slopes of mountains, hills, etc., so that the methods of diverting the storm water, referred to in paragraphs 102 and 103 cannot be employed to their full extent, and other methods have to be devised.

106. In areas with a high rainfall the veld plants naturally grow more luxuriantly and closer together than in areas with a low rainfall, and were it not for the agency of man the dense vegetal covering of the high rainfall areas would, to a large extent, have prevented the yawning dongas that now exist. Even in the low rainfall areas the protection and maintenance of the veld vegetation might have done much towards preventing the removal of our valuable soil.

107. Although we have not in this booklet even attempted to mention all the damage that is caused by soil erosion we have at least tried to indicate a few of the primary causes of the evil. Further, we have endeavoured to show that several factors are, either individually or collectively, the cause of this national peril.

108. From whichever angle the whole problem may be regarded the irrefutable fact stares us in the face, namely:— *That the systematic destruction and annihilation of our veld vegetation is not only the chief cause of the evil of soil erosion but it is also the cause of all the other contributary evils.*

109. If we could, re-establish the devastated vegetal covering of our veld and protect those plants that are still on the veld or supplement them by other useful plants the battle would be won. But in order to win the fight against the mighty elements of nature, we as reasonable beings, should cease to help those elements in their destructive work, and in the second place the whole nation—not merely the 722,000 souls that constitute our European rural population — should declare war on this national peril.

110. The primary cause of the evil is mentioned in the latter part of paragraph 108 and the best remedial measures in the first part of the foregoing paragraph. In order, however, to ensure that the remedial measures shall be applied simultaneously or generally throughout the Union it will be necessary to make the whole South African nation realise the seriousness of the position, but to that end propaganda, education, organisation and demonstration would be required. These things necessarily take time and for this reason we are now merely offering a few hints which may be of assistance in combating the evil on their farms, to those, who have already realised the seriousness of the problem. On the 14th of November, 1929, the Minister of Agriculture called a Conference in Pretoria to discuss organization in connection with the combating of soil-erosion. This was the first step that was ever taken by a

Government against this national danger. It was gratifying to see not only *all* Government Departments represented at this Conference, but also farmers from all the four provinces of the Union as well as representatives from Municipalities, Divisional Councils, Provincial Councils, Education Departments, Agricultural Unions, etc. About 10 days before this Conference took place the Afrikaans version of this brochure came out in print and copies were issued to most of the delegates with the hope that more interest would be evoked among our people.

111. In paragraph 100 we have already pointed out that it is impossible, in combating erosion, to formulate a definite plan of campaign. Our chief objective, however, should be to re-establish and protect the devastated vegetal covering of our veld. To do this it would perhaps be the better plan to start first of all with the small tributary sloots that feed the big sloots and deal with them in such a manner that plants will in course of time be enabled to grow and multiply in them. When the big or central sloots are no longer fed so plentifully with storm water by the smaller branch sloots, it will also be possible, in many instances, to reclaim even these by establishing in them a dense growth of exotic or indigenous grasses, shrubs or trees. Even though a certain proportion of storm water may then still be carried down from time to time by such central sloots the vegetation in them will prevent them from eating back and also prevent the formation of fresh tributary sloots, besides catching and retaining a mass of soil material that may be contained in the water, with the result that the sloot in course of time becomes shallower instead of deeper.

112. Where soil erosion has been stopped or checked in places where the vegetal covering had been almost entirely denuded it is marvellous to see how soon the vegetation is able to re-establish itself. The value of a proper control of soil erosion has been demonstrated, inter alia, by the experiments carried out by the "Great Basin Experiment Station" of Utah, U.S.A., on the watersheds of high mountain ranges. At the commencement of these experiments the surface of the veld carried only 16% of vegetation. After soil erosion had been checked and the vegetation had increased to 40% on the land surface, the run-off decreased by 55% and the removal of soil material by 56%.

113. A diminished water-holding capacity of the land and an increased run-off are the direct results of the denudation of the protective vegetal covering. It is clear, therefore, that if the vegetal cover were protected and even supplemented, it would also, to a large extent, enhance the value of the rainfall.

Denser vegetation, in this respect, undoubtedly spells a more valuable rainfall (see paragraphs 75 and 86). We repeat, therefore, what has already been said in paragraph 111, namely: That whatever the nature of the sloots we have to cope with in combating soil erosion, our chief objective should be the re-establishment, to the greatest possible extent, of the denuded vegetal covering or, in replacement thereof, the propagation of other useful plants.

