*Indigofera spp.* (Leguminosæ).—Among the plants sent in from the lamziekte area, suspected of causing this disease, I must refer to the large number of specimens of various species of Indigofera. In some cases, at least, Indigoferas have been picked out because of their general resemblance to species of Crotalaria; but in other cases we know they have been selected as a result of direct observation of animals which have been fed on them.

*Indigofera cryptantha* Benth. (Leguminosæ).—From the officer in charge of Bester's Put Experiment Station, Bloemfontein District, who reports that it is suspected of causing lamziekte by a farmer of the same district. Feeding tests at Bester's Put and Onderstepoort produced a certain amount of stiffness, but not lamziekte.

*Indigofera (hilaris* E. and Z. ?) (Leguminosæ).—Mr. Robertson reports that a Hottentot herbalist near Grahamstown declares that it is poisonous to cattle at certain seasons, causing them to become delirious and paralysed.

*Indigofera (hololeuca* Benth.?). (Leguminosæ).—Mr. M. J. Lombard, jr., Zandspruit, Hoopstad, O.F.S., sent specimens with the information that farmers in that part of the country are of opinion that it causes gal-lamziekte in cattle. They have noticed that when these bushes begin to form husks, the cattle also begin to die. "The bushes spread easily in the grass, consequently if the grass is a bit short the cattle will of necessity eat the bushes, together with the grass. I have often been watching, but never have seen that goats and sheep eat the bushes."

*Lasiosiphon polycephalus* (E. Mey.) H. H. W. Pears (Synonym *Arthrosolen polycephalus* E. Mey.) (Thymelæaceæ).—Sent by a farmer through the Vryburg Farmers' Association (H.6725), also by Mr. O. Webb, Oorlogs Poort, Cape Province (H.6560) as suspected of causing lamziekte. Is absent from many farms where lamziekte occurs.

*Lessertia tenuifolia* E. Mey. (Leguminosæ).—One of the T'Nenta bushes, formerly suspected of causing T'Nenta in small stock. Occasionally met with in Smitskraal and Bester's Put, but apparently absent from too many farms in the Southern Bechuanaland Region to be the cause of the trouble.

*Liliacea* (S.78). (Liliaceæ).—A suspect at Armoed's Vlakte; drenching tests gave negative results. Only leaves have been found, which are insufficient to determine the species.

*Limeum viscosum* Fenzl. (Phytolaccaceæ).—Limeums are supposed to be poisonous. Several head of cattle were grazed for some time on a patch of this plant, mixed with *L. Aethiopicum* and *Giesekia pharnaceoides*, which were eaten freely, but with negative results. Drenching tests also produced negative results.

*Lithospermum cinereum* DC. (Borraginaceæ).—Sent by P. Z. Oberholzer, stock inspector, Bultfontein, Orange Free State (H.7126). "I believe it to be the cause of lamziekte in cattle if eaten by them. The seed seems indigestible, and I believe cattle can spread it in their dung if removed to other places." This plant is common in the Bechuanaland Region, extending eastwards into Natal and south into Somerset, Graaff-Reinet, Albert, and Queenstown Divisions.

*Malva parviflora* Linn. (Malvaceæ).—In September, 1912, the newspapers reported that a farmer lost a number of ostriches and other stock from feeding them with this plant.

*Monsonia biflora* DC. (Geraniaceæ).—Received from Mr. Burnet Wilson, Hamburg, near Geluk, from a "particularly poisonous spot" on his farm. The root of this plant is often used as a remedy for dysentery; it is not known to be poisonous.

*Moræa* (*polyanthos Thunb.*?) (Iridaceæ).—The terete-leaved seedlings have been sent by Mr. A. Geiling, of Vryburg, as suspects. Drenching tests at Armoed's Vlakte gave negative results; *M. polyanthos* occurs on Mr. Geiling's farm, and is known to be poisonous; possibly the leaves obtained on Armoed's Vlakte are those of *M. Burchelli*, as to the poisonous character of which we have no data.

*Nicotiana glauca* R. Grah. (Solanaceæ).—Occasionally reported as poisonous to cattle and ostriches.

*Ornithoglossum glaucum* Salis. (Liliaceæ).—Poisonous. Not uncommon in the S.W. Transvaal and Bechuanaland

*Osteospermum muricatum E. Mey.* var *asperum* Harv. (*Compositæ*).— Keeps green in winter; much eaten by stock. The natives of Makapansstad say that it is poisonous; goats, chiefly, cattle sometimes, are said to die from it. Another species of this genus was reported poisonous by Cooper in 1860.

*Pentarrhinum insipidum* E. Mey. (Asclepiadaceæ).—Closely related to Cynanchum, and possibly poisonous. Found commonly climbing over bushes at Armoed's Vlakte. Drenching tests gave negative results.

*Physarum cinereum* Pers. (Myxomycete).—Sent by J. P. Strauss, Klipfontein, P.O. Leeuwdoorns, Transvaal. On grass, herbs, etc. Mr. Strauss thinks it is responsible for gal-lamziekte. Also found by me on grass at Kaffraria, Christiana. I am indebted to Mr. Pole Evans for the determination.

*Pollichia campestris* Ait. (Caryophyllaceæ).—Commonly met with in the Bechuanaland Region. Drenching at Armoed's Vlakte has given negative results.

*Raphionacme divaricata* Harv. ? (H.7117) (Asclepiadaceæ).—From Kaffirfontein No. 339, Amersfoort Ward, Wakkerstroom District (see note under *Rhynchosia nervosa* Benth.). Material not sufficiently complete for specific determination. A species of Raphionacme (also indeterminable) was collected by Mr. H. E. Going, Officer in Charge of the Dryland Station, Vryburg, at his sub-station at Cumnor, where animals have died of lamziekte.

*Rhynchosia nervosa* Benth. (H.7112) (Leguminosæ).—Collected by Stock Inspector Massey-Foster on Kaffirfontein No. 339, Amersfoort Ward, Wakkerstroom District, on a portion of the farm where the owner (Mr. J. L. van Reenen) had two outbreaks of suspected lamziekte in 1911. This is one of the most common legumes in the lamziekte area.

*Rhynchosia Totta* DC. (Leguminosæ).—Sent as suspect by S. H. Ewing, Vrede, Orange Free State (H.6418); G. V. S. Webb, Mooi River, Natal (H.6994); Miss G. Fleischak, Bellevue, Johannesburg (H.6502); G. W. Freear, Portlock, Graaff-Reinet (H.7152); Mr. Churchill, per Mr. van Belkum, Blinkpoort, Heidelberg (H.7105).

This legume is being constantly sent to us as a suspect, accused sometimes of causing lamziekte and sometimes stijfziekte, the two diseases being often confused with each other. It is a small shrubby plant with inconspicuous yellow flowers, leaves about an inch long and varying from very narrow to half an inch broad. The pods are seldom more than one inch long and only two-seeded. Mr. Ewing's specimen consisted of leaves found in the rumen of a beast which died, supposedly with stijfziekte or lamziekte.

*Salvia stenophylla* Burch. (Labiatæ).—Common in the Southern Bechuanaland area; spreading along roadsides at outspans and near dams and pans; 85 lb. 8 oz. fed at Armoed's Vlakte to two cows with negative results.

*Schmidtia bulbosa* Stapf. (Gramineæ).—"Sand-kweek grass"; a common and characteristic grass in the Southern Bechuanaland Region. Culms and leaves have been received, obtained from the pharynx of an ox which died of lamziekte. Is absent from many farms where lamziekte occurs.

*Scilla lanceæfolia* Baker (Liliaceæ).—Common in the Southern Bechuanaland Region and elsewhere in South Africa. Drenching gave negative results.

*Semonvillea* (H.6415) (Phytolaccaceæ).—Mr. B. C. Greyling, M.P.C., Hoopstad, sent to the Hon. the Administrator in February, 1911, samples (H.6415) of this plant growing in the Hoopstad District, which he "has reason to believe causes a good many deaths amongst cattle, and which," he presumes "contains some kind of poison to which its origin may be traced." The family Phytolaccaceæ is a small one, and contains a number of more or less poisonous species, so that the plant should be considered a suspect.

*Sesamum capense* Burm. f. (Pedaliaceæ).—A suspect on the farm of Mr. A. S. Pringle near Kaffraria, Christiana.

*Solanum spp.* (*Solanaceæ*); the Bitter-apples.—Several farmers have expressed the view that lamziekte is traceable to eating these weeds. Among the most emphatic on this point was Field Cornet Young, of Hankey, Humansdorp Division.

*Solanum incanum* Linn. (Solanaceæ).—One of the "Bitter-apples," widely distributed in South Africa, contains *Solanine*, and is known to be more or less poisonous. By some farmers strongly suspected of causing lamziekte, but drenching tests failed to produce the disease.

