GENERAL LOUIS BOTHA.

Minister for Agriculture, who has done so much for South African Dry-farming.

HEINRICH S. DU TOIT.

Government Dry-land Agronomist, for the Union of South Africa.

DRY-FARMING

BY

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ILLUSTRATIONS.

PREFACE.

I must urge in explanation of my adding to the already copious literature treating, from one aspect or another, of the dry-farming system, that the aim I have had in view in writing this little book has certainly not been to figure as a writer or to pose as a teacher of farmers, but simply to try and execute the instructions given to me by a large portion of the South African farming community. During the last three years I have received numerous invitations from many Farmers' Associations and other public bodies asking me to lecture on dry-farming and also to give field demontrations. The consequence has been that I have had to travel extensively throughout the Union and that I have thus been brought in contact with many thousands of farmers in the different parts of South Africa. I am very thankful that my work has been, apparently, appreciated by those Farmers' Associations, Agricultural Societies, etc., visited by me. However, many of these public bodies as well as numerous individual farmers have felt that useful as such lectures may be, some important points may slip their memory and that it will be much better for them to have matters in print, as this system of farming must either be done properly and correctly or not at all. Numerous and persistent have been the requests received by me to

write a book on dry-farmng. And much as I have liked to comply with the request of my brother farmers, I did not know where and how to find the time to write this book because my time is taken up in conducting experiments, attending to a very heavy correspondence in the office, and also to numbers of people continually visiting the station. Nearly half of the year is generally taken up in travelling, lecturing, demonstrating, inspecting and directing experiments on other Government and Co-operative dry-land stations. I ultimately decided to try to write a few pages of this book every time I should travel either by train, post or donkey cart, or when I should happen to be out-spanned on the veld, staying in hotels or boarding-houses or waiting for trains on railway stations. I therefore hope that the patient reader will remember my tears and grant pardon for the many shortcomings in this little work.

The Dutch edition of this little book which has left the press last March, was written under similar circumstances. The Dutch book which has been written in "South African Dutch" has met with much favour among the Dutch speaking section of the community. I am very thankful for this fact and sincerely hope that the English edition, which is not a translation of the Dutch one, will meet with a similar reception. The writer has had the priviledge of seeing and studying dry-farming in many other countries, but as so many good books have already been written by famous writers on dry-farming in other countries, it has been felt that this little work must be more or less confined to South African conditions and experiments.

Some of my readers may not agree with me on all

small points, but I shall feel fully rewarded if my brother farmers understand that my sole endeavour is to try to add *my little* to promote our great national object, i.e., *the welfare of South Africa and South African Agriculture, which mean National prosperity.*

I have already in the concluding paragraph of this book thanked the South African farmers and the press, and now beg to offer my sincere thanks to the many South African ladies who have not only urged on their husbands, brothers or "sweethearts", to dry-farm, but who have also from time to time sent a nice cake, made from dry-land wheat, to your humble, hard-worked servant—the writer. Special thanks are also due to Mr. H. de Graaf, proprietor of "Het Westen" Drukkerij, Potchefstroom, for his liberal assistance with regard to the printing of this little work.

H. S. du T.

CHAPTER I.

HISTORY OF DRY-FARMING.

It may be possible to compile a whole volume on the history of both ancient and modern dry-farming, but our main object being to try to discuss a few points connected with the more important practical dry-farming problems of immediate concern to agriculturalists of to-day, we shall not attempt a detailed dry-farming history in this little book, and shall therefore touch but slightly on this subject.

Dry-farming has been practised for many centuries by nations who have lived in arid and semi-arid countries. The reader may ask, "but can I learn anything new from such an ancient practice?" Modern farmers are, naturally, not expected to adopt ancient methods, but it must be remembered that ancient practices have, through the ages, either been abandoned improved upon or developed. Modern science is responsible, not only for scientific farming, but also for many new discoveries and better

methods in other branches of knowledge. The plough, the weapon, the wagon, medicine, etc., all these things, and others, were used by the ancients. We have, for instance, learned from history that the modern plough is the product of more than 40 centuries, of slow improvement, during which time it has developed from a crooked stick to a marvellous machine. . . . Need we compare ancient and modern armaments or means of conveyance? Before we come back to the subject under review, the patient reader will kindly allow us to quote just one passage from the medical practitioner's book of exactly 300 years ago (1613), viz. :—"For all Fluxions of Temperamentals and noxious Humours of the body there is nought so potent a virtue as the powdered Liver of a Toad that hath been slain at midnight!" The medical practitioner of 1913 uses something different for those complaints and the prescription of 2013 may again be something vastly different.

The realm of grave and hitherto incurable disease has already been invaded on every side and the danger of operation has been reduced to vanishing point.

We must admire the agriculturists who have, since the dawn of civilization, more or less successfully dry-farmed, with their primitive im-

plements and we (modern farmers) who already know a great deal of the scientfic part of this system, ought to get much better results with our improved implements.

According to agricultural history of antiquity, dry-farming has been practised from time immemorial in the arid and semi-arid regions of Palestine, Mesopotamia, Syria, Egypt, China, Mexico, Peru, Tunis, North-western India, etc.

The Jews, while in Egypt, lived along the banks and valleys of the Nile and were naturally irrigation farmers. It was therefore necessary for Moses to tell these Hebrew "trekkers" about the different conditions in Palestine :—"For the land, whither thou goest in to possess it, is not as the land of Egypt from whence ye came out, where thou sowedst thy seed, and wateredst it with thy foot, as a garden of herbs; but the land, whither ye go over to possess it, is a land of hills and valleys, and drinketh water (only) of the rain of heaven." (Deut. II. v. 10 and 11). Later on in the parable of "The Sower," Christ emphasised the necessity to till the ground well, in order to obtain a yield of sixty or a hundredfold. He also condemned weeds and shallow ploughing, as these are both great enemies of the farmer. More evidence of ancient Palestine dry-farming is found both in the Bible and in books

of ancient agricultural history. And the above has merely been quoted because it is so well known to most farmers.

Tunis.—Under the Ceasars, according to Roman records, dry-farming was extensively practised in Tunis, which country has an ever-age rainfall of about 10 inches.

Many of the agriculturists of to-day, living in the countries, above-mentioned, are cultivating large areas of land by dry-farming methods. The agricultural records of these countries show that this national system of soil preparation has been handed down to posterity through many generations.

South Africa.—The South African kaffir tribes, with rare exceptions, are all agriculturists after their own manner. The Boer "Voortrekkers" and early South African explorers, found the different kaffir tribes in various parts of the country, North of the Orange River, growing their kaffir corn, maize, etc., without irrigation. It is true that the growing period of maize and other summer crops, is also more or less the rainy seasons of these regious. It is also true that these kaffir tribes prepared their seed beds unexemplarily poor and shallow, with only their "mogomas" or "malepas" (kaffir picks). However, they seem to have unconsciously retained a

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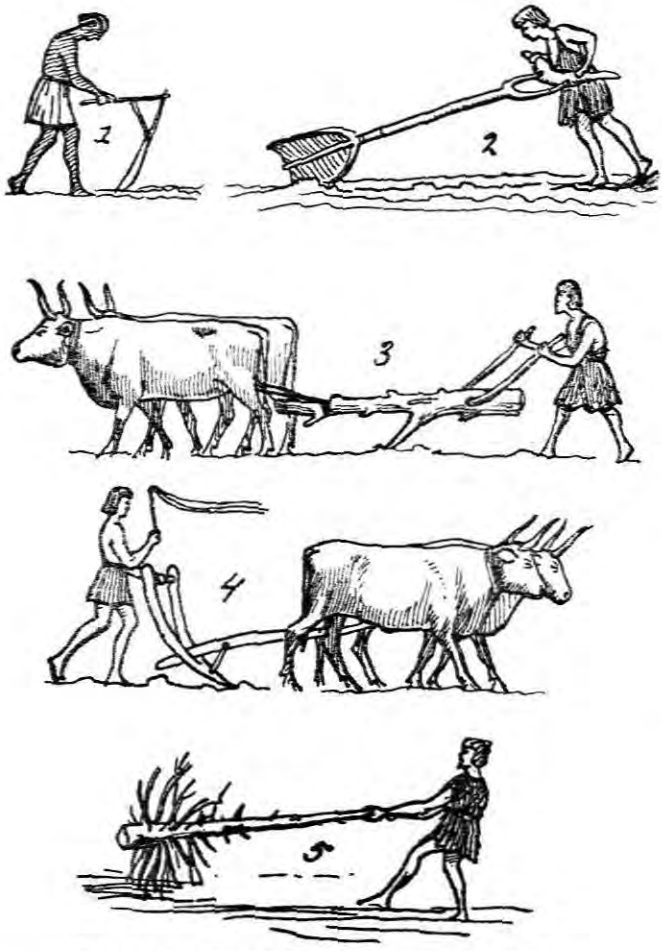
MR. BARNEY ENSLIN,

Chief of the Sheep Division for the Union, who was among the chief promoters of South African Dry-land Experiment Stations.



ANCIENT AGRICULTURAL IMPLEMENTS.

few dry-farming points, one of which is that very few kaffirs allow weeds of any description to disturb the growing crops. The native women are continually busy removing the weeds, with their mattocks, from among the crops, and in this way a soil mulch is, at the same time, unconsciously established.

England.—Jethro Tull, born in 1674, was not only the inventor of the seed drill, but also a fervent advocate of deep and thorough ploughing, besides other fundamental practices of soil culture, which are almost wholly in harmony with presentday dry-farming knowledge. While Tull's interpretation of the principles involved was wrong, his methods of soil preparation were undoubtedly excellent and he may therefore justly be called "a father of dry-farming." "Every commonwealth might well raise a monument to the memory of Jethro Tull." (Prof. Bailey). Much as his system of tillage and seeding is being praised, admired and followed by modern agriculturists, was it ridiculed and derided by many a farmer in Tull's day. History indeed repeats itself.

MODERN DRY-FARMING.

America.—It appears from many American agricultural records, that modern dry-farm-

ing was started, on a small scale, by the farmers of Utah, in the year 1847. In 1863 the system was thoroughly tested, in Utah, by settlers of Scandinavian descent. California, Washington and the Great Plains area were the next to follow and to-day dry-farming has taken a firm hold throughout the drier regions of the United States, parts of Canada, Mexico and the South American States.

According to Dr. John A. Widtsoe " hundreds, probably thousands, of individual farmers over the semi-arid regions have practised dry-farming thirty to fifty years with methods developed by themselves. And although these different dry-farm sections were developed independently yet the methods which they have finally adopted, are practically identical. About the year 1895 the word ("dry-farming") began to pass from mouth to mouth that probably nearly all the lands in the great arid and semi-arid sections of the United States could be made to produce profitable crops without irrigation. At first it was merely a whisper; then it was talked aloud, and before long became the great topic of conversation among the thousands who love the West and wish for its development. Soon it became a National subject of discussion. Immediately after the close of the nineteenth century the

new awakening had been accomplished and dry-farming was moving onward *to conquer the waste places of the earth.*"

Scarcely 45 years ago, that vast region stretching from the Missouri to the Rockies, was marked "The Great American Desert," on old maps of the United States. To-day half a dozen transcontinental railroads serve this region which, in the space of a single generation, was invaded and conquered by a vast army of settlers.

Numerous are the names of famous natural scientists who have not only contributed to the agricultural welfare of their own respective countries, but also to that of the agricultural world at large.

Every country has, more or less, its immortal Hilgards, Kings, Batesons, Burbanks, Macdougals, Baileys, etc. The United States of America has taken the lead in many things and especially in modern dry-farming, which branch of agriculture also has its special group of historical heroes, who by their resistless energy have immortalized their names in the annals of agricultural history.

The three American citizens who have (up to the present) done most for South African dry-farming, are undoubtedly Dr. Langmann of New York, Dr. John A. Widtsoe, President of the

Agricultural College of Utah, and Mr. Hardy W. Campbell of Lincoln, Nebraska.

Dr. Langmann, a medical specialist of New York, was born at Bonn, Germany, where he completed his studies. He travelled extensively, made a study of the languages and ways-of-living of many nations and ultimately chose New York as his home city where he has now been living for many years. Besides taking a keen interest in the educational matters and the agricultural development of his adopted country (America), he has also done much for South Africa and although Dr. Langmann's name is by no means unfamiliar to many of us, he has done more, directly or indirectly for this country than is perhaps generally known. Not being an agriculturist himself, his help was rendered mostly in the form of pecuniary assistance to a number of South Africans who, but for the generous help of Dr. Langmann, would not have been in a position to-day to assist themselves and their fellow South African farmers in many branches of agriculture.

Dr. John A. Widstoe, has through his famous book "Dry-Farming" rendered a great service, not only to South Africa but also to all other countries where dry-farming is or can be practised.

Mr. Hardy W. Campbell has done much to make possible the systematic study of dry-farming. His bulletins, containing his experience and experiments have greatly encouraged and aided this system in South Africa.

The following passage extracted from a letter received from Mr. John T. Burns, the energetic Executive Secretary of the International Dry-farming Congress, will serve to show what enormous progress dry-farming is making in the United States and in Canada :—

"The Oklahoma Board of Control is now organized and at work. On January 21st, 1913, the city of Tulsa will vote bonds for the erection of a 125,000 dollar (£26,000) auditorium, seating eight thousand people, for the purpose of housing our dry-farming congress. Architects are at work on sketches and estimates for Exposition buildings, aggregating one hundred and fifty thousand square feet of space, not including Executive Offices, a special Oklahoma building, and possibly government buildings for the United States and Canada."

Mr. Burns' letter continued, viz. :—"A letter received from the Honourable C. S. Chan, Minister of Agriculture and Forestry of China, thanks us for the courtesies extended to the Chinese delegate at the Lethbridge Convention, and

says: 'I wish to assure you that hereafter we shall look forward to an even closer and more active co-operation between your organization and China in the development of this great dry-farming propaganda.'" Australia, Russia and other agricultural countries have each of them their dry-farming history.

South Africa.—The wine and fruit farmers in the western portion of the Cape Province have for many years been working their orchards and vineyards on a highly perfected dry-farming system. These farmers till their ground deep and well, and never allow weeds to grow among their vines or trees, or a soil-crust to form on the surface of the cultivated ground.

Many individual farmers, living in those regions of South Africa where there is little or no precipitation during the growing period of small grain crops, have succeeded in growing wheat, etc., without irrigation along moist "vleis" for the last 40 or 60 years. Others, especially in the Free State and Transvaal Provinces have likewise succeeded, in normal years, in growing wheat and oats on the rises ("bults") away from "vleis" or naturally moist places.

The methods adopted, were in many cases not only somewhat unscientific but also varied much in different parts of the country. The un-

scientific preparation of the seed-beds was perhaps one of the great causes of many crop failures during periods of drought. It is, however, encouraging to note that our farmers are beginning to take a keen interest in dry-farming which is bound to have as a result the adoption of a uniform scientific system throughout South Africa.

The idea of establishing a dry-land experiment station in the Transvaal was first prominently brought before the public, in 1908, by the Leeuwdoorns Farmers' Association. The names of Mr. S. J. Hyde and Mr. W. H. Pilkington are closely connected with the above association. These two gentlemen have, with many others, not only resistlessly assisted the dry-farming movement in the Transvaal, but have also successfully practised the system on a large scale. In 1909, General Botha, Minister of Agriculture, decided to start, without delay, a dry-land experiment station at Lichtenburg, with Dr. William MacDonald as Dry-Land Agronomist and the writer as Superintendent.