114. In areas with a fairly high rainfall certain forest trees and shrubs usually grow luxuriantly and comparatively rapidly. Even against the slopes of and on the crowns of rocky koppies and precipitous mountains one often sees fine, luxuriant growths of indigenous trees and shrubs; and one of the most efficient methods of stopping sloots (especially in the high rainfall areas) is to plant them with suitable trees and shrubs.

115. In European countries, especially in France, soil erosion has, practically been stopped by systematic afforestation of hills, mountains and catchment areas of rivers. In Basutoland, for instance, Mr. L. F. Wacher, the Agricultural Officer of the Basutoland Administration, showed us, near Maseru and further inland, tremendous dongas that had formed against the steep slopes of the mountains. Some of these dongas have not been touched but others have been planted with self-propagating or spreading shrubs and trees, such as Robinia (pseudacacia), several varieties of poplar, Honey-Robinia (Gleditsia triacanthos), etc. These sloots, that at one time were just as unsightly as their confreres that had not yet been touched, are to-day decked out with beautiful trees and shrubs, which the farmer will not alone be able to use as fuel, timber, fencing posts, etc., but which will also serve as a splendid shelter for his stock against cold winds and rain. The devastating processes of soil erosion and plant denudation have here indeed been rendered impotent. Certain varieties of gum and acacia trees have also been used successfully for planting in sloots in places where the slopes are less steep.

116. Owing to lack of funds the Basutoland experiments had necessarily to be restricted to a small scale. The undertaking is, however, representative and on a scale large enough to demonstrate sufficiently what can be done with a little money and a few labourers under those and similar conditions elsewhere.

117. The average annual fall (rain and snow) of Basutoland is approximately 30—35 inches. The patient reader might perhaps say to himself: "Yes, it would be quite easy with such a high rainfall, to grow trees in sloots, but what about the

poor blighters who live in a low rainfall area?" We shall touch upon this point again later on but, in passing, should like merely to draw attention to the fact that the experiments that have been carried out in Basutoland were the work of the energetic Mr. Wacher and a few other responsible officers of the Administration of that territory. The Basutos have not only almost completely de-forested their country, but they are now also by means of veldburning, overgrazing and "pickaxing" lands on the steep mountain slopes, robbing the mountains, which constitute the sources of our main rivers, of their vegetal covering, with the result that soil erosion in that territory has already attained alarming dimensions. The Drought-Investigation Commission, in their Final Report, drew attention to the seriousness of this problem in Basutoland and it will, therefore, not be necessary to dilate any further upon the matter here.

118. In areas with a high rainfall, or those falling within the so-called "mist-belt" of our country, the growing of many varieties of forest trees is a comparatively easy matter. In most parts of this "mist-belt," however, soil erosion is allowed to progress rapidly and undisturbed, and why more of those landowners, who have practically the same rainfall as Basutoland, have not yet set about planting their dongas with trees is a riddle to us. For areas, not actually in the mist-belt but with an average annual rainfall of approximately 20 inches, there are also many varieties of shrubs and trees that might be grown with advantage. We have even many valuable indigenous fodder plants that have been known to grow successfully in the drought stricken parts of South Africa ever since the country was settled by white people.

119. In addition to numerous indigenous plants, that have been proved to be resistant to very severe droughts, the Union Forestry Department has furnished the following descriptive list of exotic shrubs and trees that are resistant to drought and cold and of which some are eminently suited to certain dry parts of our country, i.e. for planting sloots, for fuel or timber or as fodder for cattle and small stock:—

Cultriformis (Acacia Cultriformis). An ornamental shrub. Hardy against drought and frost.

Oldman Saltbush. (Atriplex nummularia). A valuable fodder plant. Hardy against drought, frost and brak.

White Callitris. (Callitris robbusta). Grows slowly, but very suitable for the dry parts of the country and grows well on sandy soils. Is resistant against attacks of white ants.

Deoder. A large timber tree, which produces valuable and durable soft-wood. Grows well on the High Veld and on mountains but not on acid soils. Very hardy against frost and drought in the Orange Free State. Hardy against snow.

Carob (Ceratonia siliqua). A small shade tree. Is hardy against drought. The pods are a good stock feed. The best plan is to sow this plant *in situ*.

Mesquite or Algoraba (Prosopis Juliflora). A small hardy tree or bush. Its pods furnish a valuable stock feed and its wood (timber) is strong and durable. May be sown *in situ*.

Thuya (Thuya orientalis). A small cone-bearing tree, which is very hardy against heat, cold and drought. Grows slowly but is suitable even on heavy soils.

Honey-Robinia (Gleditsia triacanthos). Closely resembles Robinia pseudacacia. Hardy against drought and frost and produces a durable timber.

White Mulberry (Morus Alba). The true silkworm mulberry. Hardy against frost and drought.