*Solanum supinum* Dunal (Solanaceæ).—Another Bitter-apple. The remarks under *S. incanum* apply to this also. Results of drenching negative.

*Tarchonanthus camphoratus* Linn. (Compositæ).—Vaalbosch. A common and characteristic bush of the Southern Bechuanaland Region. Leaves have been sent from the rumen and pharynx of cattle which have died of lamziekte. Drenching tests at Armoed's Vlakte gave only negative results.

*Tephrosia capensis* Pers. (Leguminosæ).—A suspect. Common on lamziekte farms in south-western Transvaal, Orange Free State, and Eastern Province. Common throughout Cape Colony and in Kaffraria; Port Natal. Too widespread, e.g. Pretoria and Natal coast.

Feeding tests at Grahamstown gave negative results. "Two young oxen received daily doses of 1½ lb. each (this was a lot of stuff, as the herb weighs very light) for seventy-one days, mostly cut up in succulent greenstuff, but neither of them showed any effect whatever."

*Thesium* (*racemosum* Bernh.?) (Santalaceæ).—Widely distributed in and beyond the lamziekte area, but nowhere plentiful. Feeding tests gave negative results. The Part of the *Flora Capensis* containing the Santalaceæ is not yet published, so that our determination is incomplete.

*Tragus kœlerioides* Aschers. (Gramineæ).—A common and characteristic grass of the Southern Bechuanaland Region; also found between the Composite-Karroo veld and the grass veld on the mountains near Graaff-Reinet. Specimens have been found in the pharynx of an ox that died of lamziekte. At Kaffraria I found *Physarum cinereum* crawling over this grass, but it does not follow that there is any connection between the Myxomycete and this particular grass.

*Urginea Burkei* Baker (Liliaceæ).—The well-known "Slang Kop." This bulbous plant has its centre of distribution in the Southern Bechuanaland Region, but it also extends north and north-eastward into the Limpopo Basin Region. Its poisonous character is well known. Feeding and drenching tests have proved fatal, but the symptoms produced are not those of lamziekte. It is absent from the coastal region, but its place is there taken by another species, *Urginea altissima*, which also extends into the Karroo.

*Vahlia capensis* Thunb. (Saxifragaceæ).—Suggested by Mr. Lovemore, Kaffraria, Christiana, *viva voce* January, 1912. Widely distributed. Found in many parts of the country where lamziekte does not occur, and absent from many farms where the disease is prevalent.

*Vernonia Kraussii* Sch. Bip. (Compositæ).—Suspected of causing gal-lamziekte by some farmers near Vryburg (H.6583). Feeding tests gave negative results. This plant is more plentiful and characteristic of the grassveld region of the central and eastern Transvaal than of the lamziekte area. Reported from the Lydenburg District as a cure for dysentery.

*Walafrida densiflora* Rolfe (Scrophulariaceæ).—A common and characteristic species in the Southern Bechuanaland Region; spreading rapidly along the trek roads to outspans and cultivated lands. At Smitskraal several animals were kept for a long time in a small camp in which this was almost the only vegetation; they were seen to eat of it, but only sparingly.

*Xanthium spinosum* Linn. Bur-weed or Boete-bosje and *X. Strumarium* Linn, Cockle-burr or Spitzklette.—The young plants are reputed poisonous in Australia, but Professor J. C. Arthur, of Illinois, concludes that "I am convinced that whatever may be true of decoctions of the plant, Xanthium is not poisonous in any form in which domestic animals will eat it in the field."

Feeding tests of the following grasses have been continued through the winter but without producing Lamziekte.

*Fingerhuthia africana* Lehm. (Gramineæ).—Kalk grass. One of the common and characteristic grasses of the Bechuanaland Region.

*Aristida uniplumis* Licht. (Gramineæ).—Shiny grass. Another of the common and characteristic grasses of the Southern Bechuanaland Region.

*Cymbopogon excavatus* (Hochst.) Stapf. (Gramineæ).—One of the Turpentine grasses; a "sour" grass common in patches in the Bechuanaland Region, but widely distributed.

*Digitaria eriantha* Steud. (Gramineæ).—A common and characteristic grass of the Bechuanaland Region.

*Themeda Forskalii* var. *Burchellii* Hack. (Gramineæ).—Rooigras. A sweet grass, but suspected by some farmers. It is one of the most common grasses of the region, but may be considered local and as having special requirements. In the eastern grassveld region it is replaced by the typical form (*Themeda Forskalii* Hack.) and in the coastal region by variety *mollissima* Hack.; the latter is considered a "sour" grass in the Albany and Alexandria Divisions.

*Eragrostis lehmanniana* Nees (Gramineæ).—One of the common and characteristic species.

## Veld Conditions.

Lamziekte occurs principally in those parts of the country having an average annual rainfall of 9 inches (Boshof District) to 18 inches (Hillary) or 20 inches (Vryburg), and, as far as we know, is absent from those areas having a rainfall of 24 inches and over. We therefore conclude that it is a disease of drought.

Yet it does not occur in the driest parts of the country, *i.e.* the Karroo and the Tsama veld of the Kalahari where there is very little grass, though within the same geographical region it occurs on grass-covered mountain tops. From this we conclude that it is a disease of the grass veld.

But, again, I find extensive areas within the lamziekte region which produce an abundance of grass, but which are quite healthy for cattle, e.g. ganna-vlaktes, and much of the hard river-veld; the grasses of these areas, however, are quite different from those of the limestone veld or the sand veld. We are therefore driven to the conclusion either that the lamziekte toxine is developed only in certain kinds of grasses (as is also the case in cyanogenesis) or else that the telluric conditions of these vlaktes and hard river velds are unfavourable to the genesis of the lamziekte toxine. On this point we must keep an open mind until further evidence is forthcoming.

Again we find that the grass flora of the Southern Bechuanaland Region differs greatly in composition from that of either the south-eastern or south-western Coastal Regions. This suggests that more than one species of grass may develop the lamziekte toxine.

The difference between the grass-flora of the south-eastern Coastal Region and that of the Southern Bechuanaland Region is very marked. The genus Themeda is common to both, but the relative

abundance of species of the following genera at once distinguishes them:—

| Southern Bechuanaland. | South-Eastern Coastal. |
|---|---|
| *Aristida.* | *Panicum.* |
| *Eragrostis.* | *Digitaria.* |
| | *Setaria.* |

The following genera are found in one only of the two regions, the most prominent being:—

| Southern Bechuanaland. | South-Eastern Coastal. |
|---|---|
| *Anthephora.* | *Pentaschistis.* |
| *Schmidtia.* | *Avenastrum.* |
| *Pogonarthria.* | *Danthonia.* |
| *Enneapogon.* | *Ehrharta.** |
| *Crossotropis.* | *Achneria.* |

The following also occur in one only of the two regions (although also met with in other parts of the country):—

| In Southern Bechuanaland. | In South-Eastern Coastal. |
|---|---|
| *Triraphis.* | *Koeleria.* |
| *Urelytrum.* | *Harpechloa.* |
| *Oropetium.* | *Melica.* |
| | *Lasiochloa.* |
| | *Agrostis.* |
| | *Stipa.* |
| | *Poa.* |
| | *Festuca.* |
| | *Dactyloctenium.* |
| | *Oplismenus.* |
| | *Stenotaphrum.* |
| | *Spartina.* |
| | *Lepturus.* |

We find also that within these two lamziekte regions the disease does not occur at all—or is much less frequent—where the coarse grasses have been eaten out by sheep and goats. This is the case in the native reserves at Moteeton and Taungs, which have for years been "overstocked" with sheep and goats, in addition to cattle; and also on town commonages, such as Boshof, which are well eaten down. In these cases close grazing has clearly produced a change in the botanical composition of the veld, which also suggests that—as in the case of Cyanogenesis—some grasses develop the toxine and others do not. It also suggests preventive measures.

A similar result as far as lamziekte is concerned is noticeable on the farm Hillary, near Sandflats, Alexandria Division, where a large flock of sheep has been grazed continuously on the same area for several years. But in this instance the botanical composition of the veld does not appear to have been changed by the close grazing, which suggests that in this case the difference in effect is due to a change in the *condition* of the grass, produced by closer grazing. In

* With one exception out of 25 species.

this connection it is noticeable that *Paspalum dilatatum* becomes less palatable when allowed to grow too long before grazing, and on this account some farmers have even condemned it as useless for their particular districts, while others again have found that after stock have been forced to graze it down it becomes palatable again.