Previous to this, dry-land experiments had been conducted at Grootvlei, O.F.S. Province and also at Vryburg, British Bechuanaland. Mr. Thornton the principal of the Grootfontein Agricultural College has done very much to

DR. G. LANGMANN M.D. OF
NEW YORK CITY

who has so generously assisted a number of South African boys with regard to their Agricultural Education, and who is still assisting our South African Dry-farming movement in many ways.

W. COHEN.

Koedoesvlei, Zoutpansberg.

An energetic and successful Dry-land farmer in Northern Transvaal.

promote dry-farming especially in the Bechuanaland territory. In response to repeated petitions from farmers, two more dry-land experiment stations were established before the consummation of the Union, one at Pietersburg (Zoutpansberg) and one at Warm Baths (Waterberg). After Union a small station was started at Groenkloof near Pretoria.

CO-OPERATIVE EXPERIMENTS.

There is, in addition to "our endeavour" with regard to the Experiment Stations explained in Chapter III, a new development in our work which we believe will not only promote the knowledge of proper dry-farming methods, but will also help to bridge the gulf which, in the past, has too often existed between the farmer and the townsman, and strengthen that fraternal feeling so essential to all real agricultural progress, and, that is the inauguration of co-operative experiment stations with town councils. There are various other reasons why the Department of Agriculture should co-operate with Municipalities in all matters pertaining to rural industries.

In the first place a town is the natural centre of the farming community. Farmers congregate there for business, for the pur-

chase of agricultural implements, for shows, divisional meetings or nachtmaal. Almost every municipality in South Africa holds a vast area of uncultivated land. A town council is usually composed of a number of commercial men, most of whom are more or less connected with farming. The soil and climatic conditions of such a town will be more or less representative of the soil and the climate of the surrounding district, and such co-operative stations ought to serve their respective districts better than any other experiment station, provided they are *whole heartedly* supported by the public. Co-operative stations are supported by the Government on the £ for £ system. The maximum Government grant-in-aid is £300 per annum, for each station, provided, of course, that £300 or more have been contributed by the public.

THE DRY-FARMING CONGRESS.

The first dry-farming Congress was held at Klerksdorp, in the Transvaal Province, in March 1910 under the presidency of Mr. J. A. Neser, M.L.A., who is now also Vice-President of the International Dry-Farming Congress. It was a most successful and enthusiastic gather-

ing and plainly proved that our farming community is anxious to discuss, accept and apply the better methods of soil preparation. With the consummation of Union the Congress was re-organised in order to embrace all dry-land farmers throughout South Africa. The first Union Dry-farming Congress was held at Pretoria in 1911, and the second at Bloemfontein in October 1912. The Congress is now firmly established. It affords a convenient meeting place at which, once a year, dry-land farmers can congregate to discuss the science and art of their profession.

Mr. William A. M. McLaren of Vereeniging was the first South African farmer to whom the Jethro Tull medal was awarded for dry-farming (1911). In 1912 the Tull medal was awarded to Mr. J. A. Neser, M.L.A., for the great services rendered by him to the South African dry-farming movement. The name of Mr. J. A. Neser, who is the distinguished president of the dry-farming congress, will always live in the annals of South African dry-farming history. The General and International Secretary of the congress is Dr. William MacDonald, late Dry-land Agronomist, now Editor of the Union Agricultural Journal. There are very few South African farmers (if any at all) who

do not know what Dr. MacDonald has done for dry-farming in South Africa.

Mr. Barney Enslin, Chief of the Sheep Division for the Union, was among the very first Officials who have resistlessly worked for the establishment of Experiment Dry-land stations, in South Africa. Mr. Enslin was, before Union, also acting Dry-Land Agronomist during which time he has not only worked very hard but has also displayed great capabilities and tact. Mr. Enslin's name shall always be very closely connected with South African Dry-farming history.

A feature of this congress is that delegates travel, not only from Rhodesia, but also from German and Portuguese territories to take part in our deliberations.

Senator S. Marks has also rendered much valuable aid to encourage S. African dry-farming by awarding yearly a number of cash prizes to dry-land farmers, who have successfully grown wheat, oats, rye or barley under dry conditions. The following farmers were among the first prize-winners in the "Senator Marks Dry-Farming Competition." (Eastern Transvaal) Messrs Thos. Honiball and F. van Zijl; (Western Transvaal) Messrs. J. L. Botha, J. B. Roode and R. van Vuuren; (Central Transvaal) Messrs.

Manual and Ockerse; Southern O.F.S. Province) Mr. H. B. Chatterton; North Western Cape Province, Philipstown) Mr. Izak du Plessis.

Numerous are the South African farmers who have since the establishment of the Division of Dry-Farming not only been assisting and encouraging the movement, but have also been practising the system with great success.

Of course, we also have our customary critics, prophets or "Cold-water pourers," but these are essential to uphold the well-known "Exceptio regulam confirmat."

CHAPTER II.

THE SOIL.

The soil is undoubtedly a vast theatre of the most extraordinary and complicated vital activities and modern science has practically only begun to teach us that "mother earth" is by no means so simple as we used to suppose. We therefore hasten to tell the patient reader at the very start that we shall not even attempt a simple description of the soil, and a scientific or detailed analysis will be severely avoided by us. The scientific world is practically only at the beginning of things with regard to the secrets of the soil's laboratory, and what has been discovered has already been described by the discoverers. However, seeing that the success or failure of the dry-land farmer depends so much upon the soil and the treatment thereof, it may not be out of place to say something at least about this wonderful machine of nature.

The most important known elements of which the earth's crust is composed are :—Oxygen, Silicon, Aluminum, Iron, Calcium, Magnesium, Sodium and Potassium.

Among the smaller constituents, are carbon, phosphorus, sulphur, etc. According to some scientists, nearly 98 percent of the solid crust of the earth consists of silicates of the six metals, Aluminum, iron, calcium, potassium, sodium and magnesium (in this order of relative abundance). The name *rock* is commonly applied to the mineral matter, (in varying stages of consolidation) of which the arth's crust is composed. Rocks are again classified according to the theory of their origin. Those formed through the agency of heat or eruptive origin are called „Igneous" rocks.

When for instance, granite (which is of Igneous origin) has been disrupted by physical and chemical processes and the disintegrated granules having been transported and deposited in strata, by wind or water over river bottoms, etc., have become reformed into compact masses by the cementing action of the acids, alkalies or salts, these form another class of rock called "Gneiss."

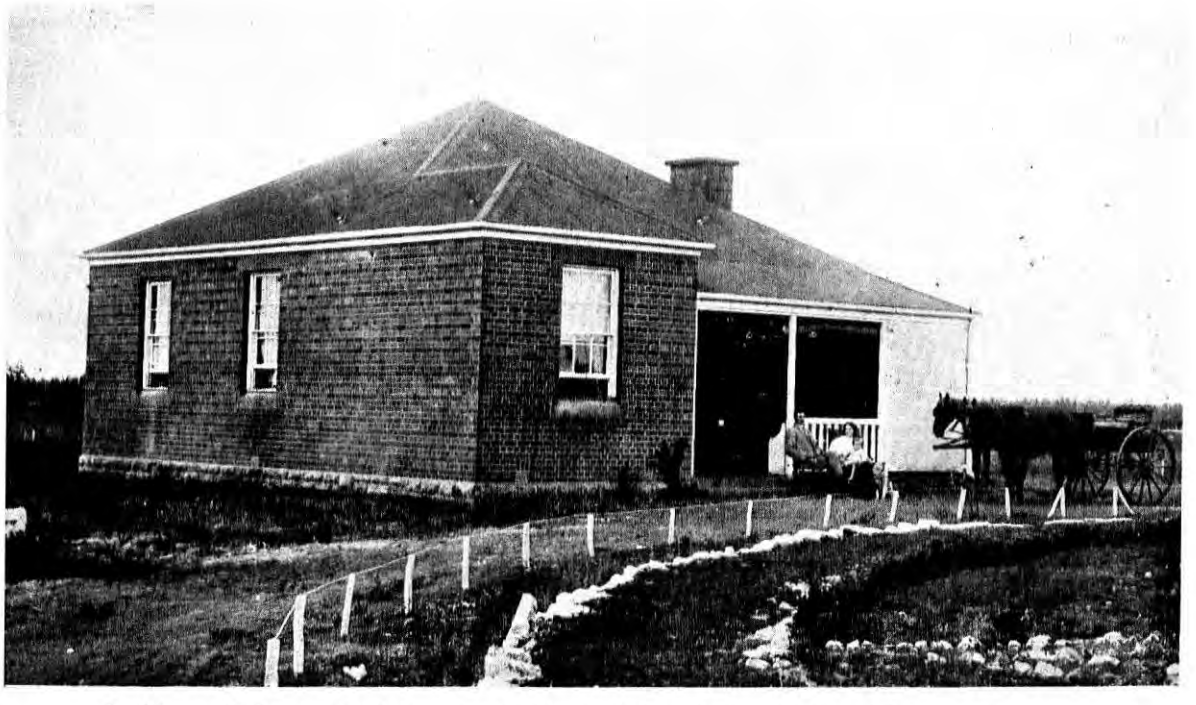
Quarts, Shale, Limestone and many other rocks are again of different class and composition. It will certainly not be necessary to tax the patience of the reader with a description as to how these different rocks have been and are being pulverised to take the form of soil, because every farmer knows that this has been and is being brought about by both physical and chemical agencies, such as heat and cold, wind and water, snow and ice, frost, plants, animals, etc.

A soil derived from a granite or other rock containing much free silica (quartz) is generally *sandy* or, if thoroughly decomposed, a sandy clay.

Soils derived from syenite or trappean (quartzless) rocks lack the sandy particles and are of a *clayey* nature.

HUMUS.

Large amounts of organic matter have been deposited in such places where animal and plant life have been particularly active or the remains of animals, the roots and leaves of plants, grasses, etc., have been washed down from the surrounding higher land into hollows or "vleis", where an accumulation has taken place



Residence of the Dry-Land Agronomist. Dryland Experiment Station, Lichtenburg.

A Portion of the Nursery, Government Forest Station, Lichtenburg.

as the inevitable result. These organic residues, mixed with deposits of fine earth, have undergone a partial decay in the soil, to which it imparts a black or brown colour, and have thus formed compounds known as *humus*.

The importance of a proper proportion of humus in a soil is so well known to our farmers that it needs no description.

The brown or black colour of a soil or the clayey nature thereof, is not always due to animal or vegetable matter, but is sometimes also inherited from the parent rock. This is only true of certain more or less, residual soils.

Kraal, stable or green manures incorporated with sandy soils not only add to the fertility of the land, but through the decay of such manures (especially the first two named) humus is formed, which means that we have not only improved the texture and physical condition of our soil, but have also increased the water-holding capacity thereof.

KINDS OF SOIL.

Soil strata are commonly classed as *top* and *sub-soil*, and in the naming of a soil type the character of the top stratum is generally indicated. The character of the sub-soil, especially

with regard to dry-farming, is of no mean importance.

The composition of the soil, with regard to its physical properties, texture etc., is continually being changed by its perpetual transportation, formation, intergrading, etc.

A classification of soils by us, farmers, is therefore only possible from a stand point of origin.

We shall here only name a few soil types so well known to our South African farmers viz :—

(1) Gravelly... ... ... soil
(2) Sandy ... ... ,,
(3) Sandy Loam... ... ... ,,
(4) Clay ,, ... ,,
(5) Silt ,, ... ,,
(6) Black or Brown Clay ,,
(7) Alluvial ... ... ,,
(8) Colluvial... ... ... ,,
(9) Loess * ... ... ,,
(10) Alkali ("Brak") ... ... ,,

(a) *A gravelly soil* contains much gravel, of one sort or other, without silt or loam.

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*) Large deposits of Loess soils are found in European countries and in America.

(b) *Sandy soils* do likewise contain a predominant amount of sand without much silt or clay. Soils of this nature are generally poor in both humus and natural plant food.

(c) *Sandy Loam* soils contain, approximately, from 15 tot 25 per cent of silt, clay and organic matter with sand in predominance.

The fertility of these soils depends upon their depth and the amount of organic matter, clay or silt they contain.

(d) *A clay loam* contains much clay with loam, and its fertility depends upon proper ventilation and tillage.

(e) *Silt Loams* are as a rule, naturally fertile when properly worked.

(f) *Black or brown clay* soils are, in South Africa, generally found in "vleis" or hollows as a result of accumulated organic matter. These soils are, with rare exceptions, rich in natural plant food.

A great draw-back, especially with regard to the black clay soil, is that it is rather "heavy" to work and that it has a great tendency to crack, besides being found, as a rule in low lying localities where the frost is more severe than is the case with "bult" lands. However, if this kind of soil is properly drained,

ploughed, planked and harrowed and the crops planted after the severe frosts are over, magnificient crop yields may be expected.

(g) *Alluvial soils.* River valleys and other low-lands are generally the depositories of alluvial soils. Fine arth, intermixed with organic matter and many other, more or less, fine materials are carried by water from higher to lower places where these are deposited in layers of various thickness. Such alluvial deposites are as a rule very fertile.

(h) *Colluvial soils.* Huge boulders, breaking loose, and sliding down the slopes of mountains, cliffs or steep hillsides, and loosening other stones in their course; "cliff debris", gravel ect. are brought down in avalanche-like manner to the valleys and hollows at the foot of such mountains. Mud, sand, gravel and boulders so commingled and deposited form a *colluvial soil*, which is from an agricultural stand point of no great importance.

(i) *Loess soil* is, in part, characterized by the absence of pebbles. It consist largely of silt, with some fine sand and but little clay. It has been transported by wind as a rule and in some places is found in high elevations.

Loess is considered of a very fertile character.

(j) *"Brak" (Alkali) soils.* When a soil con-

tains so much alkaline salts as to interfere with the growth of vegetation it is generally called a "brak" or *alkali soil.*

An alkali soil generally contains more than one kind of salt. Typical alkali soils are generally divided into "*black alkali*" and "*white alkali.*" A soil containing a high percentage of sodium carbonate (sal-soda or washing soda) is the much dreaded "black brak," while soils containing much sulphate of soda (Glauber salt) is known as the, (less dreaded) "white brak." Rocks contain many soluble materials and with the disintegration of such rocks these materials (chemical salts, etc.) are liberated and gradually carried off by water in a dissolved or partially dissolved state. This water collecting in shallow "pans" or remaining standing on level places, is evaporated by the sun and the alkali salts are left behind. Alkali lands are generally found in regions where the land is flat and the rainfall is small.

In these regions the alkali salts are not rapidly enough taken into solution by water or carried off to the ocean and consequently collect and remain on the land and within the zone of root action. Alkalies are often washed into our cultivated lands through constant irrigation.

"Inasmuch as irrigation does not also provide underdrainage, the area of alkali lands tends to increase as irrigation increases. It is one of the problems of modern agriculture to prevent this increase; and it is another problem to find some means of ultilizing alkali land. (Bailey)."

