *Cynanchum capense* is one of the two plants causing “*Krempziekte*,” but it is clear he is not familiar with the course of either *Cynanchosis* or

*Cotyledonosis*. Although recorded in Zululand (Curson 1923), *Cynanchum capense* has not been incriminated as a toxic plant, and is not referred to by Bryant in his work on native medicine plants. No one, it would appear, has ever investigated the plant chemically.

*Conditions under which Poisoning Occurs*.—All natural cases seen by the writer have been in dairy cows grazing along the bush-covered sea-shore in the Cape Peninsula. Mortality, however, is experienced in all classes of stock particularly on farms situated along the coast of the South Western Cape Province. Melck has encountered the condition inland, and with regard to an outbreak at Montagu he writes:—"This plant grows to the tops of the mimosa and was eaten when the bushes were chopped down . . . It is possible that the plant is more poisonous when the hot sun has shone on it than it would be, say, in winter." Cases of poisoning may occur at any time of the year, but the condition seems most prevalent during the early winter.\* Farmers, however, aver that it is most poisonous during the summer especially after wilting.

*Symptoms*.—In field cases it is generally an acute attack that is observed not only because it is the commonest form of the disease, but also because a veterinary surgeon would not likely be summoned unless the case appeared to be a serious one. Melck, who investigated the condition at Montagu, writes (31.1.21):—"The animal trembles and drops down with its head thrown back and the limbs straight out. The eyes roll and there appears to be loss of sight. Two cattle have recovered and are not yet able to rise, being still paralysed in the fore-quarters." In the cases observed by the writer there was a staggering gait, the animal fell stretched out on its side and was apparently unconscious. There was generally tympany, the eyes were open but lacked expression, breathing was hurried and shallow and the pulse small, hard, and accelerated. At the beginning intermittent spasms (clonic) are common in any group of muscles, and these later become tetanic. Finally in severe cases there is opisthotonos, the jaws are shut and with convulsive movements of the limbs, accompanied by groaning, death follows. In milder cases the posture frequently seen in Milk fever is assumed, but consciousness soon returns and after a day or two recovery is usually complete.

*Post-mortem Appearances*.—The carcase on examination shows little or nothing of diagnostic value, i.e. apart from the presence of the stems and fragments of leaves in the rumen and reticulum. There is generally tympany and ecchymoses of the heart, especially the left ventricle.

*Differential Diagnosis*.—The affections which might be confused with *Cynanchum* poisoning or krimpsiekte are:—

- (1) Heartwater.
- (2) Dichapetalum poisoning.
- (3) Dourine.

It may be noted that locality itself is almost sufficient to indicate the nature of the affection. Dourine for example is prevalent in Griqualand West, Dichapetalum poisoning is encountered usually north of the Magaliesberg in the Transvaal, *Cynanchosis* is only reported from the South Western

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\* The rainfall in the Cape Peninsula is essentially winter, but the pasture is not at its best until the spring.

districts of the Cape Province, while heartwater occurs throughout sub-tropical South Africa. In the coastal districts between Mossel Bay and Port Elizabeth, heartwater and *Cynanchum* poisoning probably co-exist; but it is remarkable that the latter condition has not been recorded further east. As to actual differential diagnosis (1) Heartwater clinically may resemble the convulsive stage of *Cynanchosis*, but on post-mortem examination the rapidly coagulating hydropericardial effusion would denote the former condition; but the stomach in the case of the latter would almost invariably show fragments of the toxic plant. With regard to (2) *Dichapetalum* poisoning, it would be impossible to differentiate during life in acute cases, but in subacute cases the tendency to arch the back and gait generally would serve as a point of distinction. On post-mortem inspection in acute cases evidence would also be forthcoming in the stomach contents. Concerning (3) Dourine, this is a rare disease in South Africa but has to be considered since the arched back in subacute cases along with protrusion of penis in male subjects occurs also in *Cynanchum* poisoning. In the former disease the complement fixation test would be positive whereas in the latter it would be negative. There would be progressive loss of condition in Dourine and a daily improvement in *Cynanchosis*. History in all cases would be valuable in basing a diagnosis, and in Dourine, sub-inoculation experiments might reveal the presence of trypanosomes.

*Treatment*.—(See page 221).

#### MELIANTHUS POISONING. (MELIANTHOSIS.)

Plant responsible: *Melanthus major*, Linn.

Natural Order: Melianthaceae.

It is, however, probable that the 5 species (*Flora Capensis*) are all toxic.

*Other Names of Plant*.—The Dutch term “*Kruidje-roer-mij-niet*” (literally “little herb do not touch me”) has reference to the irritant nature of the plant; but the name has been corrupted to “*Truitje-roer-mij-niet*,” (*Truitje* = *Geertruida* or *Gertrude*). Other abbreviations of the Dutch name are “*Kruidje bos*” or “*Krikkie bos*.” The native term (*Xosa*) is “*ubuhlungu benamba*” or more correctly “*ubuhlungu bemamba*” so-called from its supposed efficacy for snake bite.

*Description of Plant*.—Shrubby, stem up to 5 feet high, fistular ribbed. Leaves imparipinnate the lower 1 foot or more long, the upper smaller. Leaflets up to 5 ins. long and 2½ ins. broad, deeply and broadly serrated, the teeth pointed. Petiole naked at the base and winged between the leaflets. Racemes simple many flowered over 1 foot long. Peduncle naked up to half-way, flowers pedicelled; pedicels pubescent. Bracts ovate acuminate as long as the pedicels. Calyx 5-parted, large up to an inch or more long, unequal, 1 lobe calcate at the base. Petals 4 only developed smaller than calyx, clawed, claws hairy. Stamens 4, 2 slightly longer, filaments thick and flattened, anthers exserted. Ovary about ½ in. long, 4-lobed, 4-celled. Ovules 5. Capsule 1–1¼ inch long membranous, netted veined, glabrous, the valves compressed 4-winged, girt at base with the persistent calyx, deeply emarginate and 4-lobed at the apex, the lobes opening by their inner sutures. Seeds two in each cell, black and shining. (Dr. E. P. Phillips, *National Herbarium, Pretoria*.)