It is quite possible that the poison collects at the joints ("nodes") of the grass stem; this is known to be the case with certain salts which occasionally accumulate in grass stems. If this is the case with the lamziekte toxine it is not improbable that close grazing would check the accumulation of the poison, which might, perhaps, explain the beneficial effect of close grazing with sheep. The mowing and removal of the long grass might also prove beneficial.

This mown grass could be made into hay, but it would probably prove injurious unless fermented either as silage or in the form of "sweated" hay. We hope to be able to prove that either method of treatment will remove the toxine.

It has also been brought to our attention that on some farms veld fires have produced distinct changes in the botanical composition of the veld, and that lamziekte has developed on a large scale simultaneously with the burning, while being absent from the unburned veld. This also suggests that certain grasses are more subject to toxinegenesis than others, but it might also be due to a change in the condition of the grass brought about by burning.

Our experiments for several months past have been directed towards finding out whether the grasses themselves are actually the cause of gal-lamziekte. On the farm Bester's Put, Bloemfontein District, we have lost two cows which were being fed exclusively on fresh grass cut on a lamziekte area; the symptoms were those of lamziekte. The particular area from which the grass has been cut produces several distinct species of grasses, among which *Aristida uniplumis* and *Aristida stipoides* var. *meridionalis* predominate. Neither of these grasses occurs in the south-eastern Coastal Region where lamziekte has been so bad during the last few months, so that if they are the cause of lamziekte at Bester's Put some other grasses or plants must be responsible in the Uitenhage and Alexandria Divisions.

On the same area at Bester's Put other grasses occur, such as *Cymbopogon excavatus*, *Themeda Forskalii* var. *Burchellii*, and *Anthephora pubescens* none of which occurs in the south-eastern Coastal Region.

### *Plants eaten by Animals in the Lamziekte Region.*

In the light of our theory that Lamziekte is due to the accumulation of a poison in the animal system, from some grass or other plant which the animals eat, it is necessary to know what plants they usually feed upon in the regions where the disease occurs.

I have made careful observation and notes on these plants while travelling through those parts of the country where the disease is prevalent.

The plants which form the bulk of the pasturage for stock in the Southern Bechuanaland Region are:—

In the grass-veld areas:—

*Anthephora pubescens.*
*Panicum nigropedatum.*
*Panicum coloratum.*
*Schmidtia bulbosa.*
*Digitaria eriantha* and *var. stolonifera.*
*Sporobolus fimbriatus.*
*Eragrostis lehmanniana.*
*Eragrostis superba.*
*Themeda Forskalii var. Burchellii.*
*Aristida uniplumis.*
*Eragrostis betchuanus.*
*Cymbopogon excavatus.*

Of these the three last-named are generally classed as sour grasses, and are eaten only when very young, or when the other grasses are finished.

Some years ago Mr. Percy Greathead sent me specimens of *Anthephora pubescens*, *Panicum nigropedatum*, and *Pennisetum cenchroides*, from the Bechuanaland farms of the South African Farms, Limited. Commenting on the remarkable feeding value of these grasses, he made the following interesting observations:—

"I have noticed these three grasses growing also at the farm Koedoesfontein, Pilandsberg, Rustenburg District, and I have seen them thrive also at various places along the Matlabas River in both the Rustenburg and Waterberg Districts. My observations lead me to believe that horned stock thrive better on these than on any of our (other) native grasses. Wherever these grasses preponderate, cattle seem to keep in good condition all the year round. No. 2, "Krul-gras" (*Panicum nigropedatum*), is preferred by animals to the other two, though No. 1, "Blauw-Buffel" (*Anthephora pubescens*) follows closely in their estimation."

On the River-veld we find:—

*Cynodon Dactylon.*
*Panicum minus var. planifolium.*
*Rottboellia compressa var. fasciculata.*
*Acacia horrida* (in season).
*Salix capensis* (in season).
*Gomphostigma scoparioides* (at low water).

*Salsola aphylla* is often met with in the brak hollows behind the higher river-bank. (Examples of Riverveld are shown on Plate 24.)

In the Karroo-veld or "bosjes-veld" as it is sometimes called, we have the following:—

*Pentzia virgata.*
*Pentzia globosa.*
*Felicia fascicularis.*
*Othonna pallens.*
*Nenax microphylla.*
*Salsola aphylla.*
*Tarchonanthus camphoratus.*

The three first-named are usually found in association; the other four usually under special conditions controlling their distribution. Examples of Karoo-veld are shown on Plates 15A, 21 and 25B.

*On lime outcrops.*—Outcrops of dolomite and patches of recent lime deposits (derived from the dolomite?) are of frequent occurrence in the Southern Bechuanaland Region. They generally produce a very mixed vegetation of bushes, etc., among which *Salvia rugosa, Fingerhuthia africana, Pentzia virgata, Pentzia globosa*, and *Tarchonanthus camphoratus* are prominent; the three last named are the ones principally eaten. *Olea verrucosa* also occurs plentifully, though only locally, on these outcrops and is much browsed.

*Homestead or Werf plants.*—The constant grazing by stock kept on the werf or round the kraal has resulted in the disappearance of many of the commoner veld grasses which have been replaced mainly by closer-growing sorts among which *Cynodon incompletus* and *C. Dactylon* predominate. These are known as "sweet" grasses, and are much and closely grazed by all kinds of stock; even cattle, which are proverbial for preferring a long grass around which they can twist the tongue, manage to feed on the close, lawn-like surface of *Cynodon incompletus* when so short as to appear only suited to sheep and goats, and I have watched horses also grazing the same grass under similar conditions. (See Plates 25A and B.)

Among these "Quick-grasses" tufts of *Eragrostis plana* and *Sponobolus indicus* are often to be found; these are coarse, wiry grasses, but are much liked by stock, especially the young tender foliage.

In such localities we usually find specimens of the Solanums, such as *S. incanum* and *S. supinum*, which are usually kept closely browsed probably because they are able to keep green longer than the surface-rooting grasses, owing to their deep rooting habit. The Thorn-apples (*Datura Stramonium* and *D. Tatula* also occur in such places, and are occasionally browsed, at least by goats. The Pieper-gras (*Lepidium capense*) is often plentiful and furnishes plenty of good grazing while young.

*In the "Eastern Province."*—It is generally stated that lamziekte is absent from the areas of bush, as well as from the River-veld, and that its occurrence in this part of the country is confined to the open grass-veld of the higher ground and clearings in the bush. Such areas often have a limestone formation, which has led many local farmers to associate the disease with the presence of limestone.

In the "Addo Bush" the following are eaten readily:

*Euclea undulata* (Guarri) and *Portulacaria afra* (Spek-boom) considered the best browse plants, and *Sarcostemma viminale* (Melktouw).

*Bontebosch veld.*—This is open grass-veld with rounded clumps of bush scattered through it, commonly seen in parts of the Albany and Alexandria Divisions. The dominant grasses are *Themeda Forskalii var. mollissima* (here considered a sour grass) and *Tristachya leucothrix.*

*River-veld of the Eastern Province.*—This is classed as "Sweet" veld, and is usually composed of bush (*Acacia horrida, Salix capensis, Combretum salicifolium, Zygophyllum Morgsana,* etc.) and such grasses as *Panicum maximum, P. deustum, Setaria sulcata,* etc., which are quite different from those of the Bontebosch veld.

The following is a list of the principal plants eaten. This catalogue cannot be considered complete, and it is published as a preliminary one only, in the hope that farmers who have observed their cattle eating other native grasses and other plants, will oblige us with information. Every fact collected is one more point in the history of the disease, and we cannot at present tell which of these points will prove most useful in clearing up the problem; no one can say in advance that this fact or that is useless!

*Acacia giraffæ* Burch. (Leguminosæ).—Kameel-doorn. The large woody pods are mealy and sweetish though astringent within, and are much eaten by game and stock in winter. Said to have been a favourite browse of giraffes when they occupied that part of the country. The largest tree of the Southern Bechuanaland Region; commonly met with on sandy soils, forming groves, occasionally marked as "forest" on the maps, and giving somewhat the appearance of the Limpopo basin bush veld. Formerly the principal source of fuel around Kimberley and Mafeking.

*Acacia horrida* Willd. (Leguminosæ).—Sweet-thorn, Zoet-doorn, Mimosa. Southern Bechuanaland Region, common around fonteins and on river banks. Deciduous in winter; the young foliage is eagerly browsed by sheep, goats and cattle. Burchell notes that in Griqualand West the bark was chewed or pounded on stones by Hottentot women to make a string. Two of these strings rolled on the thigh are twisted into one; this string is used to fasten rush-mats. He also states that the branches are preferred by the Korannas for kraal fences.