"Alkali land is sometimes natural, cultivation never having been attempted. The greater part, however, is land that has accumulated alkali through the irrational practices of the irrigator. Much of it that was once under cultivation, and that had considerable time and money invested in it, in leveling and preparing it for crops, through rise of alkali is now idle, though lying under irrigation canals and in every way favorably situated for irrigation. Other areas are now only slightly damaged, but are gradually becoming more charged with alkali, and each year productiveness is lessened; still other large areas of good land are threatened with destruction unless there are changes in the methods of irrigation and cultivation. Other countries have had similar trouble, Egypt, India, Algeria, Italy, France; in fact, wherever irrigation is practised the problem is recognized, constituting a question of the greatest public concern. Large areas of once fertile lands now lie barren, and some of the countries of oldest civilization

are now desert, due in part to the "rise of alkali". (Thos. Means.)

A soil containing too high a percentage of sodium carbonate (black alkali) is often beneficially treated by the use of gypsum (landplaster) which has the effect of converting some of the "black alkali" into "white alkali." This gypsum is usually deposited in the dam or reservoir or even in the furrow for the water to run over or through before reaching the land.

The incorporation of kraal or stable manures or even straw or grass with an alkali soil, will greatly help to improve the physical condition of such a soil. A better soil mulch will also be obtained; evaporation, and consequently the rise of alkaline salts will be checked. Of course time must be allowed for the manures etc., to decay before the desired result can be expected.

"It is clear that whatever means will prevent the excessive evaporation of water from the surface will in so far lessen the concentration of salts there, and hence frequent and deep cultivation, to form effective mulches, will lessen the rise of water, and therefore of salts, to the surface and in this way permit crops to be grown on soils which are critically near the limit of sterility on account of the high salt content." (King).

We have, in our day, been conducting many experiments with alkali soils with fair, good and excellent results, but we may not be significant enough to some of our readers and have therefore, purposely quoted the above famous authorities.

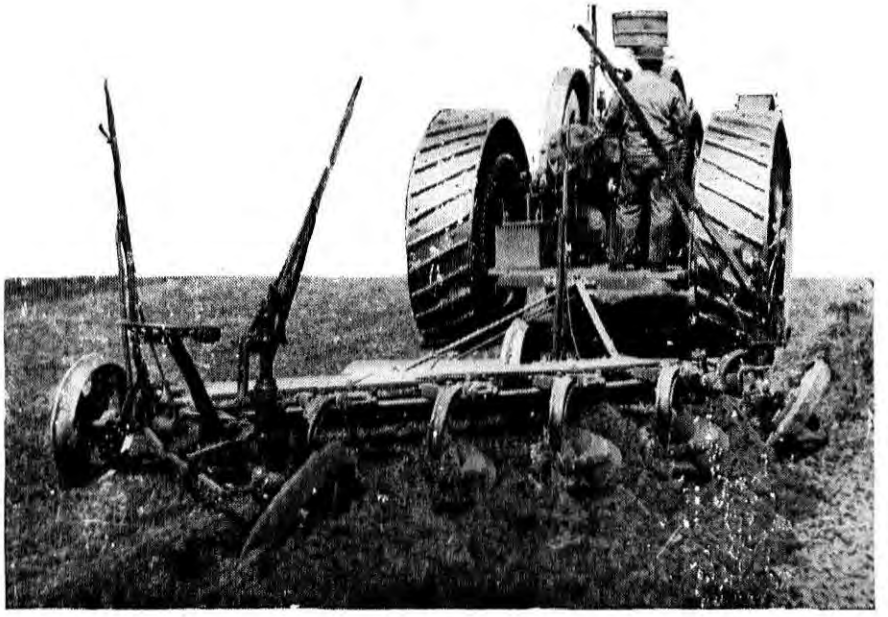
Certain varieties of lucerne and sugar-beets, also kaffir corn, sorghum, Bermuda-grass, Sarui-Budga wheat and various kinds of trees are fairly good alkali resisters.

Another popular method of reclaiming alkali soils is to establish open or closed drains in such lands. These fields are then flooded from time to time. The alkali salts dissolve in the water and are, in this state, drained out of the soil and carried away in ditches to some spruit or river which will ultimately pour these salts into some ocean, helping to keep up the saline reputation of sea water.

In Egypt many thousands of acres of alkali land have been reclaimed in this manner.

Of course we, dry-land farmers, cannot adopt this method, because we have no free water to use, neither can we treat large fields with kraal or stable manure, bcause we have not always got these in bulk. We must therefore always resort to *thorough tillage* of our fields to keep down the injurious salts. Still those farmers having

Farmers' Congress, Vrijburg, 1912.



"THE DUFFETT & KOCH" Modern Motor Plough.

alkalies, may make use of the periodical storm water for drainage purposes, and in the course of time may not only stop the spreading of harmful alkali, but even rid their lands of it.

FERTILITY OF THE SOIL.

Every soil possesses a certain crop-producing power. This power varies according to the amount of natural and available plant food present in the soil.

Farmers generally determine the fertility of their land by its crop-producing power. If this power is strong, the soil is classed as *fertile*, and if the producing power is small, then the chemical composition of such soil is unbalanced and can be amended by farm manures, commercial fertilizers, judicious rotation of crops, green manures (legumes), thorough tillage, etc.

A medical doctor generally ascertains the nature of a disease from certain symptoms, and does not prescribe the same medicine for all human complaints, although it is said that a certain doctor during the Anglo-Boer war prescribed a No. 9 Pill for all complaints, even for broken limbs, etc. Our grand and great grandmothers gave the children castor oil for most ailments. Now, every farmer is not a "soil-doctor," and if the crop-producing power of a field

is unsatisfactory, and the farmer does not know what plant food ingredients are missing, he cannot go far wrong to (like granny with the castor oil) judiciously incorporate kraal manures with such soils.

There is a considerable amount of experimental evidence to show that certain commercial fertilizers will increase crop yields to a somewhat greater degree, than is the case with farm manures. But farm manure is also a great source of humus, the true value of which cannot be overestimated.

Fertilizers do not supply humus and if the productive condition of a land is to be kept up, special measures for the production of humus must be employed.

It is entirely a matter of condition and also of opinion as to whether farm manures should be applied in a decomposed, partially decomposed or fresh state.

Our experience, from a *dry-farming point of view*, is that if fresh manures are to be used, these must be incorporated with the soil, at the beginning or during the rainy period and as *long* as possible before the seeding of such crops as wheat, oats, rye or barley. This applies to lands prepared from October to February and sown from April to July.

Fresh manures are generally of a somewhat dry nature and the decomposition thereof depends largely upon the amount of moisture it comes in contact with. And while the dry-land farmer has to plough his lands, early in the rainy season, in order to conserve all the moisture he possibly can in the soil, he might as well, at the same time, plough such fresh manure under. If the lands are prepared late in the rainy season, it is essential that rotten or partially rotten manures be incorporated. The dry-land farmer ploughs his lands only once, every season. Planting is later on done with a grain drill. Little or no rain falls in these parts (Western Transvaal) during the growing period of winter crops. The incorporation of farm manures with the soil is therefore advisable at ploughing time.

For summer crops, irrigation lands or regions where abundant rains fall during the growing period of the crops, quite different manuring methods may be followed.

Farm manures consist of the solid and liquid excrements of stock and the litter used for bedding.

The composition of such manures depends largely on :—

(1) The proportions of the above present.

(2) The kind of animal producing.
(3) The age of animal producing.
(4) The condition of the animal, working or idle.
(5) The way in which animals have been fed.
(6) The treatment and management of the manure.

Manures exposed to sun and dry hot winds in open kraals etc., lose a great deal of nitrogen in the form of ammonia gas (which is generally brought about by too high a temperature).

Manures made in covered kraals or sheds or in properly arranged manure depositories are much richer than those made in open kraals, etc.

It is also advisable to use litter to absorb all the liquid excrement.

Before we close our brief discussion about the soil, the patient reader will kindly allow us to state that the time is near at hand that farmers will have to make their soil what they want it to be, as long as they have a fair depth of it. Even now "dynamite farming" is trying to solve the shallow soil problem.

Then, the semi-arid regions may have more harmful alkali than the humid climes, but the humus of semi-arid localities is relatively much richer in nitrogen than is that of zones with a

high rainfall and hence much smaller amounts of it will meet the want of crops or plants.

The soil of even a small farm may differ so vastly that certain crop varieties will grow well on one portion of the farm and will not thrive at all on another portion of the same farm.

It is therefore essential that every farmer be as much as possible, his own experimentalist.

"Speak to the earth and it shall teach thee" (Job 12 vers 8).

CHAPTER III.

THE "DRY" OF DRY-FARMING.... WHAT IS MEANT BY DRY-FARMING?

We have known a kaffir who was so extraordinarily black that a piece of charcoal would almost have made a white mark on his face, and the name of this kaffir was "Snow." Now, with the exception of his teeth and the sclera of his eyes, there was certainly very little white about "Snow" and let us say at once that excepting the dry-soil mulch (ground blanket) on the surface of our seed-beds, there is nothing dry about dry-farming, and the term "dry-farming" is therefore entirely a misnomer, as will be seen later on.

"Arid-farming," "Scientific Soil Culture"; "Dry-Land Farming"; "Dry-Land Agriculture" and "Dry-Farming"; these are the terms used in America, of which terms the latter is the most common and has also been adopted by the South

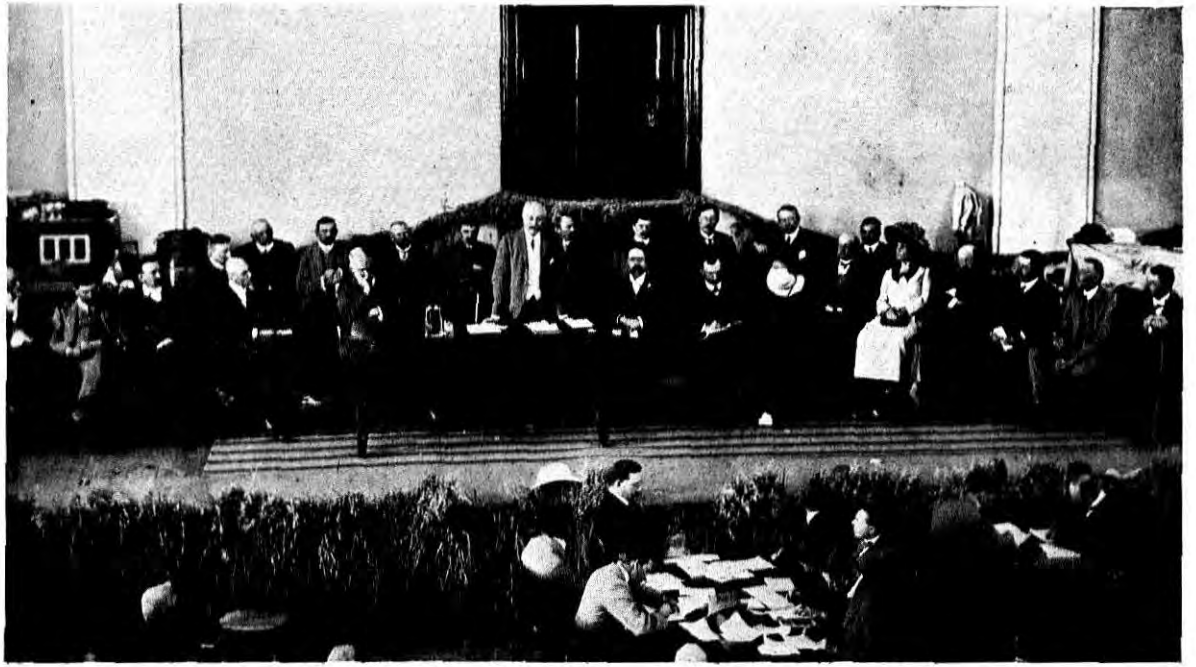
African experiment stations and Agricultural Press.

It is amusing how some people interpret the term "dry-farming." We have received letters from some agricultural implement firms, offering us certain ploughs which they claim to be capable of ploughing ground *harder than a street* and, of course, "*just the thing for dry-farming.*" Some people again are very anxious to know what will become of our prepared seed-beds in case a soaking rain falls on them and, "how do we get them dry again?" because the dry fields being wet, are sure to upset the dry-land experiments altogether. Others again seem to think that we must be arch-enemies of irrigation because we belong to the division of dry-farming. A number of correspondents wanted to know whether it was true that a certain wheat crop was reaped at the Government Dry-Land Station Lichtenburg, "which was planted in a *dry soil* and reached maturity without rain from planting to reaping time." These and similar questions are continually being asked. We may at the outset say that we have really succeeded in growing the above mentioned (mysterious?) wheat crop; and that the land on which this crop was grown, had been prepared in December 1911; that 18 inches of rain fell

upon these prepared seed-beds; that from ploughing to seeding time, the ever essential soil-mulch (ground blanket) was established and re-established by the harrow from time to time; that the moisture from heaven and the capillary water from the earth were "banked-up" in the soil and that the seed was planted in a well prepared ploughed stratum, laden with more than sufficient moisture for a crop to grow and mature upon, without the further aid of rain during its growing period.

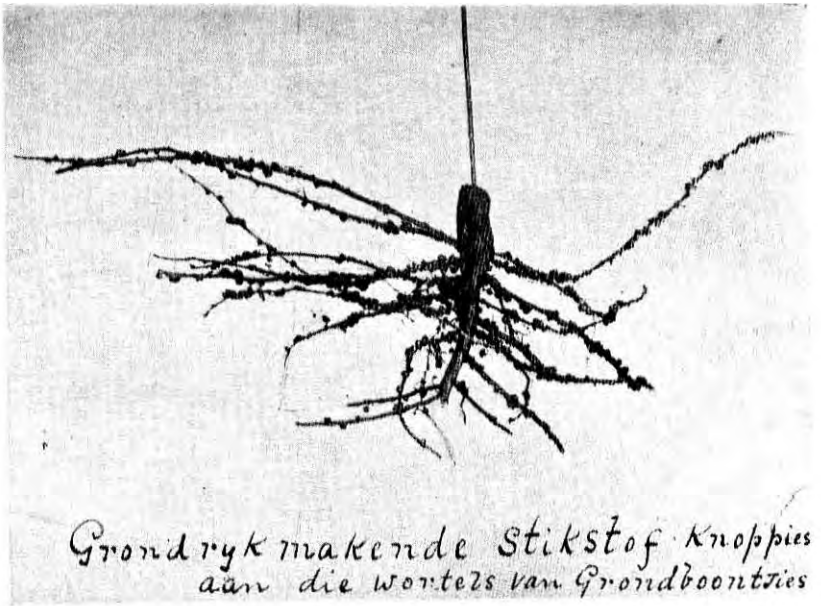
Good soaking rains, at regular intervals, during the growing period of a crop will naturally do it all the good in the world and the conservation of soil moisture will scarcely be necessary but light showers of rain, with long stretches of dry, hot weather in between, will perhaps do the growing crop more harm than good, because in the first place the "ground blanket" will be destroyed and a soil crust formed instead and secondly, the plant will be tempted by the warmer moisture near the surface, to throw out too many surface-rootlets, thereby retarding the downward tendency of the larger roots and their laterals. And these surface-rootlets not being able to utilize the deeper soil-moisture and plantfood, will discontinue operations as soon

Photo Abe Goldstein, Johannesburg.



