

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS

PREPARING LAND
FOR
GRAIN CROPS ON THE PRAIRIES

COMPILED BY
J. H. GRISDALE, B.Agr.
Director, Dominion Experimental Farms

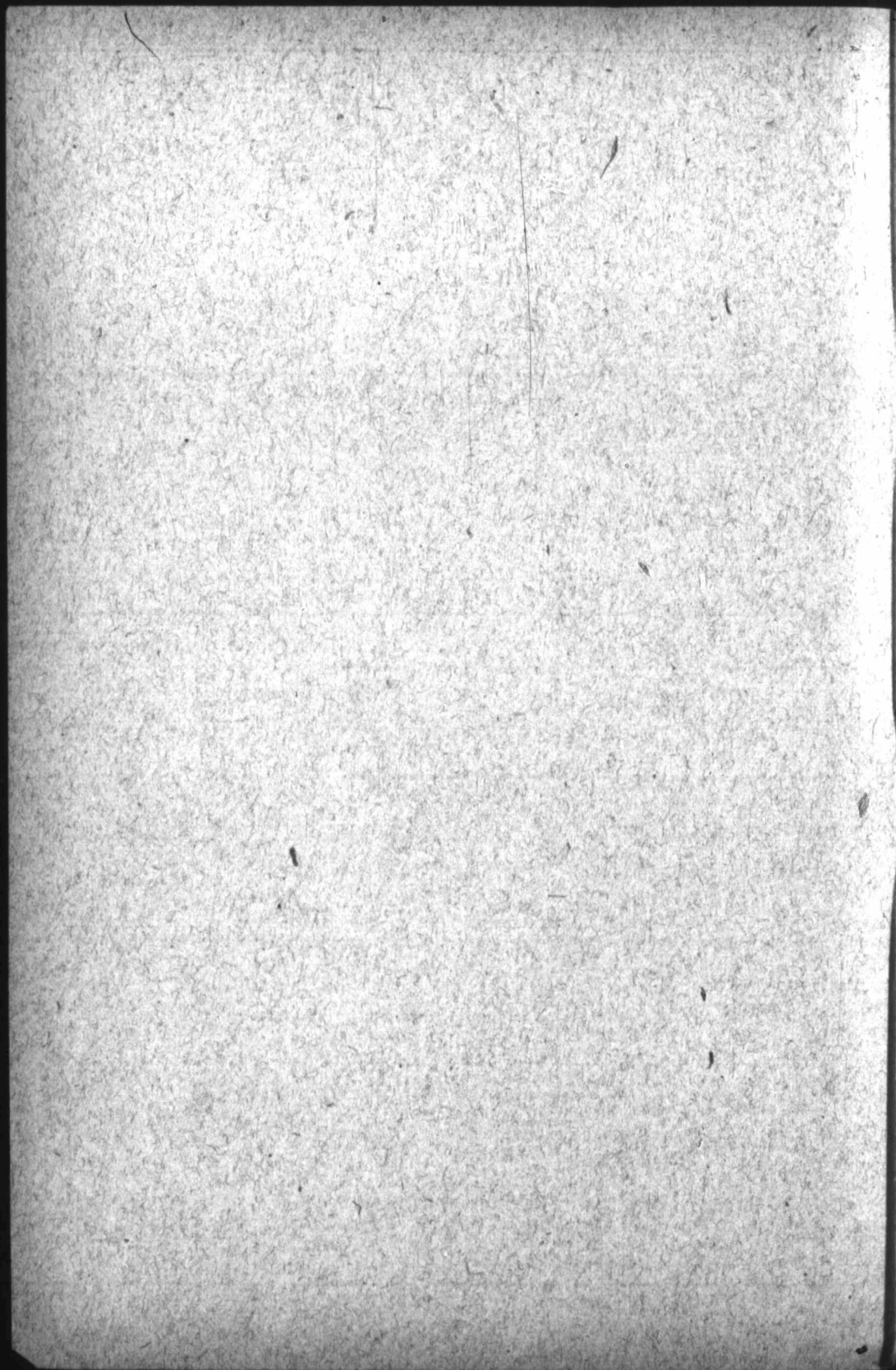
BULLETIN No. 15

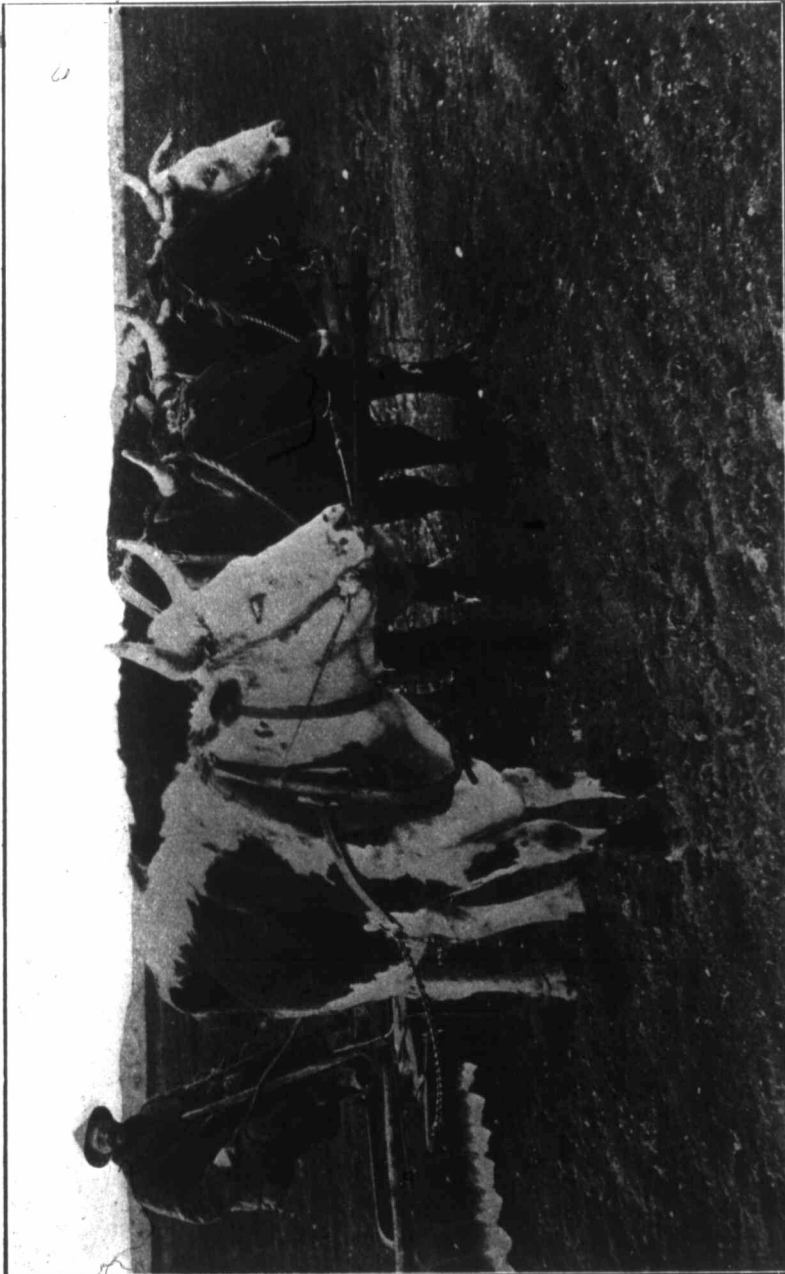
SECOND SERIES

Bulletins of the Second Series of the Bulletins of the Experimental Farms treat of such subjects as are of interest to a limited class of readers and are mailed only to those to whom the information is likely to be useful.

Published by direction of Hon. MARTIN BURRELL, Minister of Agriculture, Ottawa, Ont.