*Acacia stolonifera* Burch. (Leguminosæ).—Terrasibosch (*i.e.*, Dutch terras—terrace). The young spring foliage and the autumn pods are eaten by stock; deciduous in winter. A low bush, spreading underground and forming a sand-binder. Mier-kats often take advantage of its protection to make their colonies among its roots.

*Amarantus paniculatus* Linn. (Amarantaceæ).—Mest-briede, Pigweed, um-Buya. An annual, greedily eaten by stock, horses, mules, pigs, ducks and fowls, and especially useful for pigs. A troublesome weed of cultivated land, but killed by the first frost of autumn. The seed, which is hard, black and shiny, appears to pass through the digestive tact of animals undigested; it is found in great abundance in kraal-mest and stable-manure.

*Amarantus Thunbergii* Moq. (Amarantaceæ).—Cape Pigweed, mest-briede (said to be the true "Mest-briede"). A common weed of roadsides, homesteads and kraals. Considered a good pig feed, (B.D.1633).

*Anthephora pubescens* Nees. (Gramineæ).—Blaauwbuffel-gras. A common and characteristic grass of the Southern Bechuanaland Region extending westward to Hereroland. Much eaten by stock at certain seasons, and considered one of the three best pasture grasses in those parts where it occurs. The flowering stems are tall and bare of leaf, and the foliage rather short and close, while the tufts are not

large nor dense. This grass would therefore seem to be more useful for sheep and goats than for large stock. I have, however, seen cattle grazing it.

*Argemone mexicana* var. *ochroleuca* Lindl. (Papaveraceæ).—Mexican poppy; miscalled Scotch Thistle or Scots distel. Browsed by sheep and goats in the Bloemhof District, in times of drought. A favourite ostrich food; ostriches have been successfully camped on it for purposes of eradication.

*Aristida spp.* (Gramineæ).—These grasses are particularly abundant in the Southern Bechuanaland Region and through the Kalahari to the Atlantic coast. They are, as a rule hard, wiry grasses, and often left by stock until other feed is exhausted.

*Aristida brevifolia* Steud (Gramineæ).—Langbeen Toa-gras, large Bushman grass. A common and characteristic grass of the Kalahari Desert region. One of the principal food grasses (along with *A. obtusa* and *A. spp.*) of the Kalahari desert.

*Aristida ciliata* Desf. var. *tricholæna* Hack.; another Langbeen Toa-gras; much eaten.

*Aristida dregeana* Trin. and Tupr. (Gramineæ).—Langbeen Toa-gras; large Bushman grass. (For economic value, etc., see note under *A. brevifolia*).

*Aristida obtusa* Del. (Gramineæ).—Small Bushman grass; fijne Toa-gras. A common and characteristic grass of Great and Little Bushman-land, the Western Kalahari, and Great and Little Namaqualand. The principal food (along with Tsama melons) of the stock and game of the Kalahari desert.

*Aristida uniplumis* Licht (Gramineæ).—Langbeen Toa-gras; large Bushman-grass; shiny grass. One of the most common and characteristic grasses of the Southern Bechuanaland Region extending westward to Namaqualand. It is a hard, wiry grass, eaten when young, but afterwards left until the other grasses are finished. Mr. T. Lanham reports that it is good for stock in the Kuruman Division.

*Aristida vestita* Thunb. (Gramineæ).—Eaten by stock. B.D.12730.

*Arundinella Ecklonii* Nees. (Gramineæ).—A grass of wet lands common in vleis and around fonteins. A coarse, hard grass sometimes cut for rough forage and often for horse bedding, but apparently of little feeding value, although in some places it is reported as being "good for cattle."

*Asclepias fruticosa* Linn. (Asclepiadaceæ).—Shrubby milkweed; Melkbosch; Wild cotton-bush. Deep-rooting alien weed, apparently spreading through the country; it keeps green well into the winter, and is freely browsed by goats and cattle. It is known to be poisonous when eaten in large quantities, and has no value as fodder.

*Asparagus spp.* (Liliaceæ).—Kat-bosch, Kat-doorn. Though very spiny, goats and sheep and cattle eat it. The young shoots are succulent, tender and usually spineless, and are eagerly sought by stock. The plants are perennial, and are generally found in the protection of bushes, over which they scramble to the light.

*Atriplex Halimus* Linn. (Chenopodiaceæ).—Eaten by stock. (B.D. 12714).

*Atriplex rosea* Linn. (Chenopodiaceæ).—Eaten by stock. (B.D. 12617).

*Babiana hypogaea* Burch. (Iridaceæ).—Burchell states that in 1812 he found the Bechuanas eating the corms of this plant under the name of "lichus." It is probable that buck, small animals and perhaps also goats and pigs eat these corms.

*Bauhinia esculenta* Burch. (Leguminosæ).—I am not aware that the foliage of this plant is eaten, but Burchell states that the seeds, called tammani, as well as the astringent tubers, were eaten by the Bechuanas.

*Berkheya sp.* (Compositæ).—This species is common in the South-western Transvaal. The leaves lie close to the ground, but are pastured by stock at certain seasons of the year.

*Bidens pilosa* Linn. (Compositæ).—A weed of gardens and old lands. The young plants are a favourite forage with horses and mules. Said to be highly nutritious.

*Bulbine narcissifolia* Salm-Dyck. (Liliaceæ).—Said to be good feed for sheep and goats, in the Bloemhof District, but I have no personal proof of this.

*Buphane toxicaria* (Thunb.) Herb. (Amaryllidaceæ).—Not infrequently browsed by stock in Bechuanaland and in the Transvaal. A correspondent informs me that horned cattle are very fond of the leaves, and it is noticeable that when the young leaves first come out in spring they are nearly always browsed.

*Cassia mimosoides* Linn. (Leguminosæ).—Occasionally browsed by stock.

*Cassia obovata* Collad. (Leguminosæ).—A common and characteristic herbaceous plant in the Southern Bechuanaland Region. Leaves deciduous in winter. Occasionally browsed by stock, but not as frequently as most other plants.

*Chloris gayana* Kunth. (Gramineæ).—Rhodes' grass. A perennial summer grass occasionally met with in the Southern Bechuanaland Region; where it grows freely it is considered a valuable forage and hay grass. It is sensitive to frost; it seems to prefer damp, vlei bottoms.

*Chloris petraea* Thunb. (Gramineæ).—Stony kopjes in the Transvaal and Southern Bechuanaland. Eaten by stock. Found scattered among other grasses; not gregarious (or forming pure stands) with us.

*Chloris virgata* Swartz. (Gramineæ).—A common grass in cultivated lands where it is apt to become a troublesome weed. Eagerly relished by stock and considered highly nutritious; if cut before the seed-heads are ripe it makes excellent hay. An annual.

*Chrysocoma tenuifolia* Berg. (Compositæ).—Bitter Karroo-bosje. A low-growing, yellow-flowered Karroo-bosje, with brighter foliage and darker flowers than *Pentzia virgata*, also without ray florets. The foliage is resinous and bitter, and it is not much liked by animals; ostriches and other stock sometimes eat it, however, in times of scarcity, but it is said to produce stomachic and biliary disorders if eaten in quantity. It is generally considered to be a veld weed and is reported as spreading injuriously in some divisions of the Eastern Province, choking out the better species. It is common throughout the Northern Composite Region of the Free State and the Cape, and the Bloemhof District of the Transvaal.

*Cleome rubella* Burch. (Capparidaceæ).—When found in the veld it is often seen to have been browsed. The Capparidaceæ are usually pungent and stimulating.

(*Cluytia sp.* ?) (Euphorbiaceæ).—Occasionally eaten by stock in the Southern Bechuanaland Region; not plentiful.

*Convolvulus ornatus* Engl. (Convolvulaceæ).—Common in the Southern Bechuanaland Region. Much eaten by stock. Mr. Van Aswegen, of Graspan, Border Siding, notes that cattle are very fond of it.

*Crotalaria virgultalis* Burch. (Leguminosæ).—Mr. Cresswell, of Geluk, Vryburg, states that his oxen browse on this bush and get fat on it. Common in parts of British Bechuanaland.

*Cyanella lutea* Linn. (Hæmodoraceæ).—Burchell reported that the bulbs were eaten by the Bechuanas; it is probable that they are also eaten by small stock.

*Cymbopogon excavatus* Stapf. (Gramineæ).—One of the turpentine grasses, containing a pungent, essential oil which gives it a strong, resinous taste; it is therefore a "sour" grass, disliked by stock. Yet even this grass is eaten in times of scarcity. Common in patches in the Southern Bechuanaland Region, and inclined to be gregarious; widely distributed.