*Distribution.*—According to Thonner (1915) *Melianthus* is essentially a South African genus. *M. major* is generally found growing in low-lying situations such as vleis or along the banks of rivers. Throughout the Cape Province, especially in the Karroo, the red-flowered *M. comosus* is also looked upon with suspicion by owners of small stock.

*Literature.*—Smith (1888) describes *M. comosus* as being one of the most notable of the snake-bite plants, the juice or a leaf paste usually being applied to the wound. He also states that “the most noted alkaloid present is morphia,” and that it is “an excellent general medicine and gently moves all the digestive organs in succession,” for which purpose 10 grains of the bark would suffice. Marloth (1913a) in his resume of the chemistry of South African plants mentions that “nothing is known about their (*Melianthus* spp.) chemical ingredients.” The same year Marloth (1913b) in describing *Loranthaceae* refers to *M. comosus* acting as host plant to *Loranthus namaquanus*. He adds: “Although it (*M. comosus*) possesses injurious properties, the farmers do not experience any loss through it, as the animals do not touch it on account of its unpleasant smell. The *Loranthus*, however, is eagerly eaten by the animals, and the farmers state that they have lost goats, which had eaten some *Loranthus* that was growing on the *Melianthus*. If the animals had really not eaten some of the *Melianthus* together with the *Loranthus*, this occurrence would indicate that the poisonous principle had passed from the host into the parasite growing on it.” Two years later Juritz (1915) described experiments on guinea-pigs and dogs with *M. comosus* and his conclusions were: “. . . *M. comosus* possesses very toxic principles, more especially in the roots; further that an infusion made from the latter acts as a violent depressant, producing emesis, and also exerts a marked cardiac action, resulting fatally when administered in large doses . . .” He also referred to chemical tests employed in investigating the active principle which in the roots was present to the extent of 0.065 per cent. and in the leaves “there was practically none of it.”

*Conditions under which Poisoning Occurs.*—Mortality is reported among equines and ruminants especially when pasturage is scanty. Mr. Melck M.R.C.V.S., of Worcester, has informed the writer that equines seem particularly inclined to partake of the luxuriant green foliage with serious consequences. It is hardly possible for the plant to be present in hay as is the case with *Ornithogalum* spp. and other poisonous species. Although described by Smith (1888) as a native medicinal plant Bryant (1909) makes no mention of it in his article on Zulu herbs.

*Symptoms.*—In natural cases, (several reported by Mr. Melck and two personally observed) symptoms were those of an ordinary irritant vegetable poison, e.g. *Homeria* spp. or *Moraea* spp. There was acute diarrhoea, and salivation and colic were marked. One of the two cases personally observed succumbed, the sufferer showing blood-stained faeces and extreme exhaustion prior to death.

*Post-mortem Appearances.*—These were marked congestion of stomach and small intestines (donkey). In reported cases nephritis also seems to be present.

*Diagnosis.*—One would rely on history and in case of mortality on examination of stomach contents on post-mortem.

*Treatment.*—(See page 221).

#### MELOTHRIA POISONING. (MELOTHRIOSIS.)

Plant responsible :—*Melothria punctata*, Cogn.

Natural order—Cucurbitaceae.

*Other Names of Plant.*—To the coloured folk of the Cape the plant is known as “Davidjes wortel” or simply “Davidjes,” but it must be emphasized that the latter term is also used for *Cynanchum* spp.

*Description of Plant.*—Large fleshy tubers. Stems slender, trailing and twining. Leaves up to 2 in., membranous, cordate slightly 3-5 lobed, white scabrid above pilose, scabrid or hairy below, margin denticulate. Petiole slender, about  $\frac{3}{4}$ -in. long. Inflorescence axillary, the male flowers yellow on long peduncles, the female solitary or in sessile umbels. Calyx 5-toothed, tube fused with corolla tube. Corolla 5-lobed hairy within, ♂ stamens 3; filaments almost as long as the tube, hairy; anthers short, straight or slightly curved, hairy. Fruit: Globose, about the size of a pea, lightly pitted. (Dr. E. P. Phillips, *National Herbarium, Pretoria.*)

The plant has a disagreeable smell when bruised and the taste is unpleasant.

*Distribution.*—*Melothria* is a genus containing many species which are scattered throughout the tropics and sub-tropics. *M. punctata*, the subject of this paper, has a wide distribution in South Africa, being particularly common along the coastal districts of Natal and Cape Province.

*Literature.*—The only reference to *Melothria punctata* in literature pertaining to pharmacology is that of MacOwan (1897) who, in discussing the efficacy of *Monsonia ovata* for dysentery in man, mentioned the names of several plants awaiting professional investigation, one of these being *Melothria punctata*.

*Conditions under which Poisoning Occurs.*—In spite of its unpleasant taste, the plant is readily eaten by stock, chiefly cattle during the autumn and winter when green fodder is scarce in the South-west Cape Province. By the dairymen around Capetown, the plant has long been regarded with suspicion, although most cases of poisoning in the neighbourhood are undoubtedly due to *Cynanchum* spp.

*Symptoms and Post-mortem Appearances.*—Definite cases of poisoning have not yet been observed by the writer in the field, but suspected cases are characterized by gastro-intestinal derangement, there being scouring and in fatal cases inflammation on post-mortem examination. The plant is, however, described here as on experimental investigation a tincture prepared from the leaves injected intravenously caused severe purgation and death.

*Diagnosis.*—A veterinary surgeon would be guided by the history of the case, and the detection in the stomach of leaves of *Melothria*, in the absence of other positive information, would indicate poisoning by this plant.

*Treatment.*—(See page 221).

## ORNITHOGALUM POISONING. (ORNITHOGALOSIS.)

Plant responsible :—*Ornithogalum tenellum*, Jacq.

Natural order—Liliaceae.

In the positive experiments carried out under Hutcheon's (1904 b) supervision in the Western Province, *O. thyrsoides* was employed.

*Other Names of Plant.*—The plants of the genus *Ornithogalum* are referred to generally as Chinkerinchee, or occasionally "Violtje" by the Dutch. Marloth (1917) also gives the local name of "Star of Bethlehem," and Hutcheon that of "Snowdrop."