OTTAWA
GOVERNMENT PRINTING BUREAU
1913





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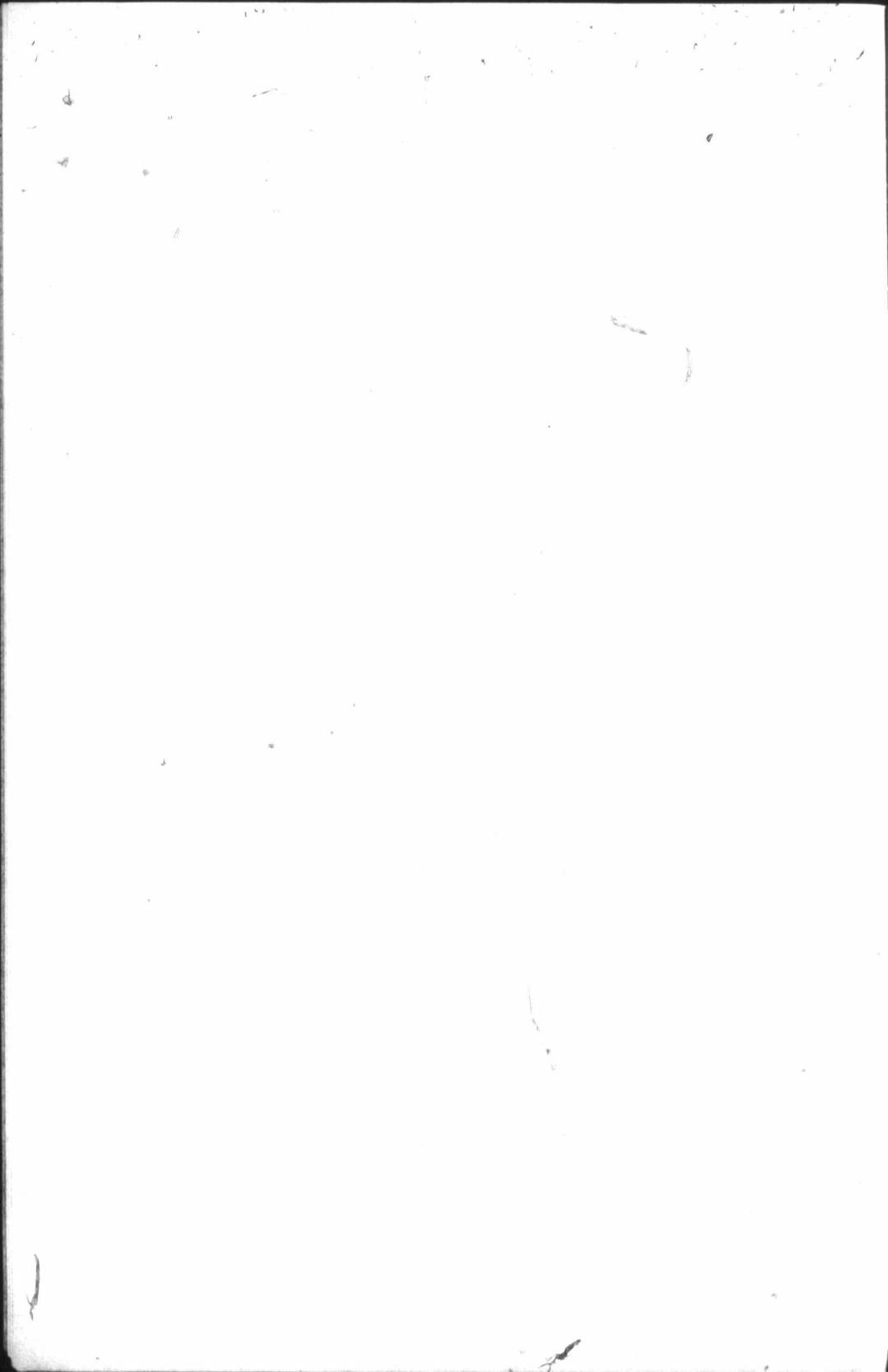
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The Honorable

The Minister of Agriculture,
Ottawa.

SIR,—I have the honour to submit herewith, for your approval, Bulletin No. 15 of the Second Series, compiled by myself.

The greater part of the material included in this publication has already appeared in pamphlet form or as part of an annual report of the Superintendent of the Experimental Farm at Indian Head, Sask. The notes prepared by the Superintendents at the other Experimental Farms or Stations on the prairies, as well as some of the material from Indian Head, now appear for the first time.