Tamarisk (Tamarix gallica). A small ornamental tree with a mass of small pink flowers; grows rapidly when young and is hardy against drought and frost. Is a great help as a stock feed in times of drought.

American Aloe (Agave americana). This is a well-known plant and grows practically under any condition of climate. In America this plant and other members of its family, such as sisal, are used for planting in sloots, especially those against the steep slopes of hills and mountains. Sometimes these trees are planted in long horizontal rows, at right angles to the slope. These rows are usually from 25 to 50 yards apart, and by reason of the fact that the big plants usually develop a mass of smaller plants around them such a lane or avenue becomes indeed a notable buffer against soil erosion, because when storm water rushes through or over such a lane the smaller plants break its force and it is prevented from cutting holes and sloots in the soil lower down. Further, the lane catches a mass of soil material that would otherwise have been washed down the slope. Messrs. A. and T. Murray in the district of Graaff-Reinet have, according to articles that have appeared from time to time in the agricultural press, achieved remarkable results with this aloe, especially as fodder for cattle. (See Pamphlet No. 43 of 1923 by Mr. Arthur Stead and issued by the Department of Agriculture).

120. According to our botanists we have some thousands of indigenous varieties of bushes, shrubs and trees in this country. Many of these indigenous plants are not only very drought hardy but they also possess a live stock food value of an exceptionally high standard. Most botanists, however, mention the fact that we in South Africa have as yet very little knowledge of the life history, propagation and germination qualities, food value, etc., of our indigenous plants, and although

some of our progressive farmers have given considerable attention to a limited number of our karroo plants, it is only during the last few years that the Department of Agriculture has in this regard begun a scientific investigation. Our severe droughts, our sheep and goats and our cattle have, however, shown us long ago that our country contains many veld plants that are drought hardy and at the same time excellent stock feed. If our farmers, especially those living in the drier parts of the Union, would not only assist these plants to cover our pasturage but also to cover our sloots, the plants themselves would provide more fodder for stock, help to retain more rain-water on the land and check the erosion of the soil and the formation of sloots and surface erosion.

121. More than fifty years ago the late Prof. MacOwan, in his report to the Cape Government Commission on Stock Diseases, mentioned that South Africa—more so than any other country of the world—possessed, in her indigenous plants, a very valuable asset.

Regarding the Spekboom (Portulacaria Afra) the professor wrote in effect as follows:— "When the Almighty planted the Spekboom on the hills of the Karroo areas, He did so with the intention of spoiling the farmers living in those areas."

After Prof. MacOwan other scientific men, such as the late Prof. Pearson, Dr. Marloth, Dr. C. Juritz, Prof. J. Bews, Prof. R. Compton, Prof. G. Potts, Dr. S. Schönland, Prof. D. Thoday, Dr. Marchand, Dr. I. B. Pole-Evans, Dr. E. Percy Phillips and others lectured from time to time at meetings of the South African Biological Society and the Society for the Advancement of Science, and also published scientific articles, on our indigenous plants. Some of these gentlemen, e.g. Dr. Marloth, Dr. Juritz, Dr. Marchand and Mr. A. Stead, even went so far as to investigate the feeding value of a number of our Karroo plants. (See Appendix No. 47, Final Report, Drought Investigation Commission). The Government Laboratory at Onderstepoort, the Division of Plant Industry (Pretoria), the Agricultural Faculties of the Universities of Stellenbosch and Pretoria and a few of our Agricultural Schools have also from time to time conducted investigations on some of our indigenous plants.

122. The compilation of a complete list of plants that are drought hardy, that may be used to plant in sloots in dry parts, that may serve as fodder and, incidentally, provide the animal with a certain amount of water is a problem that has still to be tackled. Our practical farmers and our scientists have as yet so little knowledge of the matter that out of the many thousands of plants growing in South Africa we are able to mention here

only a few that conform, more or less, to the abovementioned requirements.

123. Just as with animals, we have here bad as well as good plants, and of the thousands of plants growing in South Africa a certain proportion may, so far as feeding value is concerned, be regarded as useless, but which could nevertheless be utilized with advantage in planting sloots or as fuel or timber, etc. Further, we have plants that are poisonous or that may be regarded merely as weeds. We shall, however, confine ourselves here to a brief discussion of non-poisonous and useful plants that may serve as cover in sloots or as a veld covering and at the same time as pasturage.

124. In paragraphs 120 and 122 it has been pointed out that we have very little knowledge as yet of the properties of our indigenous plants and before we proceed to give a description of some of our drought hardy fodder and other plants we wish once more to emphasize the fact that we are here touching very lightly on only one aspect of a stupendous problem.