Dr. Ramsbottom, Administrator of the O.F.S. Province, opens the Dry-farming Congress at Bloemfontein, 1912. To his left, the Mayor of Bloemfontein, Mr. Ivan Haarburger and Mr. T. A. Neser, M.L.A.

Nitrogen Bearing nodules on the roots of Pea Nuts.



Botanical Experimental Station Skinner's Court.

as the upper portion of the ploughed-stratum becomes dry and the plant will, to a certain extent, suffer.

It has also been proved beyond doubt that sufficient moisture can be conserved in the soil to grow and mature drought-resistant crops upon and the growing of such a crop, at Lichtenburg, may therefore not be considered a miracle.

We sincerely hope that this little book will help to minimise the "dry" of dry-farming.

In South Africa as in other countries, dry-farming has been severely criticised. Some writers have even attempted to ridicule the whole system. Others again have declared it impossible or impracticable and glad as we shall always be for constructive criticism, it must however, not be forgotten that the scientific world especially with regard to the soil and plant breeding is only at the very beginning of things; and if we attempt to limit what shall be possible we run the risk of being stultified by events as similar prophets have been in the past.

We read and speak of the "dark" bygone ages. Why dark? The sun and its satellites and the other elements of nature were as much in evidence in the time of our ancestors as they

are to day. The ancients must always be admired for what they have accomplished in their day, but at the same time it must be admitted that their world was rather dark with regard to science, civilization, etc. And although marvellous progress was made along scientific lines during the 18th and 19th centuries, it can hardly be said that the sun of knowledge has, during that time, risen more than a few feet above the horizon; and the 20th century with all its discoveries, inventions and wonders will most decidedly not see this sun in its zenith and posterity may even look upon this century as a dark one.

Of what use is it then to prophesy, to guess of to "gas" of what shall be possible and what not?

Even a third class prophet must have been looked upon as a wonderful being in those days, when the prediction of an eclipse of the sun was thought black magic. But the order of things have changed and divine inspiration with power to fortell events is a matter of the past. Present-day prophets therefore not being entitled to a hairy mantle, can only base their predictions scientifically, otherwise their friends and children may declare them false prophets.

Zechariah of the Bible was certainly one of the good and true prophets of the past, who has correctly predicted the fate of present and future would-be-prophets: He says, "It shall come to pass in that day, that the prophets shall be ashamed every one of his vision, when he prophesieth; neither shall they wear a hairy mantle to deceive; but he shall say, I am *no* prophet, *I am a tiller of the ground*" Zech. 13 :4). Exactly what is wanted in South Africa: more homes, more *tillers of the soil*, more thorough energetic experimentalists among the farmers themeslves, more hard workers in connection with the more important practical problems of immediate concern to agriculturists, more leaders in the world's scientific thought and *less "cold water pourers" or prophets.*

Every farmer must try to "cross-examine" his soil in the shape of thorough tillage and many experiments, and the soil will truly respond in the form of crop-results at harvest time. This procedure may also lead him to the discovery that, dry-farming under certain climatic conditions is not only possible but also profitable; and that the ugly "dry" of the compound technical term, "dry-farming", has nothing to do with dry-seed beds.

Let us hope that the day is not far distant,

when we, farmers, and also the "know-alls" will say "we are scientific tillers of the ground and no prophets."

WHAT IS MEANT BY DRY-FARMING?

Dry-farming is a certain method of soil cultivation, whereby it is made possible to conserve sufficient moisture in the soil, to grow and mature crops upon without the aid of irrigation and in regions where the rainfall is limited or in places where irrigation is impossible or impracticable. Allow us please to repeat that it is *not* farming *without moisture* for that would be plainly impossible.

Our Endeavour. Ever since the establishment of the Division of Dry-farming our object has been (a) To encourage farmers to arrest the water running or falling on their farms in all possible ways viz :—In dams, reservoirs, etc., and also in the *soil*, where irrigation is impractical or impossible. (b) To prove that under certain climatic conditions, with some depth of soil, and proper tillage sufficient moisture may also be "banked up" in the soil itself to grow and mature crops upon during periods of drought. (c) To try and make a certain class of man take more interest in his best friend, the soil, and to encourage the better methods of

cultivating the same. (d) To find out which cereals and plants will grow best and most profitably in the dry-land zone of South Africa. (e) To try and find out more truths about dry-farming, by pushing the practical side of the work and by conducting our operations, as much as possible, on a scientific basis. (f) To keep in touch with the experiment stations of other countries and (g) to experiment on a small scale and exercise a rigid economical procedure, in order to encourage even the poorest farmer to apply the system on his farm and also not to give the impression that the Government is competing with farmers on the market.

Besides, the word *experiments* is sufficient to explain what we are after. No one expects *all* experiments to succeed and in order not to risk time and money, it is necessary to conduct experiments on a small scale until such time as the experiment has been thoroughly tested. Then even, the idea is that the farmer, and not the Government, must grow such tested varieties on a large scale.

CHAPTER IV.

THE CONSERVATION OF SOIL MOISTURE.

The greatest sceptics with regard to dry-farming are generally quite willing to believe in this system of crop production provided we are lucky enough to divert their minds from the "dry" of dry-farming and prove to them, that dry-farming is only one of many ways to conserve water for the use of plants.

The water in the soil may be in three forms viz :—Free, capillary or hygroscopic water.

The free water of the soil is that which flows under the influence of gravity, and is the source of supply for springs, wells, rivers, etc. And although this free water is not utilised directly by cultivated plants, it is, nevertheless, very valuable, when removed a proper distance from the surface to serve as a reservoir from which moisture may be drawn up to the root area of plants by capillary action.

CAPILLARY WATER,

is that which surrounds the soil particles and root-hairs in the form of a film and furnishes crops, etc., with the necessary moisture that they require for growth. Capillary water moves through the soil from a moist to a less moist area, *even in opposition to gravity*, and is capable of moving downward or sidewise as freely as upward.

The famous American Professor, King, says, among other things, the following about capillarity. "Whenever a lamp is lighted there is at once started a current of oil, rising from the bowl through the many interspaces between the threads of the loosely woven wick, and this flow continues so long as the oil is removed from the upper end by burning. So, too, when a wet soil is exposed to a drying wind, the removal of water from its surface results in setting up a flow from deep in the ground upward toward and to the drying surface, to make good these losses. Then, again, when the root of a plant threads its way among the soil grains and withdraws from their surfaces a portion of the water with which they are charged, there is, at once set up, to make good this loss, currents of water travelling from various directions in the soil

toward the absorbing root. By what mechanism are these movements maintained, and what is the source of energy by which the work is performed?"

"When the water rises from a well through the action of the pump, we know that the energy generated in the muscles of some man's arm has been transferred, through the pump handle and the piston, to the rising column of water; or if not the energy of human muscles, then that from the moving wind, acting through the windmill, or some other equally evident source of power. Matter is never moved, work is never performed except at the expense of energy in one form or another; so in the capillary movements of water through the soil, and in the rise of oil through the wick of a lamp, work is being done, and energy from some source must be expended."

"The first careful study of the rise of water in capillary tubes was made by Hauksbee nearly 200 years ago, but history shows that the phenomena were known to Leonardo da Vinci, the famous artist, who lived between 1452 and 1519. But notwithstanding the large amount of very careful study which these phenomena have received even during recent years we are yet in the dark as to just how the energy which forces the capillary fluids to move is transformed

MR. J. BOTES.

Assistant to the Dry-land Agronomist for the Union.

ARA G. DU TOIT.

One of the first farmers who has successfully applied the scientific principles of dry-farming in the Cape Province.

into current motion; but all are agreed that it is in some way brought about through the surface tension of liquids."

We have often noticed how ink when dropped on a piece of blotting paper travels in al directions, and how tea and other liquids spread in a lump of sugar. Now, whatever the energy or energies may be, causing this current motion of fluids, we are satisfied in our own minds that water is drawn up from great depths to the surface of the earth, to disappear into the atmosphere in the form of vapour.

The maximum depth from which water is capable of rising under the laws of capillarity has not yet been determined. Some scientists claim that capillary water will rise almost to any height provided that the interspaces between the soil granules are of the correct size.

We may also mention here that capillary water is not only held by adhesion to the soil particles, but also in the very small openings between such soil grains as in a sponge.

HYDROSCOPIC WATER .

is present in even the driest road dust, and it may constitute from 1 to 3 per cent or more of

the weight of the soil. It does not move under the influence of gravity or capillarity and it is driven off only when the soil is exposed to a temperature of 212° Fahr.

The scientific world is not agreed as to the laws governing the hygroscopic moisture of soils; consequently it has not been ascertained yet whether this moisture is of importance to plant life or not. It is therefore clear that capillary water plays the most important part with regard to plant life, and that even the free water, conserved in dams, reservoirs, etc., for the use of crops, must practically first be transformed into capillary water before our cultivated plants can make use of it.

The waterholding capacity varies widely in different soils. A cubic foot of saturated soil will hold from 20 to 32 lbs of moisture. The waterholding capacity of sand or sandy soil is lowest; is greater in loam or clay, and reaches its highest point in soils containing a large amount of humus or organic matter.

Water falling on the land moves in three different ways, viz :—(1) Under the influence of *gravity*, as free water; (2) as *capillary water*: (3) *thermal*, (i.e., water evaporated by heat).

The great object of the energetic farmer must therefore be: (a) To store the gravitational

water in dams or reservoirs; (b) to prepare his non-irrigable lands in such a way as to convert as much free water as possible into capillary water; (c) to stop the evaporation of water from the soil, and so also utilise the lands where irrigation is impossible or impracticable.

THE QUESTION OFTEN ASKED

by farmers is: "Is it possible to conserve enough moisture in the soil to grow and mature crops on?" The answer to this question is that with a certain amount of precipitation, a certain depth of soil and with a well and *timely* prepared seed-bed, it is quite possible to grow large and profitable crops; also fruit and forest trees.

How do we know that this can be done? Because dry-farming is an old practice and has been practised from time immemorial; the principles thereof have been successfully applied by ourselves and by large numbers of our farmers. Consequently this method of crop production has long since passed the experimental stage and it now only awaits the general adoption of it by the South African farming community.

Dry-Land Experts have practically found it impossible to determine the minimum amount of

precipitation under which it is possible to dry-farm successfully because so much depends upon the climatic conditions, depth and fertility of soil; also whether the crops receive a certain amount of rain during their growing period or not, or whether the farmer makes use of drought-resistant seeds or not. Prof. Widtsoe has calculated that in arid districts and under average cultural conditions, approximately 750 lbs of water are required for the production of one pound of dry matter i.e., one pound of wheat with its straw.

It has further been found that one inch of water over one acre of land weighs approximately 226,875 lbs., or more than 113 tons. Now, if 750 lbs of water are required for the production of one pound of dry matter then there is a maximum possibility of producing 25 bushels of wheat per acre annually with a ten inch rainfall.

The above calculations were made for arid regions where the evaporation is very high and it is therefore obvious that less water will be required in semi-arid ,or sub-humid localities.

We must, however, remember that under no known system of tillage is it possible to store all the water that falls on our ploughed lands, because

directly from the soil before our lands are dry enough to re-establish the ground-blanket and some may be lost in many other ways. Some dry-land authorities put the lower limit of successful dry-farming at 8 inches, others again claim that 10 inches of rain is a safe minimum. However, every thinking farmer will realise that on the depth of a soil depends largely its water-holding capacity, its water-moving ability, and to a great extent its productivity. Not only can a larger amount of water be stored in a deep uniform soil but also the soil moisture rises much more freely from great depths to the root-zone of our crops by capillary action than is the case with shallow soils. But although a deep uniform soil generally produces a better crop than a shallow soil, the success of the dry-land farmer does not entirely depend upon a particular sort of soil, for dry-farming has proved profitable alike upon shallow sandy soils and heavy clays. Of course, larger yields may naturally be expected from the best lands, such as deep rich loams.

We have heard numerous statements and have received many letters from reliable farmers (even from well-known progressive farmers

living in the drier parts of the Cape Province), that they have successfully dry-farmed under much less than 10 inches of rain. It is, however, obvious that crops receiving a certain amount of rain during their growing period can reach maturity with much less rain then crops which have to subsist and mature entirely upon the "banked-up" moisture in the soil. It is furthermore clear that certain mountainous regions have a cooler and more even climate and consequently a less degree of evaporation.

It is also essential that dry-land farmers use as much as possible drought-resistant seeds. Desert plants use, near enough, the same mineral and atmospheric plant food as plants of the same variety growing in humid climes, only the desert plant has to stand its own against "all comers," and has consequently hardened itself against "all comers" such as drought, hot winds, etc. It is not so long ago that the scientific world has started to give full attention to the problems of the farmer, and it has not only succeeded in making numerous new discoveries and in hardening seeds and plants against drought, but has even reclaimed vast areas of semi-arid regions.

"Men, my brothers, men the *workers* ever reaping something new." (Tennyson).

It is also of great importance to prepare our seed-beds for such crops as wheat, oats, barley and rye at the *bginning* of our rainy season (if we have a fixed rainy season at all) in order to conserve as much moisture as possible during the remaining rainy months.

Those parts of South Africa where there is no fixed rainy period may perhaps get a less amount of precipitation then regions having regular periodical rains, but then those drier localities may get a certain amount of rain during the growing stage of their crops, and they may also have other advantages which the rainy districts have not.

Now, in order to conserve the moisture for the use of our crops in our cultivated lands, we must prepare such lands in such a manner as to retain the largest amount of moisture.

The dry-land farmer must therefore plough his soil well and deep. "Why deep?" Because deep ploughing is the most efficient means of pulverising the soil properly, and of bringing up "new soil" to the top, mixing it with the stubble, weeds, etc., increasing thereby the amount and depth of humus. Deep ploughing further encourages the growth of soil bacteria, deepens the soil reservoir, increases the waterholding capacity of the soil, kills weeds, promotes fertility

generally, and enables us to get the seed-bed in the best condition.

Now what was said of ploughing with regard to the conservation of soil moisture, the enrichment of our soils, the success or failure of our crops, may emphatically be said of good *harrowing*. We know that crops cannot grow on a rock, no matter how much plant food it may contain. We also know that a finely divided mellow, friable soil, is far more productive than a hard lumpy one of the same chemical composition, because a well pulverised soil holds and retains more moisture, holds more air, promotes nitrification and therefore fertility, hastens the decomposition of the mineral elements in the soil, has less variable extremes of temperature, and allows a better root-hold to the plant. In all these ways (and others) the mellowness of the soil renders the plant-food more available, and affords a congenial and comfortable place in which the plant may grow.

Next, let us suppose that the extent of our field selected for dry-farming is eighty acres (virgin soil) and that in one or two days time we have ploughed say, one, two or more acres of this field. Then, for various reasons, do not let us go on ploughing, but let us first (while the clods are still soft) get our harrows and make

Modern Steam Plough as seen from behind.