These instructions for prairie breaking, soil cultivation and crop production to a limited extent, should be of very great value to the new settler and homesteader. Further, all the instructions and suggestions submitted should be in the hands of, and followed by, many of our long-established western farmers.

I have the honour to be, sir,

Your obedient servant.

J. H. GRISDALE,

Director, Dominion Experimental Farms

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PREPARING LAND FOR GRAIN CROPS ON THE PRAIRIES.

SOUTHEASTERN SASKATCHEWAN.

Mr. Angus Mackay, for twenty-six years Superintendent of the Experimental Farm for Southeastern Saskatchewan at Indian Head, has said and written much on this subject of Prairie Breaking and Crop Production on the Prairies. After his many years spent on the prairies in a careful study of the various problems which confront the old as well as the new settler, he should be, and is, well fitted to outline the best cultural methods to follow to insure satisfactory crop returns.

The following information from his reports and pamphlets has been recently revised by him and may be said, therefore, to summarize the experience and work of a close observer and experimentalist, who has spent his whole life on the prairies.

For many years, commencing in 1888, the methods of conserving moisture by 'Breaking and Backsetting' and by 'Summer-fallowing,' now called 'Dry-farming' for a change, have been recommended and universally adopted by the older settlers, but to very many of the new settlers they are unknown. The latter, it is hoped, may be benefitted by the following explanation of the methods, which, for a great many years, have proven uniformly successful at the Experimental Farm at Indian Head, and may with confidence be recommended for almost every district in the province of Saskatchewan.

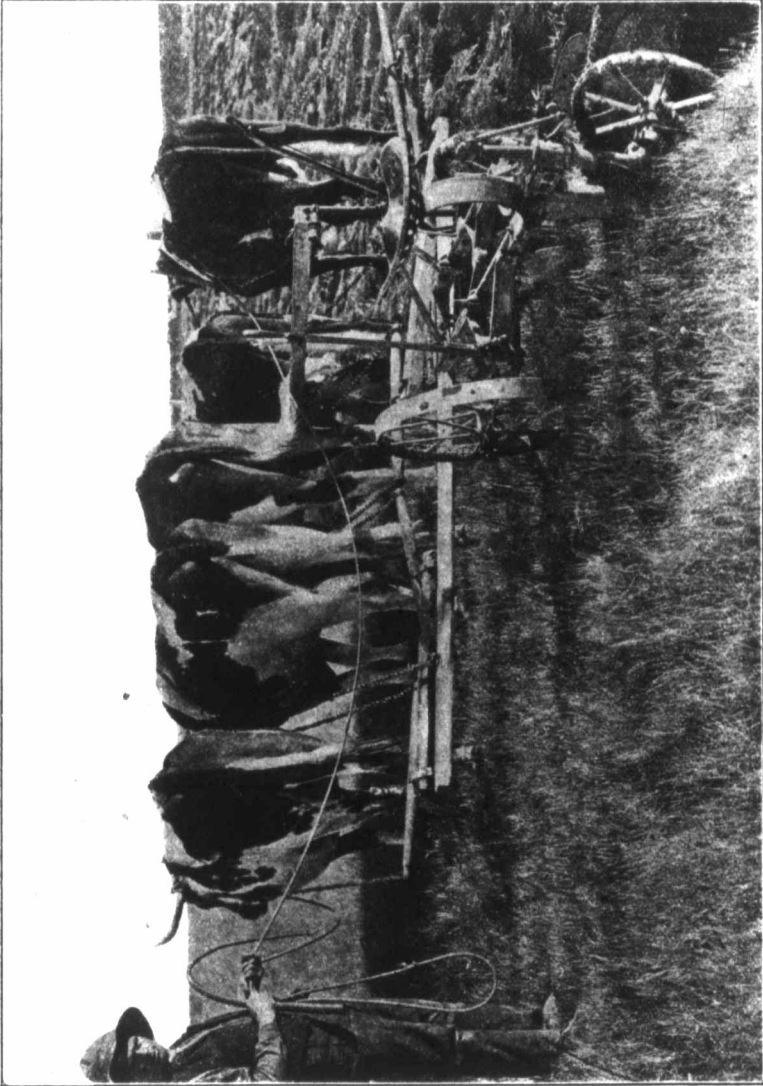
BREAKING PRAIRIE SOD.