125. The following short list is the result of personal experience and further in accordance with particulars that have been obtained from Karroo farmers and some of our botanists. The plants appear in the list in alphabetical order and not necessarily in the order of importance:—

Aambeibossie (Lasioscorys Capensis). This plant is found in many parts of the Union. It has a strong tap root and attains a height of from 1 to 1½ feet. Towards the end of the winter when grazing is scarce stock will eat it down to the roots (Phillips). The aambeibossie will grow in most parts of the Union and it will furnish excellent vegetal covering where other plants will not do well.

Aarbossie (Walafrida Geniculata, Rolfe). Grows in the districts of Riversdale, Mossel Bay, Humansdorp, Uitenhage, Albany, Victoria West, Queenstown, Prince Albert, Somerset East, Richmond, Hanover, Graaff-Reinet, Aberdeen, Colesberg and also in certain parts of the Orange Free State. MacOwan states that this plant is excellent fodder for sheep and goats and that it is drought hardy.

Anaboom (Acacia Albrida Delile). A Damaraland thorn tree, drought hardy and the pods are a very nutritious stock feed.—(Marloth).

Appelbos. Grows in various Karroo districts but more especially in Carnarvon and the adjoining districts. Is regarded by local farmers as a good fodder plant and drought hardy.

Beesbos. (Chrysocoma teunifolia). Grows in several Karroo districts. A good stock-feed. Is drought hardy and suitable for planting sloots and as vegetal covering for the veld.

Beesporselein. (Portulacca Oleracea). Is also found in Carnarvon and other Karroo districts. Also grows well in brackish soils. Is drought hardy and is, according to local farmers, a good stock-feed.

Blinkblaar. (Rhamnus prinoides and also Zizyphus mucronata). Is also a xerophyte that is of considerable value to farmers in the Karroo areas and that can be employed advantageously in combating sloot formation and surface erosion.

Blomkoolganna or Koolganna. (Salsola Zeyheri). A sweet and very valuable fodder plant of the central and north-western Karroo districts. Is one of the most drought-resistant shrubs in South Africa (Thornton). This is a well-known plant and would form an ideal vegetal covering, but instead of protecting it stock farmers (with few exceptions) destroy it ruthlessly by overgrazing.

Bobbejaankos. (Angea capensis, Thump). A small shrub with thick fleshy leaves which, according to Crokhan, can retain its moisture for 75 days.

Brakbos, Vaalbrak, Soutbos. (Artiplex Halimus L.). One of our indigenous salt bushes. Grows in common with other plants of equal food value over extensive areas on soil that is impregnated with soda. According to Juritz this plant contains more fattening properties than the Australian salt bush, (A. Nummularia), while the latter again contains more strength-giving properties. This "brak" bush is found in several districts of the Cape Midlands, in parts of the Southern Free State and in Little Namaqualand. Several farmers have, even as high up as the Western Transvaal, succeeded in covering bare patches on their veld, where formerly a tortoise could not live, with this brakbos, with the result that many merinos now obtain abundant grazing from those patches and remain fat throughout the year. And the streams of "brak" water which formerly came down from these places, which contaminated adjoining areas with brak and formed sloots, are now no longer seen.

Brakganna. (Salsola Aphylla L.). A shrub that is also very drought hardy, grows on brak soil, is good stock feed and is useful as vegetal covering.

Brakslaai. (Mesembrianthemum Crystallinum). An excellent fodder plant when young (Marloth). Grows with Atriplex Halimus and should form a good source of food in time of drought, being full of insipid watery juices (MacOwan). This "vygie" would also be suitable for planting on bare, brak places, also for increasing the carrying capacity of the veld and reducing or checking the run-off.

Bok-Noorsdoring. (Euphorbia enobla, Boiss). Grows in the districts of Jansenville and Willowmore. Is a good fodder plant, (Marloth)

Doringboom, Karodoring, Witdoring, Soetdoring. (Acacia Karroo, Hayne). Its leaves, flowers and pods are eaten by all kinds of livestock, but more especially by goats and ostriches, (Thornton). We all know the thorntree and it is unnecessary, therefore, to dilate here upon all its good properties. It is a pity that it is such a slow grower; nevertheless the farmer will always be repaid with interest for the time he has to wait for it.

Doringvygie. (Mesembrianthemum spinosum). A small, thorny shrub of the Karroo areas and regarded in some of those parts as the best fodder plant, (Phillips). This "vygie" is drought hardy and suitable for the establishment of vegetal covering or for planting where other plants will not give the desired results.