"Groot Trekker" double furrow Plough. Operating in the Cape Province during the drought of 1912. (Beckett & Co. Ltd.)

fine, that is, thoroughly pulverise, what we have already ploughed, and in this way let us go on (ploughing and harrowing) until we have finished the whole eighty acres. It is impossible to get the soil in the desired condition if we allow the clods and furrow slices to get hard. It is not enough to harrow our field three or four inches deep after we have ploughed it and leave the fat slices intact underneath, for the root-system of our growing crop lies considerably deeper than four inches. It is also essential that the large air cavities, gaps, cracks and crevices in the under portion of the ploughed stratum, be destroyed in order to bring the soil particles once more in close connection with one another, thereby re-establishing the capillary connection with the sub-surface soil. Again the dry-land farmer may ask :

"WHY MUST MY SOIL BE MADE FINE

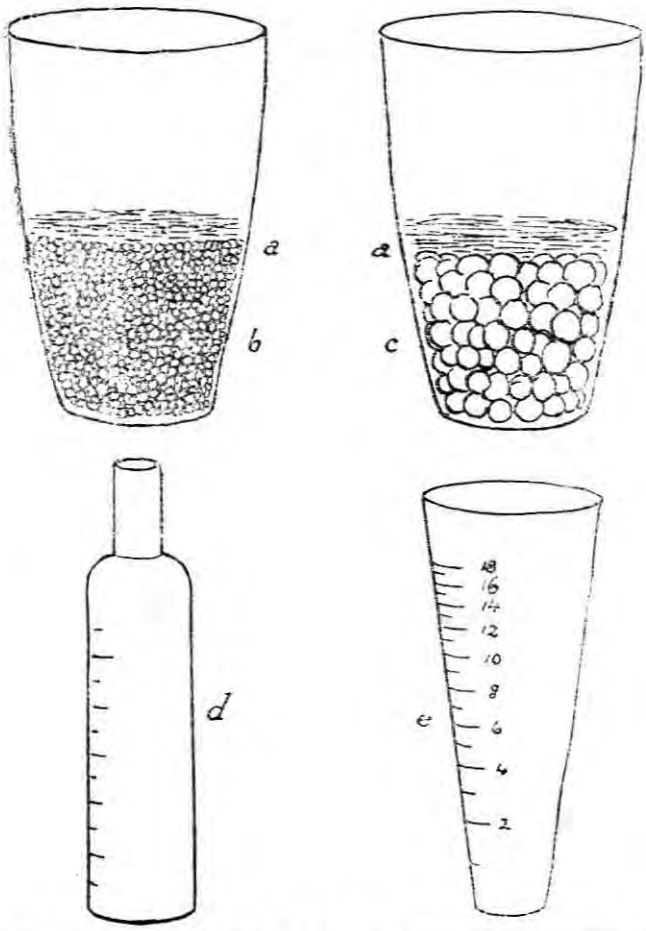
to such a depth?" The answer has already been given above, but let us see how a great authority on "soil" explains that a fine soil can hold more water than a coarse one. He says :—"A marble of exactly one inch in diameter will just slip inside a cube one inch on a side, and it will hold a film of water 3.1416 square inches in area.

But reduce the diameter of the marble to one-tenth of an inch, and at least a 1000 of them will be required to fill the cubic inch, and their aggregate surface area will be 31.416 square inches." This shows the great advantage of breaking down large clods into small particles, as the area for the roots of the crop to feed upon is very largely increased.

We shall also notice that the water film clinging to the (aggregate) surface of the 1000 small marbles is more than 10 times larger than that of the "mother" marble. Then we also know that capillary moisture can only readily climb over from one soil particle to another, when such particles touch one another in such a manner that the interstices between them are of the correct size. When the soil grains are too closely packed together, we have a hard "pan," etc. Again, when the interspaces are too large, the capillary moisture cannot get across such big gaps.

The ink does not spread or travel about in a smooth sheet of writing paper, because the particles of paper are pressed together too closely. This reminds us of ground with a hard layer on the surface or a hard pan below.

In blotting paper again the ink travels rapidly in all directions because the particles are



To prove that a fine soil holds more water than a coarse one. The tumbler (*a b*) contains an amount of fine "bird shot". The tumbler (*a c*) contains an equal amount of coarse "buck shot". A measured quantity of water is poured from the measure glass (*e*) or from the little bottle (*d*) on to the "bird shot". An equal quantity of water is poured on to the "buck shot". The tumblers are well shaken. The water is then drawn off into the measure glass or into the bottle (which is used when no measure glass is at hand). When the water so drawn off is separately and carefully measured, it will be found that the fine "bird shot" retains more water than the coarse "buck shot".

packed together in just the right manner for the fluid to climb over from one to the other.

Of course we do not mean that our soil particles must be as fine as those in a piece of blotting paper. These are only examples, on a miniature scale, of a hard and of a mulchy soil.

Now, how can we retain or

STORE UP THE RAIN WATER.

in the soil? The reply is: By placing a layer of "something" between the soil moisture and the flaring rays of the sun or in other words between the outer air and the soil moisture.

We have often noticed that when we turn over a flat stone, kick away a piece of old sack or work away a heap of straw, etc., that the soil is quite damp underneath such things, although the surrounding earth is quite dry. The stone, sack or straw, etc., has broken the sun's rays and the absorbing power of the hot wind to such an extent that the heat of these elements of nature was not strong enough underneath the mentioned objects to turn the soil water into vapour. Now we cannot expect a farmer to place a layer of stones, etc., over the surface of his ploughed lands to protect his soil moisture from escaping into the air. But we all know perfectly well that nothing on earth can resist

heat so well as "mother earth" itself, and it is therefore quite clear that we are going to build this "sun-ray" and "hot-wind-breaker" from the very earth itself. And how do we establish such a layer? With the harrow or cultivator. The cultivator is mostly used for inter-tillage, i.e. tilling between the rows of crops or trees.

Now after we have prepared our seed-beds, as already described, the rain falling on such seed-beds is greedily absorbed by the soil. But after the rain is over and the surface of our lands is beginning to dry, we shall find that a thin soil crust has formed on the surface of our ploughed field. This moisture-losing crust must be destroyed with the harrow the moment the soil is dry enough to be worked, because our capillary moisture lies now directly underneath this thin crust, escaping as vapour through the numberless little cracks, which act as flues in such a soil-crust.

The proper ventilation of our soil is also partly obstructed by this crust. In destroying this crust, the teeth of our harrow stir the top soil of our field to a depth of three or four inches, spreading the soil grains so far apart that soil water cannot pass from one soil grain to the other, or but very ineffectively. This loose soil mulch is called

The granules of the soil in this "ground blanket" besides having few points of contact, with large interspaces, also generally get very dry, and dry soil repels moisture to a certain extent.

We see thus that by establishing a "ground-blanket" we have broken the top steps of the ladder, so that the soil moisture cannot climb out to the surface. Besides, the dry soil mulch or ground blanket on the surface not only breaks the sun's rays but also fights back the soil moisture creeping up from below.

It has been proved over and over again by experiments that a good "ground blanket" thoroughly checks the loss of water from the soil. In one case (mentioned by King) a number of very drying days failed to appreciably decrease the mean amount of water in the upper four feet of a field, while an immediately adjacent and entirely similar land, not ploughed, lost, during the same time, the full equivalent of $1\frac{3}{4}$ inches of rain or more than nine pounds of water per square foot. Many very interesting experiments on the conservation of soil moisture, water-holding capacity, water-moving ability, etc., have also from time to time been made on the Government dry-land experiment station at

Lichtenburg. It is however felt that the reader will attach more value to the results obtained by the great Prof. King than to those obtained by our humble selves. We have therefore decided to mention (above) the results obtained by King on this subject.

It has also been proved by irrigation experts that fully one half of the arable soil of our globe cannot be irrigated and must be worked (if at all) on the dry-land system.

Humanity has, and is still, making wonderful discoveries. Not so long ago the conquest of the air was started with, and we all know that the air is to-day practically conquered. Now why cannot the South African farming community stand together and conquer the South African non-irrigable lands?

It is impossible for the few Government dry-land officials to conquer such vast territories alone; we need the help of all our farmers and we shall be very thankful if every individual farmer, especially the farmers of the drier parts of the Union, will make small dry-land experiments on their farms. This will help the farmer to find out exactly what can be grown profitably and on a large scale on his particular farm or in his district, and he will help his country, his

Government and his poor dry-land officials enormously.

Should the farmer not succeed the first year, then try again and again and great success is bound to be the ultimate result, for :—

"Perseverance is a virtue,
That wins each god-like act, and plucks success,
E'en from the spear-proof crest of rugged danger."

(Havard).

Photo Abe Goldstein, Johannesburg.

Left to right:—F. B. Smith, Secretary for Agriculture; J. A. Neser, President Dry-farming Congress; Sir Percy Fitzpatrick.

12 Inch deep ploughing with "Groot Trekker" double furrow plough, (Beckett & Co. Bpt.) During the drought in 1912.

CHAPTER V.

DRY-FARMING POSSIBILITIES IN SOUTH AFRICA.

The primary need of most South African soils is undoubtedly moisture. *Climate* is another important factor to be considered in connection with the vegetable kingdom.

Some plants are capable of adapting themselves to dry, desert air and a scorching hot sun, while others are not. The same may be said of the adaptation of plants from warm dry regions to wet cold climates. That atmospheric conditions in general have ever so much to do with plant growth is too obvious to call for comment.

Not every plant taken from a humid habitat will grow in a desert atmosphere no matter how good the soil may be or what amount of water it may get. The same is true of certain desert plants in humid regions. In such cases *climate* plays the important part.

As to dry-farming chances of success in un-

tried, semi-arid regions, several methods are available of which *actual experience and scientific investigation* are the two most important.

The first of these methods has until recently been the only method available. Under the second heading we may put *scientific research* which includes near enough all branches of knowledge. The object of dry-land experiment stations is not only to conduct actual experiments and to act as guides to the would-be settler in semi-arid regions, but also to do such research work as will be of value to dry-farming in general.

The "Carnegie Desert Botanical Laboratory" was established some eight or nine years ago near Tuscon in the Arizona Territory of the United States of America. The work of this Carnegie Laboratory, together with other similar institutions of more recent date in other parts of the world, cannot be over estimated. The average rainfall at Tuscon, near which place the Carnegie Laboratory is situated, is 9 inches of which less than one inch falls during the spring months.

In the wettest year 15 inches and in the driest 5 inches of rain fell. Our South African dry-land experiment stations are of quite recent date but our tests have been (by force of cir-

cumstances) so severe that we are fully convinced that under certain known climatic conditions vast areas of land within the Union which were hitherto, from an agricultural stand point looked upon as useless, can be profitably utilized by means of dry-farming.

Every farmer who has travelled extensively in our sub-continent must have been struck with the vast stretches of excellent land, even within the more populous centres of the Union, land not being used for any purpose and practically lying waste under a rainfall of from 10 to 22 inches and more.

We are furthermore convinced that our Great National Object, i.e. to get a larger white population on the land, can never be fully attained until the great importance of dry-farming is fully realised. No thinking man will ever deny the vast importance and great value of irrigagation with regard to the development of this country, neither will any sane person discourage the construction of irrigation works of every description, but irrigation works are not only confined and costly, but they are also impossible over enormous arable areas within the Union; dry-farming is cheap and within the reach of near enough every South African farmer. It is, in our opinion plainly the duty of South

Africans and of the Government to try and utilize, at least, certain portions of these vast stretches of waste-lying fertile land for the planting of useful crops, grasses or trees.

This will enable us to support more human beings and also to breed immensely more live stock, to work up new industries and ultimately "a white man's country."

It will certainly be unwise and short-sighted, even under the most charitable analysis, to say or claim that dry-farming, in its present state of development, is possible in howling deserts or in every portion of the arid or semi-arid regions throughout South Africa. We have, however, quite enough experimental evidences to prove that there is an enormous acreage of fertile land throughout our sub-continent which falls within the zones of possible and profitable dry-farming. So vast is the acreage that it will take decades, if not generations, to develop the whole of it properly into model farms or "holdings." The advance of agriculture in this country has during the last decade broken all South African agricultural records. Still, when we compare the amount of our arable land and the acreage cultivated thereof with that of certain other agricultural countries then we must admit ourselves somewhat slow. We are

perhaps not so much to blame for the past, but we can scarcely put in a plea of "not guilty" with regard to the future.

It is certainly true that most of the other ("young") agricultural countries have larger populations than we have, but then it is plainly our duty to display a true national spirit and this can best be done by unanimously putting our shoulders to the wheel and show the world that the hitherto waste "veld" is capable of producing more than wild grasses and bushes.

We are very thankful to the many S. African farmers who have not only individually dry-farmed with great success, but who have also assisted us in conducting co-operative experiments. But we must have *more farmers* to study and practise the system and in this way we shall soon know what profitable plants and crops will grow best in the different dry-land zones of South Africa. The acreage of land required for a settler in the various districts of the Union will by this means be more quickly ascertained, and the throwing open of our doors for good European settlers will thereby be expedited.

The late Mr. J. W. Sauer and other authorities have so often discussed the future of *the white race in South Africa.* We may or we may not share the late Mr. Sauer's theory on this matter,

but we can certainly not deny that the whites in South Africa are not increasing as rapidly as the blacks, that there will have to be, on the part of the white race, a definite and sustained effort to secure its position, that it must strengthen itself *numerically* and *industrially*, and that it must do more of the work of the country.

The lesson of African history is that no white race can hold its place in the great continent without a struggle. Is the white race in the South to-day making a sufficient effort?

Many of us have quite recently read in the papers that the Department of Customs and Excise has issued the statement for April (1913) of articles imported which are capable of being produced within the Union. The total value of food and drink imports for the month was £449,032, and of other miscellaneous imports capable of local production £166,620. It may be argued that it will not be possible to transform some of our "veld" into crop-producing fields by means of dry-farming. Now ,we have already tried to point out that, in many cases, certain crops will grow on one portion of the farm and the same varieties may not be willing to grow on the other portion of the same farm. We have also said we do not claim that dry-farming is possible on all soils or under all conditions. Not even is irriga-

tion farming possible under all conditions. But, do not, please, let us condemn dry-farming *before we have thoroughly* tried the system, and *do not let us apply the method*, before we *have thoroughly studied it.*

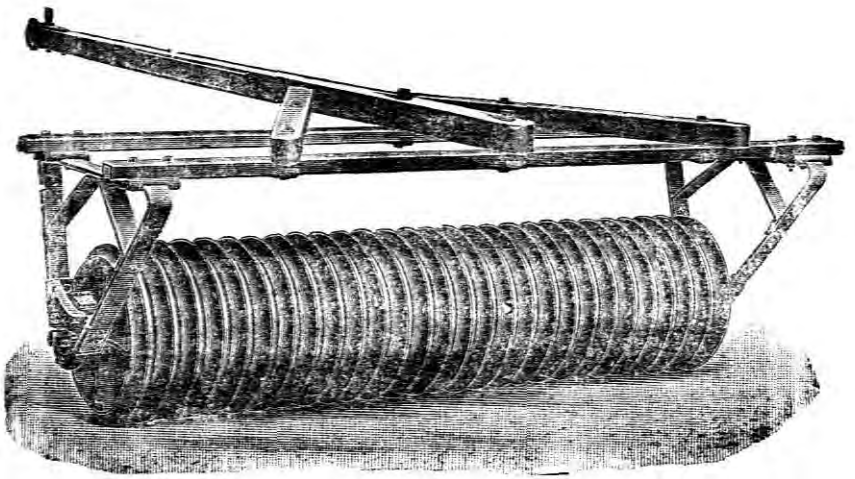
Dry-farming intelligently practised can undoubtedly be carried on at a good profit. We are inclined to believe that some are attempting dry-farming without a proper understanding of local conditions and without much more than a confused idea as to method.