The success or failure of a new settler often depends on the method employed in the preparation of the land for his first crop, and it is therefore of the utmost importance that the question of 'Breaking' or 'Breaking and Backsetting' be given the consideration it deserves.

For some years past the general practice throughout the country has been to continue breaking three, or more inches deep so long as the teams can turn over the sod, then in the fall to disc the top-soil and grow grain in the spring following. From the breaking so done before the end of June, a good crop of wheat, oats or barley is usually obtained but no amount of cultivation will ensure even a fair crop on this land in the next succeeding year. After the first crop has been cut, the soil is usually in a perfectly dry state and remains so, in spite of any known method of cultivation, until the rains come in the spring following. If they are insufficient or late, as is frequently the case, failure of the crop must be the result.

BREAKING AND BACKSETTING.

Breaking and backsetting is the true way of laying the foundation for future success in the greater number of districts throughout the province, and while this method does not permit of as large an acreage being brought under cultivation in the year, it does permit of more thorough work and ensures better results in the long run. The anxiety of nearly all settlers to sow every acre possible, regardless of how or when the work on the land has been accomplished, may be given as the reason for breaking and discing, to a large extent, superseding the older, better and safer plan.



A five-ox, two-furrow outfit, breaking prairie.

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Breaking and backsetting means the ploughing of the prairie sod as shallow as possible before the June or early July rains are over, and in August or September, when the sod will have become thoroughly rotted by the rains and hot sun, ploughing two or three inches deeper in the same direction and then harrowing to make a fine and firm seedbed. From land prepared in this way two good crops of wheat may be expected. The first crop will be heavy and the stubble, if cut high at harvest time, will retain sufficient snow to produce the moisture required, even in the driest spring, to germinate the seed for the next crop. The stubble-land can readily be burned on a day in the spring with a warm, steady wind and the seed may be sown with or without further cultivation. In a case where the grass roots have not been entirely killed by the backsetting, a shallow cultivation before seeding will be found advantageous but as a rule the harrowing of the land with a drag-harrow after seeding will be sufficient.

The principal objection to 'breaking and backsetting' is urged with regard to the backsetting which, no doubt, is heavy work for the teams, but if the discing required to reduce deep-breaking and then the ploughing or other cultivation that must be done in an effort to obtain a second crop, be taken into consideration it must be conceded that in the end 'breaking and backsetting' is the cheaper and better method.

When two crops have been taken from new land it should be summer-fallowed.

SUMMER-FALLOWS AND SUMMER-FALLOWING.

Among the many advantages to the credit of the practice of summer-fallowing may be mentioned:—The conservation of moisture, the eradication of weeds, the preparation of the land for grain-crops at a time when no other work is pressing, the availability of summer-fallowed land for seeding at the earliest possible date in the spring and the minor advantages of having suitable land for the growing of pure seed, potatoes, roots and vegetables at the least cost and with the greatest chance for success, and that of being able to secure two crops of grain with little or no further cultivation.

Summer-fallowing undoubtedly has some disadvantages, but so long as the growing of grain, and more particularly wheat, remains the principal industry of the province, it will be necessary to store up moisture against a possible dry season, to restrain the weeds from over-running the land, and on account of the short seasons, to prepare at least a portion of the land to be cropped in the year previous to seeding and a well-made summer-fallow is the best means to this end. Among the disadvantages are:—The liability of the soil to drift, the over-production of straw in a wet season, causing late maturity and consequent danger of damage by frost, and it is claimed, the partial exhaustion of the soil. The two former may, to a great extent, be overcome by different methods of cultivation, and if the soil can be prevented from drifting, I am satisfied that one of the reasons for the latter contention will disappear.