*Description of Plant.*—Bulb globose, 1 in. diameter; leaves 4-5, linear, glabrous,  $\frac{1}{2}$ -1 ft. long; peduncle slender, stiffly erect, a foot or more long; raceme dense, subcorymbose; pedicels erecto-patent, lower 1-2 in. long; bracts ovate-acuminate,  $\frac{1}{2}$ - $\frac{3}{4}$  in. long; perianth pure white,  $\frac{1}{2}$ - $\frac{3}{4}$  in. long; segments oblong,  $\frac{1}{6}$ -in. broad, not keeled; stamens half as long as the perianth; alternate filaments dilated at the base; style slender,  $\frac{1}{2}$  in. long. ("Flora Capensis." Vol. VI, p. 505.)

The leaves are green and succulent, but wither as the flowers appear.

*Distribution.*—The genus *Ornithogalum*, approximately of a hundred species is widely distributed in Africa, representatives being found in Somaliland, Kenya Colony, Tanganyika Territory, Belgium Congo, Angola, and Nyasaland. Many species, however, are localized in temperate regions such as the Cape Province. *O. tenellum*, according to Baker (1897), has only been described from Swellendam, but material was collected by the writer in Albany. *O. thyrsoides*, the species fed to horses by Hutcheon, is reported chiefly from the Western Cape Province, but it is reported to occur in Somerset East and also in Albany. The plant appears to favour moist situations such as vleis, etc.

*Literature.*—The first record of toxicity in the genus *Ornithogalum* appears to be that of Hutcheon (1904 b), who initiated feeding experiments with the dried material of *O. thyrsoides*, and proved that eight flower spikes might prove fatal to an adult horse. Later (1906), the observations of Hutcheon were published along with additional data, showing that as little as six ounces of the half-dried leaves would cause death. Next, Walsh (1909) mentioned that "Experiments . . . have since proved that the plant is exceedingly poisonous, and that the stem, bulb, leaves, and flower all contain the poisonous principle." Power and Rogerson (1910) associated the toxic principle with a resin, and later Power and Salway (1913) identified the glucoside ipuranol along with allied substances in *O. thyrsoides*. No investigations appear to have been undertaken with the closely related *O. tenellum*.

*Conditions under which Poisoning Occurs.*—As usual, eating of the toxic material chiefly occurs when animals are introduced into a strange pastoral area, or in times of drought when grazing is scanty. Stock which have been brought up on pasture where *Ornithogalum* spp. occur avoid the plant. An additional danger, however, in the case of this plant is that it occurs in cultivated lands and thus may find its way into fodder such as oat-hay. In point of fact, the plant was first suspected of being toxic after oat-hay had been fed to two cart horses which succumbed as



a result. This point is of considerable importance, especially to municipal bodies or contractors who purchase large quantities of oat-hay from the Western Cape Province. Cases have only been observed in equines, but mortality has been reported in cattle.

*Symptoms.*—It is generally when a horse shows signs of colic that attention is directed either to the hay which may contain the plant, or to the pasture where an animal may have been grazing. Otherwise, in field cases, apart from perhaps a drowsiness and disinclination to feed, nothing is noticed until perhaps abdominal pain is manifested. Purging then follows, and at this stage the temperature is generally raised a degree or two, the pulse is fast and full, and the respiration laboured. As time advances the animal becomes weak from the continued passage of faeces, the pulse weakens, and the temperature falls to subnormal. After a period varying from 1–4 days the sufferer collapses to the ground and dies in great agony soon after.

*Post-mortem Examination.*—The carcase is generally poor, the loss of condition from the illness being astonishing. The tail and hocks are usually soiled with watery faeces. On opening the cadaver the chief lesion is a marked gastro-enteritis which explains the nature of the disease.

*Diagnosis.*—One would naturally be guided by the history of the case, the locality, and an examination of the food.

*Differential Diagnosis.*—Being an acute gastro-enteritis, *Ornithogalum* poisoning might be confused with (a) arsenical poisoning, (b) other irritant plant poisons, e.g. *Moraea polystachya* or even *Acokanthera venenata*. In the former case chemical examination of the stomach contents and liver would yield arsenic, and in the latter, careful examination of locality, stomach contents, and history generally should aid in diagnosis.

*Treatment.*—(See p. 221).

#### TREATMENT.

As so little is known about the toxic principles of the plants described above, it is not possible to prescribe antidotal treatment for each plant individually. All that can be done at present is to indicate the better-known plants which appear to resemble them physiologically, and to discuss the results of experience gained in the field. In spite of the numerous so-called "cures" varying from brandy to copper sulphate, treatment generally seems hopeless once the symptoms have appeared. Cases that recover would probably do so in spite of drugs, and the veterinarian is soon forced to realize that heroic treatment is dangerous. In the case of many tropical poisons, e.g. *Homeria* spp., *Moraea* spp., *Acokanthera* spp., *Dichapetalum* spp., and *Ornithogalum* spp. experience has taught that certain agents should be avoided, these being water and alcohol (brandy). The explanation seems to be that the toxic principles of many of these plants are water or alcohol soluble, and the administration of these liquids assists in the absorption of more of the poison and thus hastens the death of the sufferer. If it is considered advisable to administer a purgative then some drug given hypodermically, e.g. pilocarpine should be tried, and similarly with stimulants and sedatives. In connexion with the plants referred to above: (a) *Acokanthera* undoubtedly resembles *Digitalis*

not only in its action on the heart, but also with regard to its irritant action in the alimentary tract. It has been noted that the active principle is water and alcohol soluble, and thus it is strongly urged that as far as possible only intravenous or subcutaneous injections be given. The application of the four golden rules in cases of poisoning, i.e. (a) remove animals from poison or poison from animals, (b) prevent absorption, (c) treat symptoms, (d) promote excretion, should be applied where practicable, but the chief measure is the treatment of symptoms. One would therefore use a trocar and canula, give demulcents, or administer atropine or chloral hydrate as occasion demanded.