These are the people who, when they fail, condemn the system instead of blaming themselves.

South Africa cannot afford failures in dry-farming. We therefore advise and implore the would-be dry-farmers to first make themselves thoroughly " au fait " with the principles of dry-farming. Start on a small scale. Try different crop varieties, grasses or trees at a time. Do not plant all the seeds on the same day or in the same month. Study your soil and local conditions. Watch the growth of your crops or plants carefullly. Try and detect the true cause of your success or failure. Do not accept a success or failure at once. Try to improve your soil and crops as you do your horses, cattle or sheep. Always look upon your farm as your own private laboratory in which tests and experiments are

being made. Grow your tested crop or plant varieties on a large and payable scale. Study the market carefully. Grow what will pay you, either for market or stock-feeding purposes, and share your experience and valuable discoveries liberally with your brother farmers.

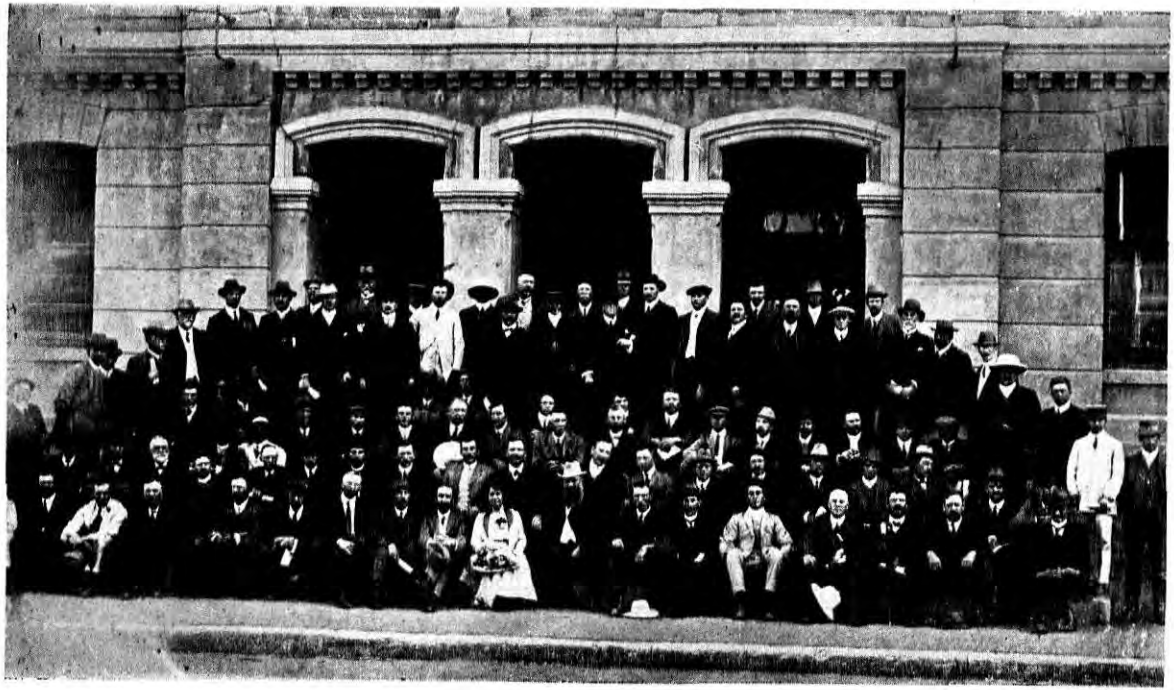
A few cases have been brought to our notice



Cambridge Landroller. (North & Son).

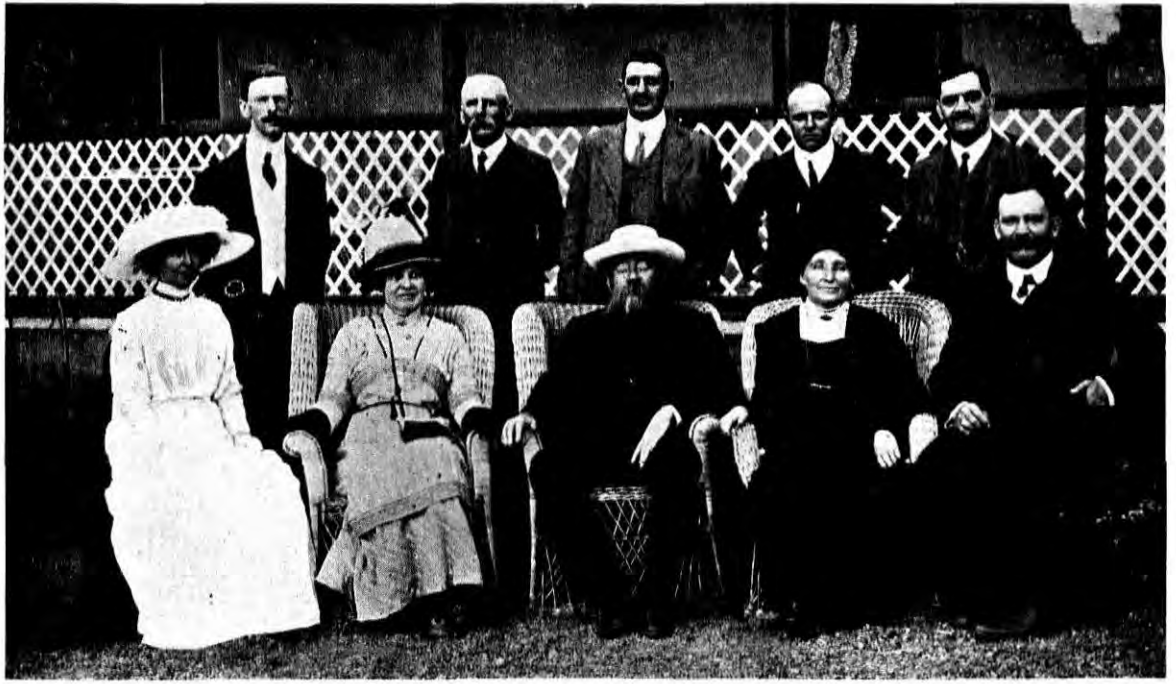
where successful dry-land farmers have deliberately misled their neighbours with regard to the proper methods of dry-farming. When these few selfish farmers were asked to explain their conduct the prompt reply in every case was : "I am not bound to preach my secrets to the world.

Photo Abe Goldstein, Johannesburg.



The Dry-Farming Congress at Bloemfontein (1912).

Photo Abe Goldstein, Johannesburg.



J. A. Neser, President Dry-Farming Congress, Visits President Steyn on his farm near Bloemfontein. Sitting with hat on, is President Steyn.

Besides, if all my neighbours produce their own bread, vegetables, fruit, forage, etc., then I shall have to sell my stuff on the market for whatever price I can get, and now I can sell at my back-door at my own price. I want to try to make money before everybody knows how to produce crops, etc., on dry-lands." Let us hope that the few cases referred to above are the only ones in South Africa.

If we look properly at human history we realise that man has always been dependent upon the rest of the living world, and that his progress and numerical increase have essentially depended upon the cultivation of other forms of life.

Man's first culture of life to maintain the life of his own species was doubtless concerned with certain animals. Students of human beginnings tell us that primitive man hunted his prey exactly as the lion, shark or spider does, and that it was a revolutionary step forward when man learnt how to tame and breed the animals upon which he depended. We are further told that man the hunter, later man the herdsman, became man the planter. Students of the history of civilisation recognise an immense and important forward step when agriculture was brought upon the scene. Many militants, from the elephant to

the tubercle bacillus, have been conquered wherever man has made up his mind to do so. Stingless bees and thornless prickly pears have been created by him. The ocean and the air have been taken into man's employ. Steam, electricity and other forces of nature have been made subservient to him. Hail and frost are being fought and will ultimately be made harmless by man's scientific tools. It is said that the changes already wrought upon the face of the earth by the activity of man, are so immense that an observer situated upon the moon could readily detect them with a modern telescope. The sceptics with regard to dry-farming, must not make too sure that the desert will never be conquered by means of dry-farming, drought-resistant plants, etc.

Personally, however, we are inclined to think that our first duty is to try and *begin at home*. The immense acreage of good fertile land stretching from our very door-steps to far beyond the horizon, and falling within the present known safe dry farm area of South Africa must first be conquered or transformed. The real desert must wait until we have cultivated and settled the now waste lying non-desert land. And by the time we have done this, agricultural science will be more advanced and the conquering of the desert made easier.

There is a very true old Chinese saying, viz :— Public prosperity is like a tree; agriculture is its roots, industry and commerce are its branches and leaves. If the root suffers, the leaves fall, the branches break, and the tree dies."

" Bread is the staff of life and wheat is the soul of bread," is an old well-known proverb. Increase or improve the world's output of wheat, and you will do more to lower the world-wide high cost of living than all the social and political experts who have ever set their hands to the task of uplifting the heavy world from under the burdens and woes that make it heavier.

From a purely human stand-point, wheat is the noblest of grains and yet from the stand point of nature it is rather among the degenerated plants.

Ages of cultivation have robbed it of its power of self-propagation and made it dependent for its very existence on such artificial provisions as a rich and carefully tended soil, proper fertilising, plenty of water,etc. Yet at one time wheat must have been a self-propagating and self-nourishing hardy grain. It must have fed man long before he learned to feed, breed and pamper it. At some time in the earth's dim past, wheat must have been growing wild. Botanists and Agronomists of the world have searched far

and wide for this primeval prototype of wheat. It was felt that the ancestor of this king of grains must have been of rugged and heavy growth, free from the pampered weaknesses that long association with and dependence on man have fastened on its progeny. It was also felt that by finding some stray survival of that hardy ancient stock, and cross-breeding it with the new species, a composite species could be evolved that would contain both the hardihood of the lost grain without its lavish incontinence and the useful refinements and rich food values of the present wheat.

It was further believed that a cereal of this sort could thrive on the vast, waste, arid areas of the earth where cultivated wheat could gain no foothold. Many thousands of stalks of wheat could grow where none grew before.

It has remained for Palestine, mother country of ancient religions, to furnish this long sought-for ancestor of modern wheat, and for a young Agronomist, Mr. Aaron Aaronsohn, head of the Jewish Agricultural Experiment Station of Haifa, at the foot of Mount Carmel, to make the discovery. Mr. Aaronsohn is now working for the Governments of the United States of America and Canada. His work in America is to introduce and foster cross-breeds of his wild

wheat varieties. He has written a very interesting book on this wild wheat, and has graphically described the plant and also the adventures he has had in connection with his long search for this ancestor of modern wheat. The discoverer as well as other famous natural scientists are now looking forward to the evolution of a new wheat species with which they hope to be able to transform into fields of waving grain, the dry and most barren stretches of the American deserts and other wide waste areas in Canada. "Wild wheat," says Mr. A aronsohn, "has also a wonderful rust-resistant power, and this power, being an inherent quality, can be transmitted to the hybrid cross-breeds we seek to evolve from it. By the selection and crossing of this wild cereal, which prefers *poor, shallow dry soil* and thrives without any cultivation, we should be able to produce new races which will be very persistent and very hardy. In this way we can extend the cultivation of wheat to regions where it is at present impossible, owing to the low quality of the soil, and the severity of the climate."

"I have had the pleasure of seeing many eminent scientists and practical men who share this opinion."

Mr. Aaronsohn further describes the gratifying results already achieved, but admits at the

same time that it will take a good many years to bring about the hibridization.

Three varieties of wild barley have also been discovered. This book on wild wheats, barley and other newly discovered desert plants by Mr. Aaronsohn has been issued by the United States Department of Agriculture.

Through the kind generosity of our old friend, Dr. Langmann of New York City, a small parcel of "wild wheat seed" (Triticum Dicoccum Dicoccoides) has recently been received by us. Our first experiments with this seed will be conducted this year (1913-1914). We shall through the medium of the Agricultural Journal, from time to time, together with other results obtained, furnish our farmers with information regarding this wild wheat, which is a true durum. We have already from time to time imported such seeds for our experiment stations as we thought would be of value to our farmers living in the dry-regions of this country. The testing of such different varieties under different climatic conditions is a matter which requires patience and time. But the whole-hearted co-operation of our farming community will enable us to conduct experiments simultaneously in different parts of South Africa. This will not only expedite mat-

ters but the truths of dry-farming will also be more rapidly revealed.

The problems bearing on the food supply of future generations have proved so enthralling to many of the leading nations that they have already taken away some of their best scientific men from University chairs to devote their time to the actual construction of new plant organisms. What may we not expect when men of this type (leaders in the world's scientific thought) are devoting themselves to the problems of the farmer?

South African Dry-Land Experiment Stations.—We have already, in chapter 3, explained that the object of our experiment stations is not to grow crops, etc., in bulk but to conduct experiments on a small scale, in order to try to find out which profitable crops or plants will grow best in the different dry-land areas of South Africa. These stations are therefore, in a sense, only small laboratories where things are being tested. It will be quite possible for us to make the existing experiment stations pay expenditure and more, but then we shall have to produce on a large scale, which means that we must not only compete with our farmers on the market but that we must also, to a great extent, neglect

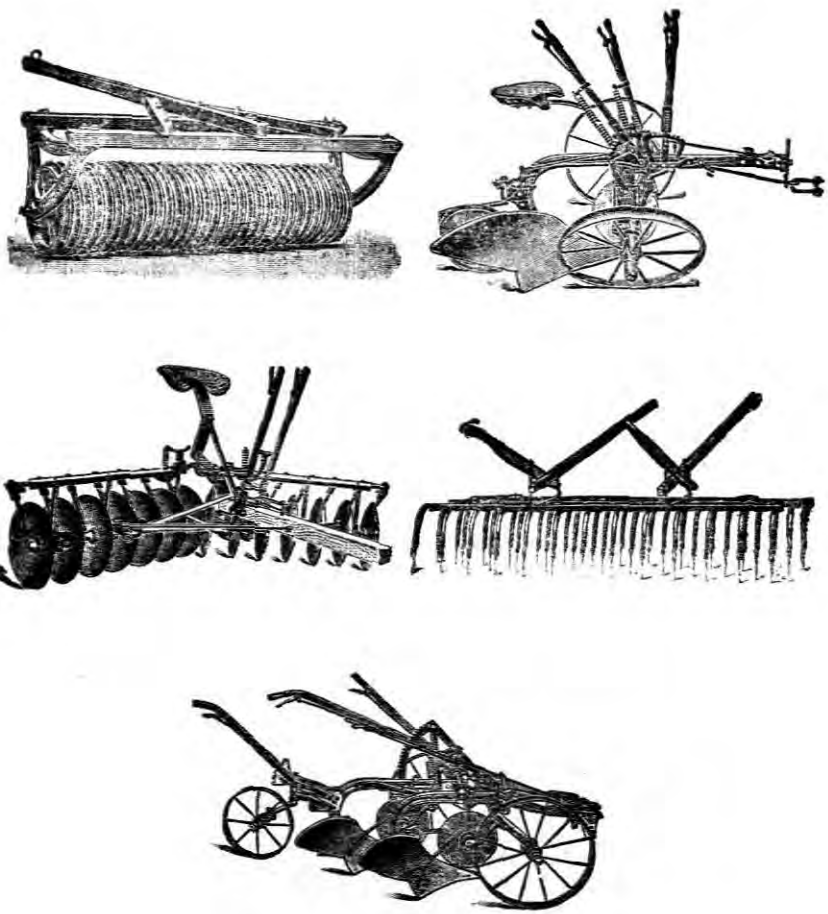
our experiment work in order to handle the crops.