Various methods are practised in the preparation of fallow and where the aim has been to take advantage of the June and July rains and to prevent the growth of weeds, success is almost assured. Where the object has been to spend as little time as possible on the work, failure is equally certain.

In my annual report for the year 1889, the following was submitted for the consideration of the settlers. Since then many experiments have been conducted on the Experimental Farm with different systems and again I submit what, on the whole, have been found to be the most successful methods for the cultivation of the soil in Saskatchewan:—

FROM REPORT OF 1889.

December 29.

'The year just passed has been one of extremes. Last winter was one of the mildest on record and March was so very fine that thousands of acres of grain were seeded from the 15th to the 31st, and at no time in the history of the country has the ground been in better condition for the reception of the seed. Immediately after seeding, however, exceptionally high winds set in, followed by extreme drought during the entire growing season. In many places the crops were injured by the winds and finally almost ruined by the succeeding dry weather. In some localities, however, where the farming has been done in accordance with the requirements of the country, the crops did fairly, and considering the excessively dry weather, remarkably well.

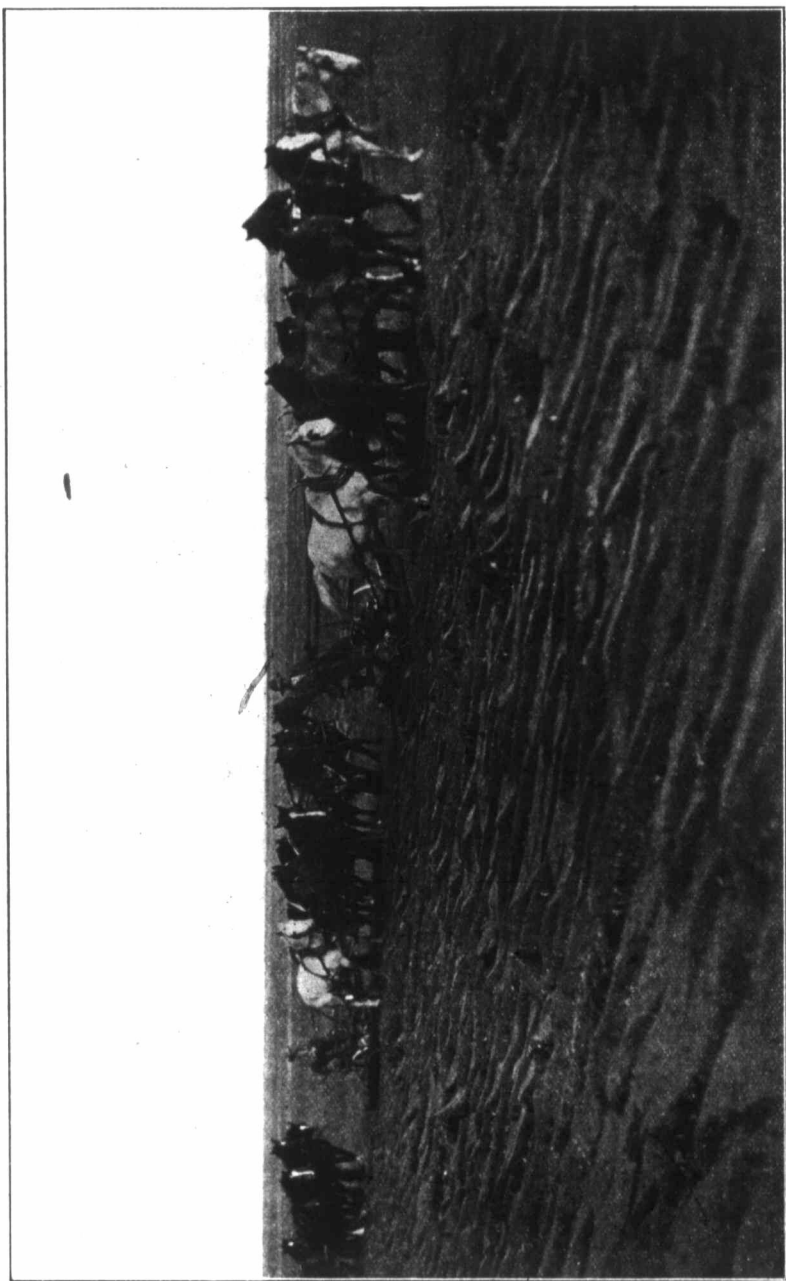
'The Experimental Farm suffered in company with every other farm in the country. Perhaps very few suffered as much from winds, but the dry weather, though reducing the yields, did not prove so disastrous as to many others. In this portion of the Territories at least, every settler knows the importance of properly preparing his land. For several years after the country became open for settlement every one imagined that grain would grow, no matter how put in, but now the man is devoid of reason who thinks he is sure of a crop without any exertion on his part. It is true that since 1882 we have had one year in which the land required little or no preparation for the production of an abundant crop but only too many realize the loss of the remaining years from poor cultivation.