*Cynodon Dactylon* Pers. Bermuda Kweek-gras; Doob-grass; Dub-grass; Kwaggakweek gras. (Gramineæ).—Common on old lands, round homesteads, stores and kraals, and in Native Reserves in Bechuanaland. Much and closely eaten by stock at certain seasons. A hard, wiry grass, not valued as highly as *C. incompletus*. Travelling through Griqualand in 1812, Burchell made the following interesting note on a certain grass which was probably this or the following species:—"Between Grootfontein (Campbell) and Klaarwater (Griquatown) we passed a spot, containing about an acre, remarkable from the circumstance of the grass, with which it was covered, being eaten down as smooth as a lawn and as verdant. What there might be in this particular spot, so different from all the surrounding country, to occasion the peculiarity, I had not time to examine; although it was evident, by the quantity of manure from various animals, principally quaggas, that it was their favourite grazing place.

*Cynodon incompletus* Nees. (Gramineæ).—Transvaal Kweek-gras. Much eaten, close to the ground, by stock, horses, etc.; called Fine quick; Fyn Kweek-gras. Plentiful in the native reserves, where it largely supplies the small stock with pasturage. (See plate 25A.)

*Cyperus usitatus* Burch. (Cyperaceæ).—Uijentjes. A favourite food of partridges (francolins) and springhaas; almost everywhere in the Southern Bechuanaland Region, in winter one finds that these animals have been scratching up the tubers. Burchell notes that the Bushmen of the Asbestos Mountains ate these tubers after roasting them slightly in the embers; Dr. Turner reports that they are used as food by the Bechuanas when pounded and boiled in milk.

*Datura Stramonium* Linn. (Solanaceæ).—White Stramonium; Stink-blaar; common Thorn-apple; Jamestown weed; Jimson weed. One of the commonest weeds of the Transvaal, common on the waste lands of every village and around almost every farmstead and kraal.

*Datura Tatula* Linn. (Solanaceæ).—Purple Stramonium, Blaauw Stink-blaar; Purple Thorn-apple. It is probable that this common species is equally poisonous with *D. stramonium*, but they are not often distinguished in reports. It is abundant in the Transvaal around cattle kraals and farmsteads, and on waste lands. It is easily distinguished from *D. Stramonium* by its purplish flowers and darker stems.

I have frequently seen goats browsing on the unripe fruits of *Datura Stramonium* and *Datura Tatula*. These plants are most plentiful around kraals, where they are probably spread in the dung.

*Digitaria eriantha* Steud. (Gramineæ).—A common and characteristic grass of the Southern Bechuanaland Region, especially plentiful where partially protected by bushes. A sweet grass, greedily picked out by stock and considered of good feeding value. In addition to spreading by seed, it produces long runners, above ground, which root from the joints. At Mr. Halse's ranch in the Vryburg Division, I measured some of the runners which were 9 ft. long; this form is known as variety *stolonifera* Stapf.

*Ehrharta longiflora* Steud. (Gramineæ).—Said to be eagerly consumed by cattle.

*Elephantorrhiza Burchellii* Benth. Elands-boontjes; *i.e.*, Eland's beans. (Leguminosæ).—The plant is deciduous in winter, but throws up shoots early in spring, before the grass is green, and at this time of the year it is eaten to some extent by buck and stock. Leaves are not infrequently found in the rumen of animals. The plant contains a good deal of tannic acid and is decidedly astringent; the underground stem is rootlike (a "wortel") and is used by the farmers for tanning hides. Burchell states that "these roots were a favourite food of elephants" when he visited Bechuanaland in 1812.

*Elytropappus rhinocerotis* Less. (Compositæ).—Rhenoster-bosje. It is generally stated that this is a useless bush and a bad weed which renders barren thousands of acres of good wheat land, and that it is not eaten by stock. Mr. G. M. G. Hunt is quoted, however, as having stated that it is a favourite food of cattle.

*Emex australis* Steinh. (Polygonaceæ).—Duiveltjedoorns. A useful fodder-plant when young, before the "doorns" are formed. Said to be especially valuable for ostriches.

*Eragrostis lehmanniana* Nees. (Gramineæ).—One of the "sweet" grasses of the Southern Bechuanaland Region; much eaten by stock: somewhat short for cattle, and more of a sheep-grass. Scraps of what appeared to be this grass were found in the pharynx of a dead ox.

*Eragrostis plana* Nees. (Gramineæ).—"Os-gras." A common grass around homesteads and outspans. A hard, wiry species much grazed by stock when young but soon becoming too hard and wiry. Horses left standing on the veld are sometimes tied to a tuft of this grass.

*Eragrostis superba* Peyr. (Gramineæ).—"Madolwana." One of the best pasture grasses of the Southern Bechuanaland Region. Much and closely eaten by stock.

*Eragrostis* sp. (H.7800) (Gramineæ).—Mr. T. Lanham reports that this is a sweet grass which is rather plentiful in the Kuruman Division and that horses and cattle are partial to it. It grows about 18 inches high.

*Eriocephalus aspalathoides* (H.7801) (Compositæ).—"Kapok-bosch"; Snow-bush. "Good for all kinds of stock. Very plentiful here. Grows to a height of 3 ft." (Mr. T. Lanham, Kuruman.)

*Euclea ovata* Burch. (Ebenaceæ).—"Guarri." I have no note that the foilage of this bush is eaten, but Burchell notes that the berry is eaten and of good flavour though of a little astringency.

*Euclea undulata* Thunb. (Ebenaceæ).—"Guarrihout." One of the best browse-plants in the Addo-bush.

*Euphorbia* sp. (H.6550) (Euphorbiaceæ).—Mr. T. Norman Palmer, of the Uitenhage Division, Cape Province, reports as follows: "A plant which grows in abundance on this farm and particularly on poor, stony (soil) ridges. It is known locally as the "melk-bosch" and its juice is used for the manufacture of birdlime. The juice is collected by cutting a saucer shaped hole in the top of the plant which fills rapidly with a milky fluid. The plant is a great favourite with all kinds of stock, so much so, that it is almost impossible to find a specimen that has not been eaten flat with the ground; they will leave any kind of grazing for it."

*Euphorbia* (*caput-medusæ* Linn.?) (Euphorbiaceæ).—Considered a very valuable cattle food in portions of the Karroo.

*Exomis axyrioides* Fenzl. (Chenopodiaceæ).—Honde-bosje. A useful member of the Saltbush family much liked by stock and said to have considerable feeding value.

*Felicia fascicularis* DC. (Compositæ).—Schaap-bosch. Much eaten by small stock in the South-western Transvaal and North-west Orange Free State.

*Galenia spathulata* Fenzl. (Aizoaceæ).—This is a common weed in the Albany Division, where it is eaten by stock. As far as I am aware it does not occur wild in Bechuanaland or in the South-western Transvaal. Mr. A. S. Pringle of Christiana who knew the plant in the Eastern Province informs me that a farmer living midway between Christiana and Bloemhof grew it from seed in his garden with success and it proved very valuable for his sheep.

*Geigeria* sp. (near *G. pectidea*) (Compositæ).—Much eaten by stock on the farm Zoutpan 169, Bloemhof District (Lazenby's).

*Gladiolus edulis* Burchell. (Iridaceæ).—Burchell reported that the Bechuanas ate the corms under the name "lituin" or "lituing." It is probable that they are also eaten by buck and small animals.

*Gomphostigma scoparioides* Turcz. (Loganiaceæ).—Abundant in the mud of the Vaal River a little above low-water mark, and in shallow water (B.D.9577); it is here much and closely eaten by horses and mules. See Plates 33 and 33A.)

*Gomphrena globosa* Linn. (Amarantaceæ).—Bachelor's buttons. A deep-rooted perennial which keeps green fairly late in the season; closely eaten by stock in late autumn and early spring.

*Grewia cana* Sond. (Tiliaceæ).—Rozyntje-bosch. One of the common and characteristic bushes of the Southern Bechuanaland Region; much browsed in the latter part of summer and early spring, when green grass is scarce. It loses its leaves in winter. The leaves

are frequently found in the rumen and pharynx of cattle. Called "Wild currant" by Lazenby at Zoetpan 169 (Britten Siding) where it is closely browsed by stock. The berries are eaten by Kaffirs and white children. They are also dried, ground into meal and made into porridge by the natives. They are small, stony, decidedly sweet but also somewhat astringent. It is also stated that the Bechuanas make a sort of beer from them.

*Grewia flava* DC. (Tiliaceæ).—Very similar to *Grewia cana* and like it eaten by stock.

*Gynandropsis pentaphylla* (L.) DC. (Capparidaceæ).—An old transport rider informed me that a pod placed in the ear will quickly extract all the wax. Willis states that the seeds are used like mustard. I am not certain that this plant is actually eaten by stock.