The Lichtenburg station was started in 1909, on a barren, uneven, gravelly and ugly looking piece of veld. The soil is for the most part a sandy loam, extremely poor in natural fertility, varying in depth from 6 to some 40 inches, and with a sub-soil of iron stone gravel. In some places a layer of rock has been encountered quite near the surface. Moreover, the chemical analysis of the soil showed remarkable poverty, in both available and unavailable forms of plant food, and more especially in phosphoric acid, nitrogen and lime. "Why have they selected the worst piece of land for an experiment station? is the question that is continually being asked by farmers and others visiting the station. Our answer to this question always is "because we want to put our experiments through a severe test and farmers seeing what is possible on a poor soil, will more readily be induced to apply the system on their richer lands. The soil of our other present stations is also perhaps not the best to be found in the districts where these stations are situated, but is in every respect better than that of the Lichtenburg station. Besides a very poor soil, we have not had one normal season since the commencement of our experi-

Photo Abe Goldstein, Johannesburg.

The Dry-Farming Congress on tour at Bethlehem O.F.S. Province.

Dry-Land forest trees, Government Plantation, Lichtenburg.



Modern Agricultural Implements.
(Malcomess & Co.)

ment station at Lichtenburg. Prolonged droughts, hailstorms, vermin and untimely frosts have been unusually common. The following crop varieties have up to the present been experimented with :—

Wheat :" Triticum Durum " (hard varieties). —We have up to the present experimented with some 9 durum varieties, the seed of which has been obtained in South Africa or imported from North Africa, Italy, Russia, North and South America. We naturally can not collate results of the different imported varieties until these have been thorougly tested and acclimatised The proper acclimatisation in different South African localities of some varieties takes some time. The varieties which have so far done best are : " Apulia " (Italian), " Chernouska " (Russian), " Beloturka " (North African) and " Kubanka " (American). The minimum yield of these four varieties (not damaged by hail or frost) was four bags, and the maximum six and a half bags per English acre. The remaining 5 kinds, together with recently imported vrieties, must still undergo acclimatisation and a longer test, before it will be possible to make a definite statement with regard to their suitability. The same may be said of different soft wheat varieties and other crops.

Wheat; Soft Varieties. (Triticum Vulgare). Of these 15 varieties have been tried. Some of the seed was imported and some locally procured. The lowest yield of these varieties has been $1\frac{1}{2}$ bags and the highest $6\frac{1}{4}$ bags per English acre. "Wolkoren" and "Holstrooi" (South African), "Federation" (Australian) and "Kufoid" (American) have thus far been among the best yielders and drought-resistant in the soft variety line.

We naturally do not expect all our experiments to succeed, but some of the low yields may have been entirely due to a different climate and a poor soil. It is a well-known fact that certain seeds from humid habitats or different atmospheric conditions require some time (if at all) to acclimatise in localities of different natural influences. We also know that the drought-resistant qualifications of crops must be specially cultivated. It is therefore quite possible that the present low yielders will in the course of time not only become better drought-resisters but also good yielders. Moreover, we are confident of finding many more magnificent dry-land wheats among the numerous untried varieties.

Barley; (Hordeum) "Chevalier", "Boer" and "Austrian." Lowest yield $7\frac{1}{2}$ bags, highest yield 10 bags (of 153 lbs each) per Eng. acre.

Oats; (Avena Sativa) "Algerian" and "Sidonian." Average yield 1860 lbs to the acre (weight with straw).

Rye; (Secale cereale). Minimum yield 360 lbs. Maximum yield of seed per acre 800 lbs.

Millets; "Boer", Japanese and Golden Millets were tried. All three the varieties did well. The yield of "Boer Manna" (millet) was highest average 1½ ton (with straw) per acre.

The feeding value of "Golden" and "Japanese" millets may be higher than that of "Boer Manna." This is however entirely a matter of opinion. Pearl millet (Pennisetum spicatum) did exceptionally well on our Warm Baths dry-land station.

Pea Nuts; ,Arachis Hypogea) "Virgenian Mamoth". This was the only variety experimented with so far. Average yield per acre 32 bushels. The great value of the pea nut as a stock- and hog, food is universally recognized. It is also a splendid rotation crop.

Lucerne; (Medicago Sativa). On this station (Lichtenburg) we have so far only grown Provence, which gave three good cuttings per season for 3 consecutive years.

Mr. H. Mellé, the energetic young manager of the Vryburg dry-land station has established five different varieties of which "Arabian"

yielded 5 cuttings during the extraordinary dry year of 1912.

We have now imported seeds of several varieties, which will be, put in this year. Lucerne answers undoubtedly best under irrigation, but if a farmer has no water for irrigation purposes, he will be thankful for even 2 cuttings per season. Besides should the farmer later on require the land on which lucerne has grown for other crops he will find that such a soil has not been exhausted but has been enriched by the lucerne.

Sunflower. (Helianthus annuus). Russian variety, has been grown by us. The average yield of seed per acre was 500 lbs.

Flax or "Linseed"; (Linum usitatissimum). Average yield of seed per acre 728 lbs.

Potatoes; "Northern Star" has so far been our best yielder. Minimum yield 30 bags and maximum 90 bags per English acre. The low yield has been due to hail, frost and want of manure. The average yield of "Northern Star" for 3 consecutive years has been 60 bags per acre. The other varieties tried were "British Queen" and „Africanus" none of which have yielded so well as "Northern Star." Several other varieties will be experimented with from this year on.

Maize. Experiments have been conducted with some 10 varieties of which "Hickory King" and "Reid's Yellow Dent" have yielded most. The lowest yield has been 7 bags and the highest 12 bags to the English acre. The other varieties were for the most part "new" imported kinds and although some of these are useful as early varieties, their yield has not been satisfactory on our poor soil.

Many prominent varieties have not yet been tried by us because our agricultural schools as well as our progressive farmers have already tested most varieties so thoroughly that unless we can evolve a new cross-breed or import a new variety which will excel the tested varieties in yield and quality, it will serve no purpose to conduct experiments with what has already been tested. Of course we grow our dominant as well as different new varieties every year (a) to experiment, improve or refine and (b) for good pure seed and feeding for our animals. Our main object is to demonstrate and show the essentiality of conserving sufficient soil moisture in the course of the rainy season to save the maize crops in case of a drought.

Soya Beans; (Glycine hispida) Variety—"Sakura"—Average yield per acre 800 lbs.

Teff; (Eragrostis Abyssinica) Average yield

(with straw) one ton per acre. The value of teff, soya beans and linseed is so well-known that a discription of it will be superfluous.

Butter Peas; Average yield per acre 255 lbs. (seed).

The result of our experiments mentioned in the preceding pages were all actually obtained from a series of (surveyed) full English acre test plots and were not results calculated or estimated from portions of an acre.

The following experiments were conducted on half or less than half acre plots.

Sugar Beans;—Many varieties.—Did fairly well.

Sainfoin; (Ornobrychis sativa) grows well.

Cotton; "Cook Long Staple." Did fairly well, considering that the climate and soil at Lichtenburg Station are somewhat against this plant variety.

Coriander; Did well at Lichtenburg.

Beggarweed; (Desmodium enirmus). Did poorly at Lichtenburg but grew very well on some of the other dry-land stations. Experiments with this variety are being continued both at Lichtenburg and on the other dry-land stations.

Phalaris Bulbosa; (grass) growing fairly well on our dry-lands.

Clover; Several varieties tried at Lichtenburg with unsatisfactory results. Experiments now being conducted on the other stations.

Ginger; Answered fairly well at Lichtenburg Station.

Most of the results mentioned in the foregoing pages have been taken from the Lichtenburg station for the following reasons :—(a) Because the soil of this station is very poor and is therefore a safer guide to South African farmers in general than would be the case with an exceptionally fertile soil. (b) The climatic conditions here are characteristic of enormous areas of land not only in the Western Transvaal, but also in British Bechuanaland and even in the Orange Free State Province and (c) Most of the other stations have not been established long enough to make definite or conclusive statements with regard to certain crops or plant varieties.

Our readers must please not imagine that the soil of our Lichtenburg station is representing that of the whole of the Lichtenburg district, because the greater part of the soil in the Lichtenburg district and also that of some of the adjoining districts is simply excellent. But we all know that near enough every district in South

DRY-LAND EXPERIMENT STATION, LICHTENBURG.

Durum wheat, sown in July, 1912. Reaped end November 1912. Rainfall during growing period 0.41 of an inch, which fell in weak separate sprinklings with long stretches of dry hot weather in between.

Durums. (Government Dry-Land Experiment Station, Lichtenburg.)
I. "Polish Wheat". II. "Chernouska". Rainfall from sowing to reaping time 0.41 or 41/100th of an inch.

Africa has its good and fertile as well as its poor and unfertile areas.

The overwhelming majority of our "disciples" (dry-land farmers) in this and other districts have on account of a better soil obtained better yields every year than we have.

We have perhaps done our stations an injustice in having recorded results so soon, because we have practically only cleared the field for "action" and feel confident that better results will ultimately be obtained from among the many different crop-varieties now under going experimentation or from that large stock of various seeds obtainable throughout the arid and semi-arid regions of the world and still awaiting the South African dry-land test. However, we know that our farmers will understand (and perhaps appreciate) our object in giving them some of our results now.

The following legumes have been grown on 5, 10 or 15 acre plots every year as green manures viz :—

Velvet beans
Kaffir Beans.
Cow-peas
Lupines (white)
Lupines (yellow)
Vetches (Vicia Villosa)

Green manures. The ploughing-under of legumes does much good, but in our opinion these legumes are not sufficient to maintain or increase to a very high degree the fertillity or the amount of humus of very sandy soils, especially if such lands are frequently placed under crops. Legumes are undoubtedly excellent rotation crops.

The preparation of the seed-bed for dry-land crops has already been described in Chapter 4, but as this item is of such vital importance, the reader will kindly allow us to repeat the following lines :—

(1) Select deep and fertile soil.
(2) Plough well and deep.
(3) Prepare your land for winter crops as much as possible in the *beginning* of your rainy season.
(4) Destroy the fat clods or furrow-slices thoroughly before they get hard.
(5) Keep the "ground-blanket" in good order and never allow a soil-crust to take the place of the "soil-blanket."
(6) Never forget that weeds are soil-moisture and plant-food robbers.

Moisture-saving Fallows are absolutely essential in regions where the rainfall is so low, that

the down-pour of one season is not sufficient to grow and mature crops upon, and the precipitation of two seasons must be arrested and kept under the "soil-blanket" for one crop. In this case the one portion (say half of the farmer's land is under crop and the other half is ploughed and prepared, weeds are kept down, and the "ground-blanket" is kept in order. In this way a crop is raised one year on one half of the land and the next year on the other half.

Our rain fall at Lichtenburg, the average of which is about 20 inches, is more than enough to grow a crop every year on the same field. Of course we "rotate" the crops in order not to exhaust the soil altogether. The rain fall at Lichtenburg may seem high, but then it must be remembered that our soil is porous, poor and of a low water-holding capacity and that very little rain (if any) falls during the growing period of our winter crops.

Manures. We have had since the establishment of our stations to rely on thorough tillage and green manures. No farm manures or fertilizers were used on the stations, excepting a little kraal manure for our potatoes. Last year we commenced with manurial tests, but unfortunately most of the crops on these plots were damaged or destroyed by hail. These manurial

tests are being continued on a small scale and the increased yields will be made known to our farmers every year.

Method of Seeding :—Although many South African dry-land farmers have obtained good crop results by broad-casting and by ploughing the seed under, personally, however, we believe in drilling in the seed, because the planting-machine drills the seed right through the loose, dry earth mulch (ground-blanket) into the moist soil below. And, besides, it plants the seed equally apart, according to the will of the operator, giving a nice even growth later on. Ploughing the seed under means that the dry ground-blanket is turned under with the seed and the wet soil is brought up to the top causing soil moisture to escape. This, of course, is said more with a view to such areas where no rain falls during the growing period of crops.

Harrowing—in such seeds as wheat, oats, barley, rye, maize, etc., cannot be recommended at all and especially not in places of a low rainfall. Let us suppose that the farmer has ploughed his land 12 inches deep and that his dry soil-mulch is 3 or 4 inches thick. It will then be quite obvious that the tooth-harrow will leave a great deal of seed in this dry blanket.

The Depth to plant wheat, etc., for dry-land

purposes is a matter of conditions and also of opinion. We believe in planting the seed of wheat, etc., 4 to 5 inches deep. And if a farmer has no seed-drill, it will perhaps still be better

Mielieplanter. (North & Son.)

for him to *plough* the seed under some 5 inches deep and re-establish the ground-blanket as soon as possible after the plough. In this case the ploughed stratum has been 12 inches deep; in

seeding the plough has disturbed 5 inches of this stratum still leaving 7 inches intact. Many are the dry-land farmers who have successfully followed this procedure. Still it means that they have to plough twice and that the results cannot be the same as when a good hoe or shoe drill has been used. Why a shoe drill? because a shoe drill goes well and deep into the ground, whereas one or more of the discs of a disc-drill are liable to come up to the surface whenever pebbles or a hard lump of something is run over and in this way the seed is dropped on the surface. This is ofcourse a matter of opinion and, as far as we are concerned, one of experience. Good "up-to-date" seed-drills will plant wheat, barley, oats, rye, lucerne, beans, etc.

The depth to plough is also a matter subject to local conditions. However, we believe in ploughing from 8 to 12 inches or deeper according to the nature of the soil i.e. black clay, clay loam, sandy, uniform or ununiform, etc. Deep ploughing renders a larger moisture and humus bed and consequently a higher water-holding capacity of the soil, etc.

Some farmers are afraid that deep ploughing will bring up the unfertile or "dead soil." This may be quite true, but if this "dead soil" is so near the surface and therefore fully within the

root-zone of our crops then it will also do much harm as an immediate sub-soil and the question is whether it is not better to bring humus-creating matter deep under and bring this "dead soil" to the top, mix it with organic matter and put "life" into it. This proces may take some time but the physical condition of our soil will then be so much better.

Rate of Seeding for dry-farming is also a matter of soil, climatic conditions, kind of seed, etc. Approximate rates : —

Wheat; 35 to 40 lbs per acre.

Oats; 60 to 75 lbs per acre.

Oats; for seed, 30 to 70 lbs per acre.

Barley; 35 to 50 lbs per acre.

Rye; 30 to 35 lbs per acre.

Lucerne; 12 to 17 lbs per acre.