(b) *Cynanchum* most closely compares with strychnine and is essentially a non-irritant nervous poison. Treatment therefore consists in decreasing nervous irritability and a physiological antidote such as chloral, recommended by Henning over thirty years ago, is advised. Although there is no evidence in the experimental work to indicate that the active principle is water or alcohol soluble, yet administration is contra-indicated since a spasm might occur during drenching, resulting in the passage of fluid to the lungs.

(c) and (d). The action of *Melianthus* and *Melothria* suggests a violent irritant drug such as Croton. One is therefore advised to employ sedatives and demulcents. In later stages where collapse threatened recourse would be had to stimulants. Experimental evidence definitely shows that the active principle of *Melianthus* is both water and alcohol soluble, while *Melothria* possesses some alcohol soluble principle.

(e) *Ornithogalum* probably corresponds most closely to *Urginea scilla*, for both plants are gastro-intestinal irritants, but the nervous action is dissimilar. Whereas *Urginea* acts analogously to *Digitalis*, *Ornithogalum* causes severe depression, one of the most striking symptoms of poisoning being the marked drowsiness of the sufferer. Here, again, treatment would be symptomatic and depend on the severity of the case. Demulcents would, in any case, be indicated.

As is generally the case in medicine, nursing is of the utmost importance, especially in tropical countries where comparatively little attention is paid to the comfort of live stock. Patients should be kept quiet in the shade, and if decubitus should be provided with bedding. To prevent bed-sores animals should be turned over every six hours, and protection from flies is imperative.

Preventive treatment is, however, the only measure which is entirely satisfactory. In the case of *Urginea burkei* and *Cotyledon* spp., eradication of the plants has been carried out on farms with success\*. The same could easily be done with *Melianthus* spp., and although the remaining plants would present greater difficulties yet the fencing in of dangerous vleis (*Ornithogalum*) or bush-lined valleys (*Acokanthera*) would assist considerably in combating plant poisoning.

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\* Mr. P. Weyer of De Toekomst, Somerset East, Cape Province (where the feeding experiments in connexion with *Cotyledon ventricosa* were undertaken in 1890), believed the plant to be toxic thirty-five years ago, and succeeded in eradicating it by offering natives 1d. per lb. of the plant which he then destroyed. Although the price is now 1s. per lb. no material is forthcoming, the plant having been completely removed. Cases of "krimp-iekte," needless to say, no longer occur.

## CONCLUSION.

In this survey, not only have most South African veld plants which have been definitely recorded as toxic in the literature been mentioned, but reference has also been made to eleven other species, which were first proved toxic by the writer. Five of these are recorded in detail. It is obvious from a glance at Tables I and II that much progress has been made since 1919.

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## APPENDIX.

Although field observations were sufficient in all cases but one, viz., *Melothria punctata*, Cogn., to establish that the plants dealt with were toxic, yet in order to have no doubt about the matter and as opportunity offered, tests were carried out. The results obtained, whether positive or negative, are described in detail under each plant as follows:—

## ACOKANTHERA VENENATA, G. DON.

*Source of Material.*—Bathurst. The determination was verified by Dr. Schonland, of the Albany Museum, Grahamstown.

(a) *Young Ox 21.*—Fasted and kept from water noon 1.7.20 until 9 a.m. 2.7.20, when animal given 1 lb. of macerated dried leaves mixed with an equal quantity of bran. As this material was untouched twenty-four hours later and the bran was sour, the manger was cleaned out, and 1 lb. dried leaves as such plus a little oat-hay was substituted. The ration was entirely consumed by 9.7.20, most material having been eaten the last day. As no untoward results were noted, the animal was discharged 12.7.20.

(b) *Young Ox 17.*—As feeding the leaves appeared unsatisfactory, it was decided to prepare an infusion and to drench further experimental animals. An infusion was accordingly made by pouring 2 gallons of boiling water on to 4 lb. of dried leaves and allowing to stand for two hours. Six pints of the filtered liquid was drenched to ox 17 at 7 a.m. 9.7.20, the animal, it should be added, having been fasted for the previous twenty-four hours. On 10.7.20 and 11.7.20 no ill-effects were noted and, although the ox laid down a great deal on 11.7.20, it continued to partake of its ration of lucerne hay.

\* Not seen in the original.

At 7 a.m. 12.7.20 the beast was found dead, lying on its right side, slightly tympanitic, and with blood-stained patches in the region of the anus, tail, and buttocks. There were, within two yards of the carcass, three clots of bloody mucus, and as these appearances suggested anthrax, blood-smears were taken, but found negative. The knees were slightly flexed, tail half extended, back slightly arched, and the hind limbs projected backwards and outwards. The mouth was half open and white foam was present in the nostrils. Internally, the chief lesions were ecchymoses of pleural wall, heart in systole, ecchymoses of epicardium and endocardium of both ventricles, pin-point hæmorrhages on summit of rugæ of abomasum, and intense congestion of first two feet of small intestines, besides two other small congested patches of small intestines. The bladder contained 510 c.c. of deep straw-coloured clear urine, and the brain was intensely congested.

(c) *Sheep 11.*—Since the previous animal had died and nothing had been observed with regard to the symptoms, it was decided to repeat the drenching of the infusion referred to above to this sheep. This was done at 12 noon 31.7.20, 1 pint of the liquid being administered. Two hours later animal showed signs of uneasiness and anxiety, and was moving about in the pen. A few minutes later moaning commenced and, although the temperature was  $103.4^{\circ}$ , pulsation and respiration were normal; this, however, did not last long, for at 2.20 p.m. the pulse was slower and its force increased. About 2.30 p.m. the pulse-rate again changed, becoming more rapid and less marked, so much so that at 5 p.m. it was scarcely perceptible. About this time the urinary bladder was emptied, but no evacuation of faeces was observed. During all this period the sheep was moaning piteously and standing uneasily, and shifting its position frequently. At 6 p.m. a sudden change occurred, the animal collapsing, first on its belly and then on to the right side. The mouth then half-opened, there followed a few convulsive spasms and, with a gradual weakening of respiration, death took place. The post-mortem appearances were cyanosis of visible mucosa, engorgement of subcutaneous blood-vessels, congestion of lungs, emphysema of both anterior lobes, froth in respiratory passages, 10 c.c. bloody effusion in pericardial sac; all compartments of heart contain dark red blood clots (systole absent), fatty degeneration of liver and kidneys, pin-point hæmorrhages of abomasal mucosa, diffuse congestion of terminal portion of ileum, arborisation of mesenteric veins, urinary bladder empty, and brain intensely congested. It should be emphasized that many of these lesions are due to parasitic infection, e.g. pin-point hæmorrhages of abomasum, and degeneration of liver and kidneys. The weight of the animal was 48 lb.