Draaibos. (Aster filifolius). A valuable fodder plant of the Karroo, (Marloth). This plant grows well on the rocky slopes of hills and mountains. It bears large quantities of seed and could easily be sown after rains. The meat and milk of animals that graze freely on this shrub acquire a strong aromatic taste which, however, disappears within a fortnight after the grazing has been changed (MacOwan). We who know this shrub can confirm what has been said about it but we would like to add that there are few plants in South Africa that are as drought resistant as this one. When practically everything on the veld seems dry and dead the draaibos is still green. In the Sneeuberge this shrub grows so high, under fairly favourable conditions, that it provides shelter for stock in cold weather, and when it is dead and dry, farmers use it for firewood. It is also one of our best fattening shrubs and would be excellent vegetal covering for the rocky slopes of hills and mountains where sloot formation is taking place.

Gacia. (Cytisus Stenopetalus). A robust shrub of South West-Africa. Excellent stock feed. Will grow well in many parts of our country both as stockfeed and a means of combating erosion.

Goeie Karo, Skaapbos. (Pentzia Incana, O. Kuntze). One of our best known indigenous shrubs, and one of South Africa's best friends because it had already, long before our gold and diamond fields were discovered, brought millions of pounds into the country through the medium of merino wool and mohair. Without this "Karo" bush and its brother "Vaalkaro," South Africa could never have attained her present position in regard to sheep farming. In times of severe and persistent droughts, when most other plants have ceased to provide feed for stock,

this shrub has been the means of keeping sheep alive. Even after its leaves have been removed by drought, stock can still subsist on the twigs of the plant, provided the animals are given good water to drink. These shrubs have, in spite of the fact that many sheep farmers have allowed them to be ruthlessly grazed and trampled out, done much in checking soil erosion. A dense vegetal covering of this plant will enhance the carrying capacity of the veld and serve to check surface erosion and sloot formation. MacOwan states that these plants are an efficient means of checking soil erosion in view of the fact that they form such a dense cover.

Haakdoring, Hakiesdoring, Swarthaak. (Acacia deotinens Burch). A thorn tree of the Kalahari and very drought hardy. Its leaves and pods are eaten by sheep and goats (Marloth). This tree is well known in several parts of the Union and can under certain conditions be utilized to prevent soil erosion.

Helichrysum. (Helichrysum argyrophyllum D.C.) Is a member of the "everlasting" family; is a xerophyte and although it is, in common with other of its species, not eaten by stock, it is nevertheless a plant that can be used efficiently in checking soil erosion, especially in mountainous parts. It does not oust or suppress other plants and its tendency is to spread and form a dense cover, even on hard, bare spots where other plants cannot grow and where there are sloots in abundance. On the Amatola mountains, near Keiskamahoek, and in the vicinity, there is a tract of about 60 square miles that carried, not so long ago, a vegetal cover of numerous useful plants, but which was in a comparatively short time so trampled out by native stock that the surface was not only completely denuded of all vegetation, but a network of sloots had also developed, that had carried away a great portion of the soil almost down to bedrock. The saving or reclamation of this tract of land had already been regarded as hopeless when good old Doctor Nature decided to take a hand in the game and in a comparatively short time covered this bare tract with a whitish carpet. Professor Schönland of Grahamstown then went to inspect the carpet and found that it consisted of helichrysum. In his pamphlet No. 55 on this subject, which was issued by the Department of Agriculture in 1927, Prof. Shönland describes *inter alia*, how the helichrysum put a stop to the soil erosion after which other useful shrubs and grasses again made their appearance and gradually ousted the helichrysum. We see, therefore, that this plant, by reason of its not being eaten by stock, is eminently suitable for checking soil erosion and thus affording other useful plants the opportunity to establish themselves.

Inkbos. (Suaeda fruiticosa). Grows in Carnarvon and adjoining districts. Is drought hardy and is regarded by local

farmers as a good fodder plant. It forms an excellent vegetal covering.

Kameeldoring. (Acacia Giraffae, Buret). A fine tree of the Kalahari. Its pods are very nutritious and are equal to good legume hay. The fibre is probably less digestible than that in hay (Phillips). We, in South Africa, all know this tree and it is to be regretted that we have assisted so assiduously in its extermination.

Kambessie, Bergpruim, Oliepitte. (Pappea Capensis). A shrub of the Eastern Karroo. Its fruit and seeds are eaten greedily by stock. Is drought hardy. Analyses by the Imperial Institute have shown that the seeds contain a valuable oil and that the meal after crushing has a fairly good nutritive value, (Phillips).

Kraalbos. (Galenia Africana L.). Very drought hardy. Is eaten by stock in times of drought, (Marloth).