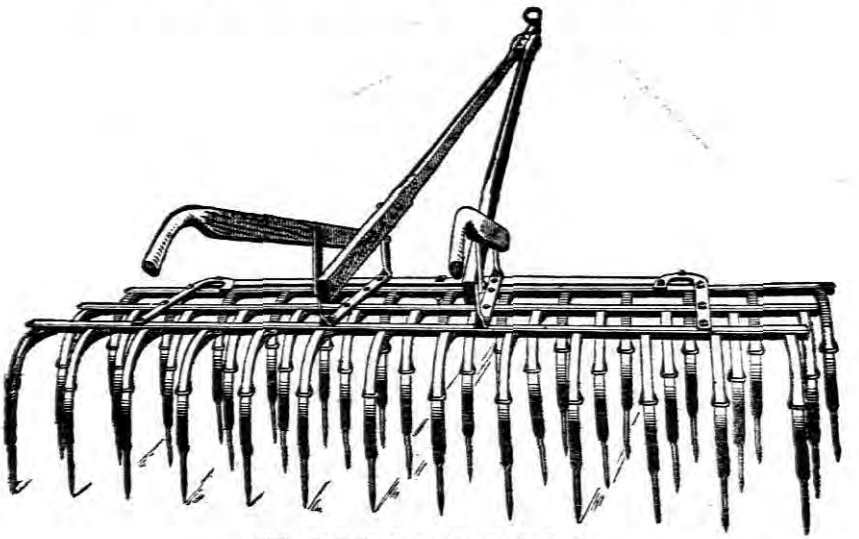
Maize; $8\frac{1}{2}$ to $10\frac{1}{2}$ lbs. per acre.

Soya Beans; 35 to 40 lbs per acre.

Time of planting. This is a matter entirely subject to climatic conditions and every farmer will know the best time for planting or sowing the different crops in his particular district.

Time of ploughing for maize. Farmers in this part of the country generally plant the bulk of their mielies from November up to 15th of December, after which date they consider that there is a risk of varieties like "Hickory King,"

etc., getting frosted in the autumn. Preparing the maize lands *for the following season, from the date when planting operations have terminated*, has proved that when next planting season comes round and brings no rain with it there is sufficient moisture conserved in the



THE WEEDER (North & Son).

soil to carry the crop at least into those months when rain is pretty certain to come. Such mielie lands are ploughed as already described. Only some of such fields being prepared late in the rainy season cannot "catch-up" the same percentage of moisture as lands prepared earlier and

Dry-Land Teff Grass. Dry-Land Experiment Station Lichtenburg.

LICHTENBURG STATION IN 1909.

Heinrich S. du Toit, Genl. J. C. Smuts,

naturally must later on get help from rain. We are confident that if maize farmers prepare for a drought every year, by preparing (ploughing and *harrowing*) their lands as *early as possible* they will soon find out the benefit of this procedure. We are pleased to state that many farmers have already successfully adopted this method. Some farmers plough their maize lands well and early enough but they *do not harrow*. This is a great mistake. Even two good harrowings between ploughing and planting time will do wonders. The lands from which maize crops were harvested may, in many cases, be ploughed in winter and be planted in summer again, provided the soil is fertile enough. In case of a normal year i.e. if the rains come in good time, the farmer may still plough an extra piece of land, so that he has (a) the land prepared during the rainy season, (b) the land ploughed in winter and (c) the land ploughed in October or November and may thus have three times as much land under mielies as his neighbour who has only started to plough when the first spring rains came. Then in case of a dry October or November, the farmer who has prepared for a drought has got his early prepared field to fall back upon.

THE HARROWING OF GROWING DRY-FARMING CROPS.

Now, while we realize that we cannot cover every known condition under which growing crops of wheat, oats, etc., may be or have been harrowed, we shall nevertheless endeavour to express our opinion, based on experience obtained both in this and other countries, in such a manner that the average thinking farmer may know under what conditions wheat or other small grain may be benefitted by harrowing.

Let us assume that our land has been prepared Dry-Farming system, which means that we have ploughed 9 to 12 inches deep, that we have a well pulverized, "mellow," friable soil and that we have established the ever essential *soil mulch* (ground-blanket) on the surface. Next let us suppose that we get rain on our seed-beds after we have planted our seed and before such seeds are properly "up." Then in case of a soil-crust having formed on the surface, we must destroy it and re-establish our "ground-blanket" for many reasons.

Such soil-crusts are either thin and fragile or thick and firm according to the nature of the soil and the amount of rain fallen thereon. A thin soil-crust can be destroyed by a light spike-

tooth or zig-zag harrow; for a thick "stubborn" crust a heavy or weighted harrow is required.

It is however hardly possible that such a heavy soil-crust can be formed on any soil when the seed and root-beds have been prepared properly. Should such a soil-crust make its appearance just after the crop is "up," then the farmer must use a weeder or a light zig-zag or steel tooth-harrow to destroy the crust. After the roots of the braird are somewhat established, a heavier tooth-harrow may be used according to the firmness of the crust. In doing this we may destroy some of the plants but we shall never miss these at harvest time if the condition of our seed and root-bed is what it ought to be. The best results are however always obtained from harrowing after the grain begins to stool or "sucker."

Some farmers believe that it is not necessary to harrow a growing crop after the foliage of the plants has practically covered and shaded the surface of the land, thereby to a certain extent breaking the direct flare of the sun's rays.

However, if it is found absolutely necessary to harrow a crop after stooling, we would certainly not use anything else but a weeder, because it is light and has long and pliable teeth, also

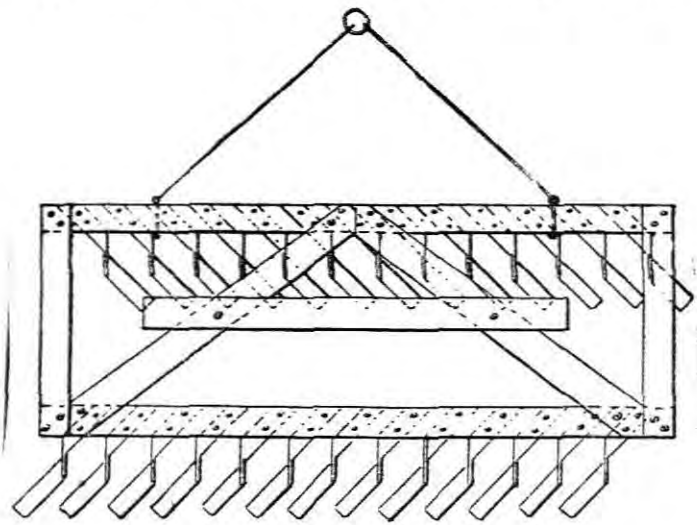
two handles at the back enabling the operator to lift it somewhat where the grain is high and no longer so flexible as the younger crops are.

The ordinary soil-crust (after rains) is generally formed by the rapid evaporation of the moisture at the surface thereby bringing about the rising to the surface of the moisture in the soil below. In its upward movement it brings the salt of the soil in soluble form, such as alkali, magnesia, etc., with it. As the vapour leaves the surface these chemicals are left in dry form among the particles of the surface or top soil forming a *crust*. When this condition is reached there are two agencies militating against the crops, viz. :—*loss of water* and *lack of air* (caused by this crust).

Some soils, when worked, become so fine that a sort of "fatty" soil powder blows and settles over the surface of the ploughed land, forming an air-tight-layer, which interferes with the growth and stooling of the grain. Such a "dust layer" must be stirred from time to time with a light harrow to admit the air to the roots of the growing crops.

When the surface soil is loose and mulchy it is not necessary to harrow a growing crop. Moreover, if we have not the soil and the moisture conditions which really are our foundation,

then we cannot expect favourable results from harrowing. Each farmer, therefore, should with great care, study the necessary physical conditions of his soil and keep in mind the vital importance of the proper percentage of both



WEED EXTERMINATOR.

(Horizontal plan, seen from above.)

air and *moisture* in his soil. And with these points well understood he will know exactly *when* and *how* to use the harrow.

The harrowing of growing crops of maize, clover, lucern, grasses, etc., is already well-

known and largely practised by our farmers and a description thereof will be superfluous.

Fruit and Forest Trees.—We have planted over 1,000 fruit trees on our dry-land stations, mostly different varieties of apples. These trees are doing exceptionally well; some of them have already borne fruit.

Forest Trees. (Eucalyptus, Cupressus, etc.) —Many thousands planted for wind breaks, etc., on our stations.

Among the varieties which have up to the present done very well on dry-lands at Lichtenburg are :—

Eucalyptus Sideroxylon.
Eucalyptus Milliodora.
Eucalyptus Rostrata.
Eucalyptus Microtheca.

The following have also been planted by us and are now doing well, viz :—

Cupressus Arizonica.
Callitris Robusta.
Acacia Cultriformis, etc., etc.

Agricultural Implements.—The implements used by modern dry-land farmers are the same as those used by progressive irrigation farmers of to-day, viz :—

A Sample of „Northern Star" seed Potatoes Grown on Dry-Land Station, Lichtenburg.

Soya Beans (Sakura) Dry-Land Station, Lichtenburg.

(1) *A good plough*, single or double furrow, steam or motor plough.

(2) *A good harrow*, zig-zag, spike or steel tooth, weeder or disc harrow. A farmer can scarcely have too many kinds of harrows.

(3) A good grain-drill.

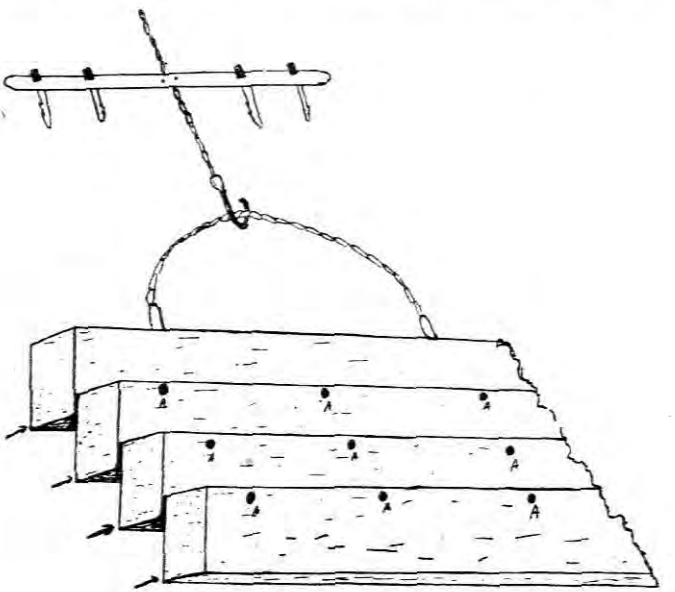
(4) The necessary cultivators for inter-tillage.

A planker is a very useful instrument not only for crushing stubborn clods, but also for levelling purposes. This implement when properly weighted with sand bags, stones, loose earth or sand, can also do the work of a land-roller. It levels and compacts the ploughed lands beautifully. The planker can naturally not be used on growing crops. Every farmer can make his own planker. Hard-wood deals of 6 by 12, 5 by 11 or 4 by 9 inches may be used. Four deals are generally used. The width of the implement is 6, 9 or 12 feet, according to the wish of the farmer. The deals are bolted together. (See figure.) The bolts are countersunk at (A) in order not to obstruct the spade or shovel when the loose earth is being scooped off.

Steel or iron strips are nailed or screwed along the edges of the deals touching the ground

(at the arrow) to prevent the deal-edges from wearing away. Old wagon or cart tyres straightened out are generally used.

Soft wood deals may also be used, but then the deals must be clamped across on top to pre-



THE PLANKER.

The front edges along which the steel strips or old cart or wagon tyres are fastened. A. Steel bolts (counter sunk).

vent the holes in the front deal from tearing out.

Cost of Production naturally varies in differ-

ent parts of the country according to the yield per acre, cost of labour, transport, deterioration, etc. At Lichtenburg the cost to produce one acre of wheat yielding 6 bags to the acre amounted to £2. This includes cost of ploughing, harrowing, disking, mulching, planting, reaping, stacking, cartage, thrashing, grain bags, weighing, twine, sewing up of bags, deterioration, etc. Cost to produce one bag of 200 lbs 6/8. When the yield is 5 bags per acre the cost to produce one bag is 7/8. Four bags to the acre, cost of production for one bag 9/2.

Maize.—The cost of production of maize yielding 8 bags to the acre have worked out at 3/10 per bag (200 lbs.).

Potatoes yielding 60 bags to the acre, cost for one bag of 153 lbs. 3/4.

Every practical farmer will readily admit that it is a difficult matter to arrive at a detailed cost of production, also that the cost varies even on one and the same farm from year to year, according to various circumstances. Some farmers use horses or mules, in which case stabling, forage, etc., have to be counted. Others, like us, use oxen which live entirely on the veld. It is therefore plain that no uniform cost per acre can be laid down throughout South Africa, and the above statement has merely been given as

one item of our experiments on the Lichtenburg station.

Labour.—We have as far as possible worked our experiment stations *with white labour.* This is our most expensive item. The object of employing white labour is to educate and interest a number of the unemployed whites (both English and Dutch) in the farming industry. A number of such people who have worked for us from time to time have found employment as foremen or managers on farms and are no longer "unemployed poor whites." The demand from progressive farm owners for such men, who have been trained in the proper cultivation of the soil, is great, and we cannot supply half of the demand because the number of labourers employed by us is limited. Of course we never recommend a man unless he has proved himself capable, hardworking, honest and sober. The class of poor white suffering from "chronic-laziness" never seeks employment at our stations, because our working hours are from dawn to dusk, and strict discipline is exercised .

Our Agricultural Colleges, and other Institutions pertaining to the problems of the farmer, have already done a great and useful work with regard to the agricultural education of our boys. We, on the other hand, are (in another

Portion of Nursery, Government Forest Station, Lichtenburg.

Dry-Land Fruit trees, Government Plantation, Lichtenburg.

sense of the word) like the "Salvation Army," trying to "pick up" those men and those areas of land looked upon by the world as useless.

The Crop Yields obtained by us up to the present on our Stations are certainly not very high nor do we claim them as records, but we are just at the beginning of things, and feel confident that dry-land farming has a great future in South Africa.

"What the dry-farmer fails to secure in *quantity* he makes up in *quality*. The quality of dry-farm seed cannot be *surpassed*, because the conditions make for good, clean seed production."—(Prof. E. A. Howes, University of Nevada).

In the *good* and *timely* preparation of the seed-bed lies the farmer's success, and in the first foot of the South African soil lie more riches than in all the gold or diamond mines of our country. Let us be as just to our soil as we are to ourselves.

Folks talk too much of themselves
As from Parliament joys debarred—
And not enough of the crops unborn,
By the work of the tiller scarred.

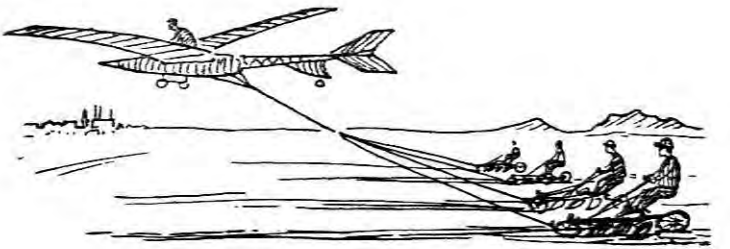
(A parody by the author, with apologies to Miss Ella Wheeler Wilcox).

In conclusion we beg to thank the many farm-

ers and others who have so whole-heartedly practised and encouraged South African dry-farming. We also beg to offer our sincere thanks to the South African Press, both English and Dutch, for their patience and for the capable manner in which they have supported the movement.

We now place this little book in the hands of our South African farmers with the hope that our short-comings will be over-looked and that this humble little work will be of some use to our brother agriculturists.

(THE END.)



THE FUTURE PLOUGH.

(The Author's prophecy).