In order to further study the effects of the toxic principle of *Acokanthera venenata*, a tincture was prepared by macerating the leaves—10 gm. dried leaves were taken in 100 c.c. of 90 per cent. alcohol, and allowing to stand for three months. With this tincture the following animals were tested: sheep 40, sheep 41, and sheep 43.

(d) *Sheep 40.*—This animal received 5 c.c. of *Tr. Acokanth.* intrajugularly at 2.30 p.m. 14.10.20. In two minutes the respiration became hurried, in three minutes there was urination, and thereafter the breathing was hurried, short and jerky for seven min. During this time the hind legs were widely separated and there was a smacking movement of the hips. Ten minutes after injection of the drug respiration was irregular, sometimes slow and laboured, and then very rapid, finally becoming gasping in character. The temperature, which at 2.30 p.m. was  $101.6^{\circ}$ , rose to  $104.2^{\circ}$  at 2.40 p.m., and about this period the head was rested against the wall of the pen for support. The hind limbs, usually kept well apart for balance, were at times approximated for short intervals. The gasping continued until 3.15 p.m., and from that time until 5 p.m. gradual improvement took place, when, apart from a staring and excited appearance of eyes, animal looked normal. The pulse-rate soon after injection became slow, but from 2.40 p.m. onwards it increased in rate, being at first full and bounding, but later very fast and hard. In the evening pulsation was still abnormally fast, but on the morning of 16.10.20 it again returned to normal. The morning temperature on 16.10.20 was  $101^{\circ}$  and on the following day  $99.8^{\circ}$ . On 18.10.20 it rose to  $101.8^{\circ}$ , and as the animal appeared entirely normal it was discharged. The weight of the animal was 59½ lb.

(e) *Sheep 41.*—Since sheep 40 had survived 5 c.c. of *Tr. Acokanth.*, it was decided to try the effect of 10 c.c. of the drug on sheep 41, which weighed 64 lb. The injection was given at 10.40 a.m. on 15.10.20 into the right jugular vein, and the effect was immediate. Swaying and urination were marked, the former condition ceasing after two minutes. For the next three minutes the attitude was normal and respiration 18. Thereafter the animal staggered backwards and fell down in a state of collapse, first on the haunches and then the head, hitherto extended, dropped with the forequarters. The respiration then became deep, slower, and heavy, and with groans and staring dilated pupils death occurred seven minutes after injection. Temperature just before death was  $103.6^{\circ}$ . The post-mortem lesions were cyanosis of visible mucosa, heart in systole and epicardium shows six pin-point blood extravasations, congestion of liver, enlargement and congestion of spleen, congestion of kidneys, numerous parasitic nodules of large intestines, urinary bladder empty, and brain congested.

(f) *Sheep* 43, which weighed 50½ lb., was injected with 7½ c.c. of *Tr. Acokanth.* intrajugularly at 11.20 a.m. on 15.10.20. Before injection, animal was excited and pulsation was 108. The temperature, too, was high, being 103·8°, but the respirations normal, viz., 18. Immediately after administration of drug the animal staggered, but recovered. Urination then followed and thereafter appearance was normal, the sheep grazing round the pen. Two minutes after injection a swaying movement from side to side commenced, and as time went on this became more marked, until eventually the sheep dropped on its belly, gave a gasp, and rolled on to its side dead. The length of illness was seven minutes as in the case of sheep 41, but respiration was shallow and hurried until a minute before death, when also the pupils were widely dilated. The post-mortem lesions were anaemia, contraction of left ventricle of heart, two ecchymoses of left ventricular endocardium, congestion of liver and kidneys, congestion of first 6 ft. and last 6 ft. of small intestines, urinary bladder empty, and congestion of brain.

(g) As a control, *sheep* C, weighing 28 lb., received 10 c.c. plain 90 per cent. alcohol intrajugularly to note the effect of the alcohol alone when given intravenously. Injection was made at 2.25 p.m. 14.10.20, and the animal at once fell into a state of narcosis, which lasted for two minutes. During this period respiration and pulse were accelerated, but the oculo-palpebral reflex did not disappear. After two minutes the animal was able to stand with assistance, but swayed if left unsupported. Temperature ten minutes later was 104·6° and the respiration and pulse unaltered. Twenty minutes after injection the sheep stood quietly with closed eyes and head pointing downwards. An hour after injection all symptoms had disappeared and the animal was apparently normal.

(h) *Dog* 21.—Having evaporated 50 c.c. of *Tr. Acokanth.* and obtained 1 grm. of bitter green resinous material, it was decided to test the effect of this on dog 21, weighing 22 lb., on 4.12.20. The material was administered as a pill at 12.30 p.m. At 1.30 p.m. there was severe vomiting, but no trace of the poison could be seen. Between 1.30 p.m. and 3 p.m. the dog vomited on five occasions, but was otherwise normal. Thereafter no further untoward effects were observed, and the dog was discharged from experiment the following day. This result is interesting, since two sheep were killed in seven minutes by intravenous doses varying from 7½–10 c.c. of *Tr. Acokanth.*, which would correspond to approximately 200 mg. of the resinous material.

#### CYNANCHUM AFRICANUM, R.Br.

*Source of Material.*—Most of the material was received from Dr. R. Marloth, who had it collected at Camps Bay, near Capetown. A further supply was sent by Mr. Melck, M.R.C.V.S., from Montagu, and this was identified by Dr. S. Schonland.

(a) *Ox* 21 was fed at 1 p.m. on 17.7.20 with 1 lb. dried stems and leaves of *Cynanchum* mixed with green barley, and an hour later the feed was finished. At 2 p.m. 19.7.20 the same animal received 5 lb. of the plant mixed as before with green barley. By 4 p.m. all the food had been eaten, and as nothing untoward had occurred by the 26th *idem* the animal was discharged.