Kinkelbos. (Tetragonia abruscula, Fenzl). Usually grows together with Atriplex halimus and is an excellent fodder plant, (MacOwan). Is very drought hardy. Grows on brak soil and will, together with other plants, form a good vegetal covering. The value of an efficient vegetal covering in connection with soil conservation has already been explained! therefore, when we know that a plant possesses a good food value and can grow under difficult and even adverse conditions, we also know that it is our duty to propogate and protect it.

Noorsdoring. (Euphorbia Stellaespina, Haw). Is a valuable fodder plant when its spines are singed off. Very drought hardy, (Marloth).

Perdebossie. (Leucas Pechuelli, Geurke). A fodder plant of Damaraland (Marloth). Is drought hardy.

Rosyntjiebos. (Grawia Cana). Very drought hardy. Grows in several parts of the Union. Is eaten by stock. Grows so high under favourable conditions that it affords shelter for stock.

Skilpadbos. (Zygophyllum morgsana and also Grubbis Rosmarinifolia). Grows in the Middle Karroo. Very drought hardy. A good stock feed.

Sweet or Blue "Melkbos." (Euphorbia Brachiata, E. Mey). A valuable fodder plant, (Marloth). Very drought hardy and an excellent plant for planting sloots.

Steenbokmelkbos. (Euphorbia arrecata). A valuable fodder plant, (Marloth). Very drought hardy.

Spekboom. (Portulacaria Afra). A succulent shrub which grows on the hillsides of the Karroo. One of the most drought hardy and nutritious plants in the world, (Marloth). Greedily devoured by horned stock. Year by year large thickets disappear by ruthless feeding off. Easily propagated by cuttings, (MacOwan). There are two varieties of spekboom, one redder in

colour than the other and has an acrid taste, (Thornton). The spekboom that grows in the Transvaal, (hence the name of the little river in the Ohrigstad area) differs entirely from the Cape spekboom and is not eaten so readily by stock.

Swartstorm. (Cadaba juncea, Benth). A leafless Karroo plant which is very drought hardy and is eaten by sheep and goats in times of drought. The food value of this plant is good but the older shoots contain a fair quantity of fibre, (Phillips).

Turksvy. (Prickly Pear). This plant certainly does not require an introduction to our South African farmers. As is well known the spiny variety has for many years been regarded as a pest in certain parts of the Union. It has overrun whole farms and large tracts of country and large sums and much labour have been expended on its eradication. In some parts it may still be regarded as a pest but it is, on the whole, not looked upon with the same amount of disfavour as formerly, because experience has taught our farmers that the spines can by various methods be rendered more or less harmless and that the leaves, especially during droughts, furnish both food and water for stock.

In course of time science helped to evolve several varieties of spineless cactus and it is these that we shall now discuss. All the cactus varieties are drought hardy, but only a few are frost resistant.

In abnormally cold parts of the Union and even in parts where the prickly pear is killed by frost, every fifth or tenth year it is advisable to plant it —a proportion — in warm kloofs, behind kranses or stonewalls, or any other places where the plants will be sheltered to some extent against abnormal cold weather. A prickly pear tree is not easily killed by frost but sometimes the winter may be exceptionally severe, in which plants will be sheltered to some extent against severely cold winds which prevail during the day while at night there will be a hard frost. .It is only in regard to these conditions that we wish to utter a word of warning to the farmer to whom the prickly pear is the standby in times of drought. Although most of us have known for years that the prickly pear is a drought hardy plant, par excellence, very few farmers have fully realised its value as a stock feed and a *substitute for water* during severe droughts.

In September 1920, the Government appointed the Drought Investigation Commission, of which the writer, who was at the time Government Agronomist, was the Chairman. The other members of the Commission were Messrs. R. J. van Reenen (Civil and Irrigation Engineer), Arthur Stead (Senior Agricultural Chemist), G. A. Kolbe (Organisation of farmers, etc.) and S. M. Gadd (Ensilage, etc.), with Mr. R. A. B. Mussmann as

Secretary. This Commission worked hard for nearly four years and addressed meetings throughout the Union. It also visited Basutoland and further collected a mass of evidence and information. At the commencement of the Commission's activities, i.e., at its third meeting, Mr. T. Kock, a farmer who lived close to Edenburg, O.F.S., gave evidence to the effect that he had made a special study of the growing of spineless cactus and its food value, and that he had repeatedly carried his cattle and small stock safely through severe droughts with prickly pear as the only feed. The Commission thereupon visited Mr. Kock's farm and noted the systematic manner in which he conducted his farming operations.