*Helichrysum Zeyheri* Less. (Compositæ).—Readily eaten by animals. A common and characteristic shrublet mixed with the grass, on the Kaapscheberg and elsewhere in the Southern Bechuanaland Region. Much and closely browsed by stock. See Plate.—The stem, though dwarf, is woody, and often flattened, as also in the case of *Salsola aphylla*. The young shoots, only, are eaten, and these are often pruned right back to the old wood.

*Hermannia brachypetala* Harv. (Sterculiaceæ).—Common and characteristic in the Southern Bechuanaland Region, especially on sandy veld. In 1904 I was informed by a farmer near Schweizer Reineke that this plant was one of the good sheep and goat fodders of the South-western Transvaal. I have had the plant under frequent observation since then, and especially during the last two years, but I have very rarely seen signs of its having been eaten by stock.

*Hermannia candicans* Ait. (Sterculiaceæ).—Not uncommon in the Southern Bechuanaland region and often browsed, but Mr. Lanham reports from Kuruman that stock will only eat it when they can find nothing else.

*Heteropogon contortus* R. & S. (Gramineæ).—Spear-grass. Yields good grazing while young but the sharp calli of the seeds when ripe, are injurious to sheep, sometimes causing death. It also becomes entangled in the wool, and is therefore a grass to be discouraged. In the Transvaal on open grass steppes of the High and Bush veld, common in places, but rather local. Orange Free State, Natal, and Cape Province, including Bechuanaland.

*Ipomoea Ommannei* Rendle. (Convolvulaceæ).—At Mr. Halse's farm, Armadillo Creek, Vryburg Division, I tested a quantity of freshly gathered plants on some cattle when they came in to be milked in the morning; a Friesland bull recently imported from the Cape ate a little, evidently without relish; the cows born on the farm or which had been there for some time, merely sniffed at it and would not eat it. I was not able to make a critical study of the plant, through lack of good material, but it appeared to be the same as the typical *I. Ommannei* of the Witwatersrand, though less silvery which I attributed to age, it being winter. There is no question that the true form as grown on the Witwatersrand and on the Eastern High Veld, is *greedily* eaten by stock; on some farms it is being eaten out and good specimens can only be obtained within enclosed areas such as the railway reserve.

*Lantana salvifolia* Jacq. (Verbenaceæ).—Burchell observes that in the Asbestos Mts., Hay Division, this plant was so browsed by goats that cropped its leaves and blossoms that it was thus constantly restrained from acquiring its proper size. Burchell does not give the specific name but his No. 2055 from "on the Asbestos Mountains, near the Kloof Village" is identified in the *Flora Capensis* as *L. salvifolia* Jacq.

*Lasiocoma petrophiloides* (DC.) Bolus. (Compositæ).—Very common, growing in sandy soil in big patches; flowers May to October, and said to be a very fine "sheep-bush."

*Leersia hexandra* Sw. (Gramineæ).—Transvaal, Orange Free State and Cape Colony. Widely distributed through tropical and sub-tropical regions. An aquatic grass, found in perennial vlei pools and slow streams of the High Veld. Eaten readily by horses. In N.W. India cattle are said to be fond of it and in Australia it is said to be much relished by stock.

*Lepidium capense* Thunb. (Cruciferæ).—Pepper-cress; Peppergrass. A common werf weed much eaten by stock when young.

*Lippia scaberrima* Sond. (Verbenaceæ).—Foliage lemonscented. Whisps are made of the leafy branches and used by Kaffir maids for sweeping out their kraals. I am not certain that this is eaten by stock.

*Listia heterophylla* E. Mey. (Leguminosæ).—"Yellow clover." A low-growing, running plant of wettish places, which somewhat resembles a bird's-foot trefoil. Closely grazed by stock.

*Malva parviflora* Linn. (Malvaceæ).—Mr. S. J. Hyde of Uitkyk, Leeuwdoorns, Wolmaransstad District, states that "this is a very valuable fodder plant for small stock as it makes good growth during the winter months and it is only then that sheep and goats eat it. Frost has no effect on it." Too dangerous to be used, and it is unnecessary to take such a risk when better things can be grown such as Tall fescue.

*Mesembrianthemum floribundum* Harv. (Aizoaceæ).—Yields excellent pasturage for ewes and lambs upon flats where the soil shows only traces of soda-salts. Where it and Spek-boom are present, stock care but little about their daily visits to the water vlei. (MacOwan).

*Mesembrianthemum obliquum* Harv. (Aizoaceæ).—Prof. MacOwen states that it yields excellent pasturage for ewes and lambs upon flats where the soil shows only traces of soda-salts.

*Monechma divaricatum* C.B.Cl. (Acanthaceæ).—"Wild lucerne." Mr. Lanham, of the Kuruman Division, writes that it is "known in these parts as Wild Lucerne; all kinds of animals as well as ostriches eat it in preference to our best known bushes and sweet grasses. It is very fattening, in fact, I consider it quite equal to the proper cultivated lucerne."

*Monechma fimbriatum* C.B.Cl. (Acanthaceæ).—In the Zoutpansberg District, on the farm Molsgat, it is said to be a fodder plant.

*Nenax microphylla* (Sond.) (Rubiaceæ).—Southern Bechuanaland Region; also near Graaff-Reinet; plentiful where it occurs, but distribution somewhat local. Considered one of the best plants for sheep and goats. A dwarf shrublet.

*Olea verrucosa* Link. (Oleaceæ).—Olijvenhout; wild olive. Common in parts of the Southern Bechuanaland Region; usually on kopjes or on limestone (dolomite) outcrops. Much and closely pruned by stock wherever they can get at it.

*Osteospermum muricatum* E. Mey. (Compositæ).—Browsed by stock. A common weed of the werf, apparently spreading along roadsides and at outspans.

*Othonna pallens* DC. (Compositæ).—Springbok-bosje. A common and characteristic shrublet of the Southern Bechuanaland Region. Much browsed by stock and buck in winter and spring.

*Panicum brizanthum* Hochst. (Gramineæ).—Transvaal and Natal: a tropical African species. Near Salisbury it is said to be "relished by stock."

*Panicum coloratum* Linn. (Gramineæ).—A common and characteristic grass of British Bechuanaland, where it grows on sandy bults. One of the sweetest of the native grasses of the region, and considered very fattening.

*Panicum hirsutissimum* Steud. (Gramineæ).—Buffel-gras Found in the Bush-veld of the Transvaal; mostly under the shade of trees. One of the best pasture grasses of the "Winter's veld", readily eaten and highly nutritious both green and dry. Also occurs in Rhodesia, Natal, Zululand, Griqualand East and part of Cape Colony.

*Panicum Holubii* Stapf. (Gramineæ).—Holub's Panic-grass. An aquatic grass of the Southern Bechuanaland Region. Browsed by cattle!

*Panicum Marlothii* Hack. (Gramineæ).—Common in the Native Reserves of Bechuanaland, where it is eaten by sheep, goats and cattle. See plate 20B.

*Panicum minus* var. *planifolium* Stapf. (Gramineæ).—Appears to be a useful grass; very closely resembling some forms of *P. coloratum*.

*Panicum nigropedatum* Munro. "Sweet grass"; "Krul-gras". (Gramineæ).—A remarkably good grass, perhaps the sweetest of all the grasses in the Southern Bechuanaland Region. Mr. Percy Greathead observes that this grass does not thrive where the sour, hard grasses abound. "I have, for instance, near Pilansberg, noticed stretches of red, sour grass without a single plant of krul-gras growing among it, but within half a mile of the sour veld and in land a bit more sandy, this grass grows so closely and luxuriantly that it might be cut with a mower for making hay; I made the same observation in Bechuanaland and conclude therefore, that one of the requirements of this grass is a sandy soil." Mr. T. Lanham, writing from the Kuruman Division, reports that this is the "sweet grass" *proper*, known also as "krul-gras". "This is the best grass we have and is relished by *all* stock; very fattening; there is an abundance of it on these farms."

*Pennisetum cenchroides* Rich. (Gramineæ).—Buffel-gras. A Bush-veld species, extending south to Marikani and the Taungs Reservation, where it is considered one of the best of pasture grasses.

*Pentzia globosa* Less. (Compositæ).—Schaap-bosje; Hair Karroo. One of the principal Composites of the Karroo bush veld. Much valued for sheep and goats; there seems to be a diversity of opinion as to its value for other kinds of stock.