(b) *Sheep* 13 received at 1 p.m. 17.7.20 1 lb. of dried material, stems and leaves, mixed with a little green fodder. The food was not completely eaten until the morning of the 20th *idem*. As no ill-effects were noted by 30.7.20 the animal was discharged.

(c) *Sheep* 18.—As nothing had followed the ingestion of the plant, an infusion was prepared by soaking 1 lb. of dried material for three hours in 1 pint of water, which had been brought to boiling-point. This fluid was administered at 4 p.m. 17.7.20, and as nothing was observed by 30th *idem* the sheep was discharged.

(d) *Sheep* 10.—As the sheep used above were adults and weighed about 60 lb. each, it was decided to now feed a young sheep (twelve months), weighing 38 lb. On 21.7.20 sheep was accordingly fed at noon with 1 lb. dried material chaffed with green barley. At 4.30 p.m. half the feed was eaten, and next morning at 9 a.m. it had been completed. During 22.7.20 the animal appeared normal, but at 9 a.m. 23.7.20 it was found lying down in a most unnatural position, the belly resting on the ground and the hind limbs projecting backwards, and, in addition, the animal was grunting, no doubt due to the uncomfortable attitude. When assisted to rise, the sheep staggered forwards a few steps and then stood with limbs widely separated so as to maintain balance. If the hind limbs became approximated there was a swaying movement of the back and quarters. The head was held high and often rotated sideways and the pupils were widely dilated. After a few minutes the sheep lay down with great difficulty, almost falling as soon as the legs were moved. The temperature was normal, as was the respiration, but the pulse was small and varied from 100–110 during the day. On the 24th July the symptoms were very much the same. In approaching the manger to eat, appetite having returned, the sheep was so unsteady that it could not pick up the food as usual, but once having taken a mouthful, it was only masticated once or twice. During this effort the sheep almost fell, but managed to recover by planting the feet widely apart. The peculiar attitude of the head, that is, raised and tilted to the side, was also seen, thus resembling a similar position sometimes seen in

ichapetalum poisoning. On the 25th and 26th July there was marked improvement, the nervous symptoms being less pronounced each day. On the morning of the 28th *idem* the animal was normal, and on the 30th *idem* it was discharged.

The above is a typical mild form of the malady and it is a condition frequently seen in practice. In general, it would be difficult to differentiate clinically from a mild case of poisoning by *Dichapetalum cymosum*, which, hardly necessary to mention, is not always fatal as is believed by farmers.

(e) *Ox 18*.—Another lot of material having been received from Dr. Marloth, it was intended to repeat the feeding test on a young ox. To ox 18 was given 5 lb. of dried stems and leaves, mixed in usual way, on 21.8.20. This was consumed within an hour, whereupon the feed was repeated on 23.8.20, the material again being completely eaten. On 25.8.20 another 5 lb. was fed as above, and again the plant was eaten. On 26.8.20 17 oz. was given with the usual ration of hay, making a total quantity of *Cynanchum* of 16 lb. 1 oz. that had been fed with no ill-effects resulting. On 3.9.20 the beast was discharged.

(f) *Ox 5*.—Another attempt was made to produce the disease; and to ox 5 was given a total amount of 26 lb. 13 oz., distributed over a period of eight days (15th–22nd September, 1920). No ill-effects followed, and the animal was discharged at the end of the month.

(g) *Sheep 17*.—Since the only successful attempt had been in a sheep, it was decided to repeat the test on an animal of this species. Sheep 17, weighing 55 lb., was therefore fed with a recent consignment of *Cynanchum* as follows: After being deprived of food on 29.11.20 the animal was fed with 8 oz. dry stem and leaves at 8 a.m. 30.11.20. At 2 p.m. another 8 oz. was given and at 4 p.m. it had been consumed. Nothing abnormal was noted this day. On 1.12.20, at 6.30 a.m., the sheep was lying in convulsions on the ground, which is usually recognized as the second stage of the poisoning by *Cynanchum*. The first stage is that described for sheep 10 and the third stage is the paralysis following the convulsive state. At 8.30 a.m. the animal became worse, the pupils were dilated, respiration hurried and stertorous, and the pulse fast and soft. Tetanic spasms frequently occurred and there was continual grinding of teeth. Consciousness was still evident; there was a little bleeding from the nostrils, due no doubt to injury sustained in struggling. There were galloping movements of the limbs such as are seen in heartwater or *Dichapetalum* poisoning, and the lips and eyelids were constantly twitching. In addition, there was tympany, and until 9 a.m. the animal feared the approach of any individual, this being shown by shrinking and onset of tetanic spasms. Death occurred at 9.10 a.m. during a convulsive paroxysm. On post-mortem examination there was distension of the abdomen, ecchymoses of both ventricles of the heart, emphysema of both anterior lobes of the lungs, and froth in the trachea. Strangely enough the urinary bladder was distended with clear straw-coloured urine. In the rumen and reticulum fragments of the leaves and stems of *Cynanchum* were clearly discernible, a most important point in arriving at a diagnosis in the field.