Reports had also been circulated relative to the good results that had been obtained with prickly pear by farmers in the Port Elizabeth and Uitenhage districts, and also with Agave Americana and prickly pear in the Graaff-Reinet district. The Commission thereupon decided to have these plants scientifically tested.

At the School of Agriculture, Grootfontein Middelburg, C.P., several varieties of spineless or "Kaalblad" cactus had then already been grown, and Mr. Arthur Stead, the above-mentioned member of the Commission, undertook to make these tests at that institution. He carefully worked out his plans and carried out the experiments in collaboration with Mr. E. Warren, Senior Lecturer in sheep and wool. The results of the experiments are contained in pamphlet No. 43 of 1923 (issued by the Department of Agriculture).

The following is a very brief summary extracted from that pamphlet, viz:—

That although the Prickly Pear is, by itself not sufficiently nutritive to fatten stock or keep them fat, the experiments have nevertheless irrefutably demonstrated the fact that if sheep are healthy and in good condition they can, without other food and without water live for 250 days (8 months) on prickly pear alone.

The ten merino sheep with which the experiment was made lost condition but, with one exception, they kept alive and healthy. An animal fed on prickly pear leaves will never feel the need of drinking water.

The patient reader will no doubt say to himself that we have strayed hopelessly from our subject, "Soil Erosion," but the reason for this digression will be found in paragraphs 109, 111 and 113.

Further information as also leaves of the different varieties of spineless cactus can be obtained from the schools of Agriculture, Middelburg (Cape), Glen, O.F.S., and Potchefstroom, Tvl. Many varieties of spineless cactus have already been established

at the Kroonstad and Pietersburg experiment stations, from which sources farmers can now also be supplied with leaves.

Vaalkaro, Vaalbossie (*Phymaspermum parvifolium*) *Grows* luxuriantly on rocky ground which will not support the "Goeiekaro," or "skaapbossie" (Pentzia incana) (MacOwan). Almost as nutritious as *Pentzia incana* but more drought resistant (Marloth). This karroo bush is as well known as the "goeiekaro" and will serve as vegetal covering where other plants will not answer the purpose.

Wildegranaat (Burchellia capensis). Grows in Carnarvon and other karroo districts. Local farmers regard it as a good fodder plant. Very drought hardy.

126. In paragraphs 114 and 118 we have already mentioned that many varieties of trees flourish in the so-called mist belt. Various varieties of grass and other useful plants will also be found to give good results in the high rainfall areas. Farmers living in those areas will therefore be in the position to operate with considerable success in stopping or checking soil erosion by planting grasses, shrubs and trees.

127. People living in areas with an average annual rainfall of from 18 to 20 inches can also make use of a considerable proportion of useful grasses, shrubs or trees.

128. Farmers in the dry areas can also, in addition to spineless cactus, make use of certain plants mentioned in paragraphs 119 and 125.

129. Those who wish to make a start with the planting, more especially, of exotic trees, shrubs or grasses would be well advised first to consult the Forestry Department or one of the Agricultural Schools before spending any money on the scheme.

130. In paragraphs 100 and 111 we have already endeavoured to show that it is not possible to lay down any fixed rules for combating or checking soil erosion, but that different methods should be adopted to suit different conditions.

131. In combating soil erosion, however, our chief aim should throughout be kept in view, i.e., to re-establish, supplement or improve the vegetal covering of the veld (see paragraph 109) and it is for that reason that we have dealt at such length in the foregoing pages with shrubs, etc.

132. There are cases, however, where it would be necessary first to do some work to the sloots before planting them with shrubs, trees or grasses.

132. There are cases, however, where it would be necessary deep use should be made of plain wire and sometimes even of netting wire. (See Figures 17 and 18.)

134. Usually the farmer constructs a wire net, more or less on the lines of a tennis net, lays this across the bed of the sloot

and builds on it a substantial wall of loose stones with an upstream cant to it. The stone wall is built on the middle length of the net and when the wall is high enough the sides of the net are drawn up tight against the sides of the wall and tied together on top. All stones are thus enclosed and tied up in the net. The stones are too big to pass through the meshes of the net and as it is impossible for the storm water to remove them either *en masse* or one by one, the wall, as a whole, is able to withstand a considerable force of water and the sloot above the wall is gradually silted up. When the sloot is very big it is sometimes dammed in this manner at intervals, so that the silt in the lower dam reaches the foot of the dam wall above it. In course of time these dams from a series of terraces filled with material that would otherwise have been carried down to the sea. Such a dam wall is, of course, a waterfall when the sloot is in spate and it is necessary, therefore, to provide some means—usually some wire netting or a pile of stones against the down stream side of the wall—of breaking the force of the fall, i.e., in cases where the wall has not been built on solid bed rock.