*Pentzia virgata* Less. (Compositæ).—Schaap-bosje; Good-Karroo; Karroo-bosch. Also known as the common Karroo. One of the dominant plants of the Karroo-bush veld. One of the characteristic plants of limestone veld where the soils are thin. The late Professor MacOwan, Government Botanist of the Cape Province, wrote me about it, as follows, some years ago: " One of the three most useful shrubby plants for sheep, not only on account of its good qualities as food, but also because of its abundance and distribution over wide areas. It produced abundance of seed, which grows freely, but also extends by natural layering, the largest shoots bending down till they reach the soil, and then throwing out roots at the tips. It tends to grow socially and sometimes so luxuriantly as to cause the partial or complete exclusion of other boscage. The soils of rich argillaceous flats, not deficient in lime, favour its growth." It has been reported that mutton from sheep pastured on this plant is particularly palatable. Mr. Lazenby, of Britten, states that it is only occasionally eaten by the stock on his farm. Mr. T. Lanham, of the Kuruman Division, reports that it is one of the best fodder plants, relished by all kinds of stock and occurring plentifully in that part of the country.

*Phragmites vulgaris* B.S. and P. (Gramineæ).—The young leaves and shoots are eaten by stock. Burchell states that in 1812 he noticed " the Bechuanas played on musical pipes made of the stems " of this plant.

*Pollichia campestris* Soland. (Caryophyllaceæ).—Greedily eaten by stock in the Southern Bechuanaland Region. Fruits white, fleshy, edible and pleasant to the taste but rather gritty, not unlike white mulberries.

*Portulaca oleracea* Linn. (Portulacaceæ).—A garden and farm weed, eaten by pigs. In the South of Europe it is considered a good salad and pot-herb.

*Portulacaria afra* Jacq. (Portulacaceæ).—Spekboom. A very valuable fodder plant said to be eaten by all kinds of stock. Farmers generally recognise two kinds of Spekboom, one of which grows in bushy form and upright, while the other produces long runners or trailing branches. It is stated that while the former is eaten readily the latter is not eaten by stock. Professor Wallace writes as follows about it: " When ostriches are brought up to eat it, they thrive well and seem fond of it. But when accustomed to feed on lucerne they sometimes lose their taste for Spekboom, and have been known to die by hundreds though clumps of Spekboom were within easy reach, which they would not touch. This bush recovers rapidly from the injury done by too close browsing by stock, if a season's respite be granted to it. Where it and *Mesembrianthemum floribundum* are present, stock care but little about their daily visits to the water-vlei."

*Psoralea obtusifolia* DC. (Leguminosæ).—Wild lucerne. Com-

found on sandy bults. Common in the Southern Bechuanaland Region. Forms large, low "mats" of dense foliage. Browsed by stock and considered a valuable pasture plant.

*Rottboellia compressa* var. *fasciculata* Hack. (Gramineæ).—A creeping grass of marshy ground, such as river banks and fonteins. It is a favourite with stock, which usually keep it closely grazed. It is a favourite with horses in the Eastern Transvaal (High Veld). It might be planted out to advantage on wet lands and in places subject to flood. According to the late Sir Ferdinand von Mueller, this perennial grass, though somewhat harsh, is recommended for moist pastures; it will retain its beautiful green colour throughout the year in dry climates. In Gipps-land it is highly esteemed by graziers. It is not injured by moderate frosts. Mr. Cellier, of Dundee, Natal, says that it is good for pasturage, according to Mr. Medley Wood.

*Royena pallens* Thunb. (Ebenaceæ).—"Blaauw-bosch". The foliage is occasionally eaten by stock when other feed is scarce, but it does not seem to be liked by them. Leaves have been found in the rumen of cattle which have died of Lamziekte in the Bloemhof District. Occasionally eaten by goats, but even these omnivorous animals do not seem to relish it.

*Salix capensis* Thunb. (Salicaceæ).—Wilde Wilgeboom; Willow tree. Along the Vaal River the foliage is browsed by goats and sheep in spring and early summer, before the grass is green (B.D. 9579); the leaves are sometimes attacked by the parasitic fungus *Melampsora mixta* (B.D. 9780).

*Salsola aphylla* Linn. (Chenopodiaceæ).—"Brak ganna". Much and closely browsed by all kinds of stock (B.D. 9590). The photograph on plate 32 shows how closely the young shoots have been browsed back to the old wood, leaving a long, bare, flattened woody stem, and very little foliage to perform the necessary functions of photosynthesis.

*Salsola Calluna* Drège. (Chenopodiaceæ).—"Rooi-ganna". A "regte rooi-ganna" is reported as growing near Boshof and to be a good stock food, but I have not seen specimens, and am unable to say whether it is this species.

*Salsola foetida* Del. (Chenopodiaceæ).—"Ganna-bosch". Mr. Lanham reports as follows: "This plant grows about 2-2½ ft. high, and is relished by *all* kinds of stock; very plentiful on these farms."

*Salvia rugosa* Thunb. (Labiatæ).—Occasionally browsed by goats, etc., when other feed is scarce, in the Bloemhof District, but not usually pastured. Mr. Lazenby of Zoutpan, Britten, states that the Boers make it into a tea, which is yellow in colour, and is used for washing sores, as well as being taken internally as a tea.

*Sarcostemma viminalis* R.Br. (Asclepiadaceæ).—"Melk-touw." Addo-bush, scrambling over shrubs. A favourite browse plant with stock. It is said that stock which eat it freely do not require to drink water.

*Schmidtia bulbosa* Stpf. (Gramineæ).—Sand Kweek-gras, one of the Krul-grassen. A common and characteristic grass of the Southern Bechuanaland Region. Much eaten by stock in summer but dying off in winter. Considered a very good grass. (Lazenby).

*Selago leptostachya* E. Mey. (Scrophulariaceæ).—Aar-bosje; Water finder. Professor MacOwan reported as follows on this plant: "A useful forage plant for goats, being a stand-by in times of drought. It is found generally on gebroken veld, and is the only one of the common Selagos that is of value as food. Generally indicates humidity—beneath the ground. An excellent bush for sheep-pastures in the Karroo, reproducing itself spontaneously with great readiness from dropping seeds and maintaining itself also by the running stems."

*Solanum incanum* Linn. (Solanaceæ).—Keeps green after the grass is dead, and when found in the veld usually shows signs of having been browsed.

*Solanum supinum* Dunal. (Solanaceæ).—Much browsed; perhaps chiefly by small stock.

*Sorghum saccharatum* (Linn.) Pers. (Gramineæ).—Sorghum; Zoet-riet; Imphee. Grown by the natives and might be used as a fodder plant, for silage, to carry the stock through a dry spring. Burchell notes that the sweet stalks were chewed by the Bechuanas at Litakun.

*Sorghum vulgare* Pers. (Gramineæ).—Kaffir-corn. Much grown by the natives of Bechuanaland, and might to advantage be cultivated for hay and silage, to carry stock through the dry season. Said to be much more resistant to drought than maize. The Bechuanas call it Mabbele (Burchell), and at Litakun it was planted in the months of August or September, according to the earlier or later falling of the rains; and was said to be reaped in April, or about that time. Burchell also states that this grain is most commonly eaten simply boiled; but they sometimes pound it (having nothing that can be denominated a mill), and after boiling it with milk to a solid substance, leave it till it became very sour; in which state they call it *Bukobi*, a name which my interpreter explained by the Dutch word brood (bread), a word which the Colonial Hottentots apply to any vegetable preparation of a similar consistence, however different in quality.

*Sporobolus fimbriatus* Nees. (Gramineæ).—Common in the Southern Bechuanaland Region. Eaten by stock.

*Sporobolus sp.* (B.D. 1636). (Gramineæ).—Considered a good grass by the Boers.

*Stenotaphrum glabrum* Trin. (Gramineæ).—Cape Quick-grass; Mission grass. Much and closely grazed by stock.

*Tarchonanthus camphoratus* Linn. (Compositae).—All kinds of stock eat it in winter (Lazenby). A tea is made from it, which is considered good for pains in the stomach and which does not purge (Lazenby). Burchell notes that the kraal enclosures at Litakun were made of sticks of Mohaka. Donovan says the stumps make excellent fuel. "I value Vaal-bosch highly because, first, the Boers taught me it was a splendid shrub for stock, and second, I have seen stock, both small and great, in magnificent condition where there was scarcely a blade of grass but plenty of Vaal-bosch, and at the same time stock looking wretchedly where there was plenty of grass and little Vaal-bosch."—T. McLetchie, Caledonia, Schweizer Reneke.

*Themeda Forskalii* var. *Burchellii* Hack. (Gramineæ).—Rooi gras. Common in the Southern Bechuanaland Region, but may be considered local, and as having special requirements. In the Eastern

Grass-veld region it is replaced by the typical form (*Themeda Forskalii* Hack). Considered a useful grass, but "sour" as compared with *Panicum nigropedatum*, *P. coloratum* and *Anthephora pubescens*. The dominant grass in parts of the South-western Transvaal, and apparently the one most extensively eaten. Cut for veld hay; makes good hay if cut before the heads get too ripe.