(h) *Horse 13*.—On 12.2.21 a supply of *Cynanchum africanum* was received from Mr. Melck, who had been investigating an outbreak of *Cynanchum* poisoning at Montagu among cattle. On 13.2.21, at 7 a.m., 1 lb. of the dried material was fed along with a little lucerne to horse 13, and as this was consumed a further 1 lb. 2 oz. was fed at 12 noon. This, too, was all eaten, whereupon the animal received his usual ration of oats and hay. On 15.2.21 nothing unusual was observed, but at 8 a.m. 16.2.21 the horse was evidently in pain, there being stamping of the hind limbs and restlessness generally. The morning feed, however, was completed. At 12 noon the animal was walking in circles, the penis was protruded, and every now and then the attitude of urination would be adopted, but no urine would be passed. During this, there was a quivering of the gluteal muscles, trembling of lips, sweating of the flanks, and a fast soft pulse. At intervals the recumbent position would be assumed and the horse would lie stretched out on his side, occasionally resting on his sternum. Breathing was hurried and there would be a sudden jerking movement of the head. At 4 p.m. there was an improvement in condition and pain was not evident. In walking the hind limbs would be lifted abnormally high and the toes would sometimes be dragged along the ground. There was also knuckling over of the fetlocks and general unsteadiness of gait. At this stage the animal was given per os 1 oz. of chloral hydrate, and at 6 p.m. respiration was deep and less hurried. Walking was, however, still of a staggering character, and to maintain balance the limbs were widely separated. On 17.2.21 the animal was not so well as would have been expected from the improvement shown the previous day. He preferred to lie down in the sun to the shade, and when compelled to rise, staggered and had difficulty in drawing hind limbs. At 10 a.m. the penis was protruding about 3 in., flanks were heaving, and there was grunting as if in pain. There was, however, less difficulty in lying down. At 12 noon horse again rose and urinated (about 3 pints being passed), the attitude assumed resembling that adopted by a cow, the legs being drawn up together. At this time  $\frac{1}{2}$  dr. of potassium permanganate was administered as a drench and water was drunk. At 3 p.m. there was an inclination to feed, and when the horse rose

he remained standing at intervals varying from five to ten minutes. At 7 p.m. another  $\frac{1}{2}$  dr. dose of potassium permanganate was given. On 18.2.21  $\frac{1}{2}$  dr. of potassium permanganate was administered. The animal showed great improvement this day, resting normally and rising voluntarily to feed. On 19.2.21 showed another attack of clonic spasms of gluteals, but appetite remained fairly normal. The usual dose of potassium permanganate was given in the morning and again in the evening. On 20.2.21 frequently rose to feed, and when standing was normal for about five minutes, after which the hind-quarters began to sway from side to side compelling horse to lie down. When down the animal preferred to rest stretched out on his side. Penis still protruded, and arching of back and other symptoms, such as knuckling over, only seen when the animal stands too long. Faeces were softer than usual and appetite was good. On 21.2.21 considerable improvement of condition was observed, and this continued uninterruptedly until 3.3.21, when horse seemed normal. At intervals, however, during this period convulsions or cramp would affect either the muscles of the back or the hindquarters. As a result of the frequent lying down the elbows became chafed, and as the condition improved there was less inclination to rest in the sun and sweating followed on the slightest exertion. As late as the 1st March even feeding was not entirely normal, for there appeared a tendency to bolt the food, which characteristic disappeared later. The horse, undoubtedly, made a wonderful recovery, and improvement cannot be ascribed to medicinal treatment. Rest was entirely responsible for the recovery, for had the sufferer been at pasture, it would have endeavoured to keep near its companions, thus causing unnecessary excitement and effort. With regard to temperature this at no time exceeded  $102^{\circ}$ , this being at 8.30 a.m. 24.2.21.

(i) *Sheep 47*.—Tests were also made with a tincture prepared from *Cynanchum* leaves, as described under *Acokanthera*. To sheep 47, weighing about 60 lb., were administered 10 c.c. of *Tr. Cynanch.* intrajugularly at 2 p.m. 8.11.20. Within the first five minutes there was urination, deep and laboured respiration, chewing movements of jaws, and unsteadiness of gait, the hind limbs chiefly being affected. Later the symptoms wore off and at 5 p.m. only dullness was evident. The sheep was discharged 12.11.20.

(j) *Sheep 45*.—This animal also received *Tr. Cynanch.* as above, this occasion 15 c.c. being introduced. The symptoms were as just described, but only a little more severe. The hind legs were widely separated when standing, and the head stretched upwards and sideways exactly as described for sheep 10. At 5 p.m. the only symptom was dullness, and on 12.11.20 the sheep was discharged.

(k) As a control, *sheep 40* received 15 c.c. of 90 per cent. plain alcohol intrajugularly at 2 p.m. on 8.11.20. This produced the typical stimulating stage of anaesthesia, there being urination, licking movement of lips, hurried breathing, accelerated pulse, and hind limbs well apart. In half an hour the animal was normal, except that the head was held a little lower than usual. At 5 p.m. the head was held as is usually seen, but expression was a trifle dull. Discharge took place on 12.11.20. It will be observed that the symptoms seen in sheep 47, 45, and 40 are somewhat similar, being due in all cases, no doubt, to the action of the alcohol. Little importance should therefore be attached to these three animals, but for completeness all experimental animals have been described.

#### MELIANTHUS MAJOR, Linn.

*Source of Material*.—A supply of the plant was received from Mr. Knight's farm Vaal Vlei, Port Elizabeth, and the identification was kindly made by Dr. Schonland.

(a) *Young Ox 19*.—5 lb. of the dried leaves obtained from Vaal Vlei Estate, near Port Elizabeth, were fed to this animal along with chaffed green barley on 5.8.20. After one attempt to eat the mixture the ox seemed disinclined to try again. However, by 10.8.20 not more than a  $\frac{1}{2}$  lb. of the herb was consumed, yet on this day purgation was marked and the animal lost condition. Water was supplied regularly, but no other food substituted. As a result the ox starved and was so weak on 14.8.20 that it was discharged from experiment.

(b) As the plant as such was not relished, a further experiment was carried out with an infusion prepared by pouring 1 litre of boiling water over 250 gm. dried leaves and allowing to stand for two hours. At 2 p.m. 16.8.20 *sheep 18*, weighing 60 lb., was drenched with 500 c.c. of the above infusion. No symptoms were noticed during the afternoon, but the animal died during the night, i.e. between the 9th and 16th hours after drenching. The post-mortem appearances were as follows: Visible mucosa injected and pupils dilated, respiratory system contained abundant froth, portions of both lungs showed atelectasis, twelve minute haemorrhages of epicardium of right ventricle, all compartments contained dark red blood clots, liver pale brown in colour and congested; spleen and kidneys congested, latter show acute inflammation; abomasum and duodenum deeply hyperaemic.