135. When the sloot or donga is very deep such a wire dam wall is at first made about 4—5 feet high, and when the dam is silted up the height of the wall is increased until the purpose of the farmer is served.

136. Whether the wall in the middel of the stream bed is to be completed simulstaneously with the height of its sides, or later on, is a matter that depends entirely on the existing local conditions and the judgment of the farmer.

137. In some cases—local conditions permitting—the dam wall is made higher in the middle than at the sides so as to divert the flood water (at one or at both ends) by canals on to level veld or to storage dams lower down. (See Fig. 17.)

138. The sensible farmer will commence as soon as possible with the planting of sloots that are either wholly or partially silted up. Any variety of plant to fix the accumulated soil is better than no soil fixing plant at all.

139. Wire netting, with or without stones in it, is also sometimes used in combating soil erosion. Usually a suitable length is stretched on twisted plain galvanised wire cables across the sloot like a tennis net. One cable running along the top of the wire netting and another at the bottom, with one or more through the middle. The top and bottom cables are securely tied, the former to iron standards driven into the banks of the sloot and the latter to iron standards or pegs driven into the sides of the stream bed. The supporting cable or cables towards the middle of the netting are similarly dealt with. Then, when

the silting up is well advanced the farmer starts planting the sloot with some suitable shrub, plant or grass.

140. In some cases a quantity of rubble dumped into the sloot may suffice for the silting up process.

In other cases again the eating back of sloots may be stopped or checked by damming, terracing and by various other means.

141. *Veld Management.* Proper veld management is certainly one of the most potent measures against soil erosion. Veld fires, overgrazing, kraaling and herding of sheep and cattle, etc., do very much unnecessary mechanical damage to the vegetation and to the soil. For this reason the general adoption of a better system of veld management is urgently needed. When a house is built, every room is used for a specific purpose and all the furniture, the stove, etc., is not piled up in one room only. Now, why must the vegetation on a farm be destroyed by piling too much stock on to the veld when the plants can bear no more?

142. Experiments in South Africa as well as in other countries have shown that, except where the vegetative stand has been practically eliminated and the exposed soil seriously eroded, the vegetal covering can be restored under properly regulated livestock grazing, almost as well and as quickly as under total protection from grazing. It has furthermore been proved by officers of the Department of Agriculture, U.S.A., over a number of years, that the veld can more easily be maintained at its best with judicious grazing than with total protection.

143. The observant farmer will soon find out whether conservative grazing, deferred or rotation grazing will keep his veld in the best condition throughout the year. Seed maturity, reseeding or revegetating of our veld plants must be studied if we want, not only to retain what vegetal covering is left to us, but also to restore, in course of time, that which we have lost.

144. Check dams, terracing, structures of stones, bushes, straw, logs and other materials have all with a greater or lesser degree of success been used to check soil erosion, but unless such works are supplemented with the maintenance of the highest type of vegetation each particular part of our country is capable of supporting, we shall not have done our duty.

145. The reason why a campaign against soil erosion has not been started long ago has already been given in paragraphs 3 and 6. It is, of course, quite possible that some farmers, who are well aware of the dangers of soil erosion, are under the impression that a campaign against it will be too difficult and far too expensive, but when once the seriousness of the position is fully realised possible obstacles will be disregarded and we

will, one and all, present a solid front to fight the evil tooth and nail, and when once a beginning is made, we will find that the fight will not be so difficult or expensive as many expect it to be.

146. The present Government is already lending a helping hand by granting a rebate on income tax to farmers who are making bona fide attempts to combat soil erosion, and the writer has long since given instructions to the officers of his Division to do everything possible, in or out of season, to bring the seriousness of the position home to the farmer and his children, and to lend a helping hand wherever possible. The writer; himself, has never neglected an opportunity to impress upon each and every farmer, throughout the Union, at their meetings, also to their children who are still at school as well as to students of Agricultural Schools and Universities, the magnitude of this national peril.

147. Man is primarily responsible for the harm that has already been done and it is now the duty of man to fight this evil, because every square inch of soil that is removed is for ever lost to us and to posterity.

148. The cumulative character of soil erosion, noticeable in all its phases, is its very worst feature and supplies an incontrovertible argument for immediate and prompt action if retrogression is to be arrested.

149. Let us as a nation and not only the farming community, follow the example set us by other nations by looking this national peril squarely in the face, and let us fight it instead of helping it along as we have done in the past. If the whole South African nation would, individually and collectively, declare war on the evil, the victory would surely be ours and future generations would be proud of us and praise us, instead of looking on our work with contempt.

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