*Themeda Forskalii* var. *mollissima* Hack (Gramineæ).—A dominant grass in the Albany and Alexandria Divisions. Farmers near Grahamstown have told me that it would require three times as much of this variety to keep a beast in condition, as it would of the variety which grows in the Bedford Division.

*Tragus koelerioides* Aschers. (Gramineæ).—Creeping carrot-seed grass. A creeping grass with very short, broad leaves, and thin, bare flower stems; too short to give much feed for cattle but of some use for sheep and goats. Common and characteristic in the Southern Bechuanaland Region; also found on the border line between Karroo-veld and grass veld on the lower slopes of the mountains near Grahamstown.

*Tristachya leucothrix* Trin. (Gramineæ).—A favourite pasture grass, and one of the dominant species in parts of the Albany and Queenstown Divisions, where it is considered one of the best pasture grasses.

*Vigna catjang* Walp. (Leguminosæ).—Kaffir-bean; Cowpea. Burchell notes that the Bechuanas of Litakun cultivated this bean under the name of Linea or Lenowa, for the sake of the dry beans which were eaten by them; the flowers were blue or yellow.

*Wahlenbergia arenaria* A.DC. (Campanulaceæ).—Common on sandy soils in the Southern Bechuanaland Region; a favourite with stock and buck.

*Wahlenbergia undulata* A.DC. (Campanuluceæ).—Much eaten by stock, etc. A favourite food with ostriches near Pretoria.

*Zizyphus mucronata* Willd. (Rhamnaceæ)—Blink-blaar-Wacht-en-beetje. The berries are sometimes used as a coffee substitute, or by the Kaffirs for porridge. Mealy and sweetish when ripe, but nearly all "stone" and not worth eating.

*Zizyphus zeyheriana* Sond. (Rhamnaceæ).—Klein-Wacht-en-beetje. Berries sometimes used as a poor coffee substitute, or by the Kaffirs for porridge, but they are nearly all "stone" and not worth eating; mealy and sweetish when ripe.

## PREVENTIVE MEASURES.

Although we have not yet obtained absolute proof that artificial feeding is a preventive of Lamziekte, we have a good deal of evidence to the effect that when used in conjunction with camping off of the veld and systematic movement of stock, it does materially assist. In spite of cases where artificial feeding does not appear to have prevented the disease, the fact remains that the people who have been most successful with their stock in the heart of a Lamziekte area, are those who either move their animals periodically from the sour veld to river veld, brak-ganna veld or karroo-bush veld, or who—lacking those types of veld to move to—move at intervals from one camp to another, and those who feed systematically a certain amount of hay or stover to supplement the veld pasturage.

This being so, farmers will have to consider how far camping and artificial feeding can be practised in connection with cattle farming in the Lamziekte regions. And one of the first points for consideration must be the kind of foodstuffs which can be produced. In this connection the work of the Experiment Station at Vryburg will be watched with interest.

## AVAILABLE FODDER CROPS.

The Lamziekte areas are, as we have seen, dry regions, and we must therefore consider the crops best suited to conditions of drought.

*Maize.*—The crop which can be grown perhaps most cheaply, *i.e.* per ton per morgen, probably is maize. This crop can be grown for hay even where the rainfall is too low and the growing season too short to produce a crop of grain. But we have now demonstrated, with the assistance of farmers in Bechuanaland and South-western Transvaal, that some breeds of maize can be grown successfully and profitably for grain with a seasonal rainfall of only 12 inches. Although it may be questioned whether 6 muids per acre of maize grain will more than pay expenses as a crop for sale, it should certainly pay well as a fodder crop for either dairy or beef animals.

Among the breeds found most successful may be mentioned:—

Chester County.
German Yellow.
Iowa silver-mine.
Wills Gehu.
Wills Dakota.

Maize fodder can be preserved for winter use either in the form of hay or of silage.

*Kaffir-corn* (*Sorghum vulgare*).—This valuable crop is not appreciated as fully as it should be. It is extensively grown for food by the Bechuanas, and is generally considered to be more drought resistant than maize, and can be prepared in the same way for fodder, *i.e.*, in the form of silage or as hay.

*Sorghum, Zoet-riet or Imphee* (*Sorghum saccharatum*).—This is another crop which is grown successfully by the Bechuanas, and which might be used for silage or hay, in the same way as hay is used.

*Teff-grass* (*Eragrostis abyssinica*).—This crop has come to stay, and is steadily spreading over South Africa. Being a two months crop it is a most excellent catch crop for regions of light rainfall, if care be taken to sow it at the right season. It is not desirable to sow it with the first Spring rains, as these are apt to be too light to bring the crop to maturity. But if sown with the first steady rains it should mature before the frosts. It is an annual crop, and must be sown afresh each season, but it yields heavily, and is one of the best fodders for keeping stock in condition through a season of drought. It is most easily made into hay.

*Boer Manna* (*Setaria italica* var.)—A useful drought-resistant hay crop, but not equal to Teff-grass.

*Pea-nuts or Monkey-nuts* (*Arachis hypogaea*).—This crop thrives in the sandy soils of Bechuanaland and furnishes a useful hay, in addition to providing peanuts, which are useful for the native trade and for feeding pigs. The yield of hay is not heavy, but being a leguminose plant, it can be used as a rotation crop, and to ensile with maize, kaffir-corn or Sorghum to "balance" the ration.

*Cowpeas or Kaffir-beans* (*Vigna Catjang*).—Much grown by the Bechuanas and a useful leguminose fodder crop for hay or silage, and as a rotation crop with maize and kaffir corn. Will probably give a heavier yield than Pea-nuts.

*Sweet potatoes* (*Ipomœa Batatas.*)—The value of this crop for stock-feeding is not as fully recognised as should be the case. It is easily grown and the foliage is greedily eaten by stock. The tubers remain safely in the ground in the dry winter season and can be dug as required; they attain a large size.

*Kaffir Water-melons* (*Citrullus vulgaris*).—These are much grown by the Bechuanas and are valuable for stock feed in winter. There are two principal sorts, known as *T'samas*, and *Likataans*.

*Pumpkins* (*Cucurbita Pepo*).—The pumpkin is a valuable supplementary crop for winter feed. Varieties with good keeping qualities are preferable, and among these the old boer Grey, the Harde-dop and the Ironbark are among the best. See Plate 27B.

*Round-leaved Salt-bush* (*Atriplex nummularia*).—This has proved a most useful, drought-resistant crop at the Experiment Stations at Grootvlei and Besters Put, near Bloemfontein. It is sometimes found a little difficult to start until one understands the best way to handle it. See Plate 28A.

Other crops, such as Mangels and Spineless Cacti, can be grown, but enough have been mentioned to give a good selection. We are not yet in a position to advise definitely as to the laying down of dry-land winter pastures in these drier parts of the country.

## CONCLUSIONS.

Reviewing the collected facts about Lamziekte in the light of the several theories advanced, we are led to the following conclusions:—

1. That Lamziekte is due to a plant **poison.**
2. That this poison is developed in grasses or other plants which are normally innocuous.
3. That its development is favoured by certain climatic and telluric conditions, in which summer drought is an important factor.
4. That the conditions which produce wilting of the grass favour the production of the Lamziekte toxine, which would account for the theory of the Bechuanas that the disease is due to wilted grass.
5. That this toxine is cumulative, *i.e.*, that it does not take effect until a certain quantity has been accumulated in the animal system. The requisite amount may, of course, vary according to the age, size or constitution of the animal.

6. That it is practically absent, or at any rate least injurious, on Karroo-veld, Sweet-veld and River-veld.

7. That it is the worst on sour sand-veld and gebroken or mixed veld.

8. That the removal of the coarser "sour" grasses by close grazing or mowing of the veld reduces the number of cases.

9. That preventive measures are likely to be found practicable, and that these will probably include:— (*a*) The camping down of the farms and the frequent movement of stock from one camp to another; (*b*) the preparation and feeding during the dry season, of more food-stuffs, such as Teff-hay, maize-hay, maize stover and maize silage.

10. This report is only a preliminary one, and the theory now advanced is but a working hypothesis. It seems to fit all the facts of the case which have come to our knowledge, but it must yet be thoroughly tested. This will be a work of time and will involve a large amount of investigation and expenditure. Our experiments have been planned, organized, and started, and we are only waiting for the season to develop the necessary climatic conditions to produce the disease in sufficient abundance to ensure definite results. If it is a cumulative poison it will take time for it to accumulate.