(c) An experiment was also carried out with a tincture prepared as described on page 224. With this *Tr. Melianth.*, *sheep 50* was inoculated intrajugularly at 10 a.m. 17.11.20, 20 c.c. being administered. The drug had an immediate effect, the breathing being slower for five minutes, after which it became hurried. Three minutes after the injection purging



commenced and continued at intervals for fifteen minutes, during which time 2 lb. 3 oz. faeces were passed. Standing was only with great difficulty after three minutes, but five minutes later sheep was able to walk slowly. During this time there was a chewing movement of mouth and lips were constantly moved about. Later sheep lay down and the head was stretched forward, the animal being dull until 12 noon, when it gradually improved. At 4 p.m. the animal appeared normal and was discharged. The weight before experiment was 58 lb.

MELOTHRIA PUNCTATA, Cogn.

*Source of Material.*—Kindly supplied by Dr. R. Marloth, who had it collected at Camps Bay, near Capetown.

(a) *Sheep 11.*—On 17.7.20 this animal was fed with 1 lb. of dried *Melothria* creeper mixed with green barley, but it was not until 20.7.20 that the material was consumed. As no untoward effects were observed by 30.7.20 the sheep was discharged.

(b) *Sheep 16.*—This sheep was drenched at 4 p.m. 17.7.20 with 1 pint of *Melothria* infusion, prepared by pouring 1 litre of boiling water over 250 gm. of stems and leaves and allowing to stand for two hours. No ill-effects were noticed and animal was discharged 30.7.20.

(c) *Sheep 19.*—On 21.7.20 this animal was fed with 2 oz. of the dried plant mixed with a little green barley, but it was not until twenty-four hours later that the material was eaten. As nothing unusual was noted, sheep was discharged 30.7.20.

(d) *Ox 19.*—On 17.7.20, 1 lb. of dried plant was fed to this animal along with a little green barley. All the material was consumed within three hours, and there being no developments the beast was discharged on 26.7.20.

(e) *Sheep 54.*—As previous tests had all been negative, it was decided to administer a tincture intravenously. The tincture was prepared as described for *Tr. Acoanth.* and *Tr. Melianth.*, and after filtration of the spirituous solution, 20 c.c. were injected intrajugularly to sheep 54 at 10 a.m. 17.11.20. The animal laid down almost immediately and faeces normal in consistence were passed; the breathing then became laboured, being slower and deeper than usual, the head was turned to the right, and the standing posture was never regained. Twenty minutes after inoculation purging was marked, and thereafter the passage of faeces was continued at intervals. At 11.20 a.m. faeces were liquid and blood tinged, and salivation was marked. Pulsation, which during the early stages of the experiment was full, fast, and bounding, gradually became soft, and finally imperceptible. Breathing, too, became fast and shallow. Apart from any specific action of the drug on the vital centres, exhaustion following superpurgation no doubt contributed to the fatal termination. The faeces passed during the experiment weighed 2½ lb., and the sheep was 60 lb. in weight before experiment. In a post-mortem examination of this subject the following lesions were most prominent: Oedema of the serous cavities, interlobular oedema, ecchymoses of the epicardium and endocardium, and marked congestion of the jejunum.

The last experiment confirms the reports received from the field as to the toxic nature of *M. punctata*, Cogn.

ORNITHOGALUM TENELLUM, Jacq.

*Source of Material.*—Collected locally at Grahamstown and identified as *O. tenellum* Jacq., by Dr. S. Schonland.

(a) *Horse 15.*—500 gm. of the fresh flowers and stems was chopped up and mixed with an equal quantity of lucerne and oat-hay and placed before horse 15 at 9.30 a.m. on 7.12.20, the animal having been fasted the previous day. By 10.15 a.m. all the material was eaten. At midday the usual ration was consumed. No food was given in the evening, as it was intended to repeat the feed of *Ornithogalum* the following morning. At 8.30 a.m. on 8.12.20, 600 gm. of fresh leaves along with green lucerne was given, but the animal showed no inclination to eat. About 11 a.m. there was an indicator of something amiss, the horse was dull, and at 2 p.m. soft faeces were passed. Food was refused the whole day, but water in small amounts were taken. The same afternoon, 4.30 p.m., the temperature was 99°, but the general appearance was indicative of nausea. Later the animal glanced frequently at the flank in a sudden jerky manner, and it was evident abdominal pain was intense. The feet were moved about uneasily and the expression was that of anxiety and depression. The ocular mucosa was injected, the pulse full and bounding, and the respiration deeper and slower than normal. About 9 p.m. purgation commenced, but pain did not increase at this stage. Drowsiness was a marked symptom, and during the course of the illness the sufferer sought the darkest corner of the box and stood there with half-closed eyes. During the night abdominal movements, e.g. peristalsis, passage of wind and pain, increased and the passage of faeces became more frequent until finally they resembled dish-water in appearance. Next morning weakness was very marked, and on walking the gait was slow and unsteady and the patient swayed dangerously from side to side. Scouring still continued, but even at this stage no blood appeared in the excreta. Pain,

however, was increasing, and the pulse was small, thready and fast, the respiration being hurried and shallow. There was grunting, pupils were dilated, the eyes glassy, and thirst was so acute that a vessel containing 5 gallons of water was rapidly emptied of its contents. The loss of condition was extraordinary, and in forty-eight hours the animal had been reduced to the state of a drought-stricken animal. The general attitude was most wretched, the ears hanging, the abdominal muscles contracted, and pulsation almost imperceptible. On 10.12.20 the sufferer was still alive, but unable to rise, there was still scouring and piteous grunting. The temperature was 98°, respiration shallow and rapid, and pain, in spite of drowsiness, was intense judging by the violent struggling. At this stage the extremities were cold and the flanks bathed in sweat. Loss of consciousness followed, but the liquid evacuations, soiling the buttocks, tail, and limbs continued. Death occurred about 11.30 a.m. on 10.12.20, being associated with groaning, dilated pupils, irregular breathing, and imperceptible pulse. The duration of the severe symptoms was thirty-nine hours.

*Post-mortem Appearances.*—The post-mortem examination conducted two hours after death showed that the stomach and small and large intestines were congested throughout, especially the small intestines. The contents of the large intestines were watery, but it is interesting to note they were not blood tinged, in spite of severe enteritis. There was also congestion of lungs, spleen, and liver. The horse weighed approximately 750 lb.