'Our seasons point to only one method of cultivation by which we may in all years expect to reap something.

'It is quite within the bounds of possibilities that some other and perhaps more successful method may be found, but at present I submit that 'fallowing' the land is the best preparation to ensure a crop. Fallowing land in this country is not required for the purpose of renovating it, as is the case with the worn-out lands in the East; and it is a question as yet unsettled how much or how little the fallows should be worked, but as we have only one wet season during the year, it has been proved beyond doubt that the land must be ploughed the first time before this wet season is over, if we expect to reap a crop in the following year. The wet season comes during June and July, at a time when every farmer has little or nothing else to do, and it is then that this work should be done. Usually seeding is over by the 1st of May and to secure the best results the land for fallow should be ploughed from 5 to 7 inches deep as soon after this date as possible. Land ploughed after July is of no use whatever unless the rains in August are much in excess of the average. A good harrowing should succeed the ploughing and all weeds or volunteer grain be kept down by successive cultivations. A good deal of uncertainty is felt with regard to a second ploughing, some holding that it is useless; others maintaining that it is an injury; while others again have found it to give from five to ten bushels per acre more than one ploughing. So far the experiments on the Indian Head Experimental Farm have shown that by far the best returns have been received from two ploughings; and more noticeably was this case when the first ploughing had been completed in May or June. Without doubt, two ploughings cause a greater growth of straw and consequently in a wet year the grain is several days later in maturing, causing greater danger from frost; but taking the seasons so far passed, 1884 excepted, two ploughings with as much surface cultivation as possible in between, may be safely recommended.

'Above all it is of the greatest importance that the first ploughing be as deep as possible, and that it be done in time to receive the June and July rains.'

After seventeen years' further experience and observation, the following was written on this subject in the Annual Report of the Experimental Farms for 1906.



Eight-horse and six-horse Outfits, breaking Prairie.

FROM REPORT OF 1906.

METHODS OF PREPARING SOIL FOR GRAIN CROPS.

METHODS OF PREPARING NEW GROUND.

'In view of the fact that every year brings to the Northwest many new settlers who are unacquainted with the methods of breaking up and preparing new land for crop, a few suggestions with regard to this important work may not be amiss.

'In all sections where the sod is thick and tough, breaking and backsetting should be done; while in the districts where bluffs abound and the sod is thin, deep breaking is all that is necessary.

'The former is generally applicable to the southern and western portions, and the latter to the northeastern part of Saskatchewan, where the land is more or less covered with bluffs.

BREAKING AND BACKSETTING.

'The sod should be turned over as thin as possible, and for this purpose a walking plough with a 12 or 14-inch share, is the best. When the breaking is completed (which should not be later than the second week in July), rolling will hasten the rotting process and permit backsetting to commence early in August.

'Backsetting is merely turning the sod back to its original place, and at the same time bringing up two or three inches of fresh soil to cover it. The ploughing should be done in the same direction as the breaking and the same width of furrow turned. Two inches below the breaking is considered deep enough.

'After backsetting, the soil cannot be made too fine, and the use of the disc harrow to cut up the unrotted sod, will complete the work.'

DEEP BREAKING.

'Deep breaking, which in some sections of the country is the only practicable way of preparing new land, and which is, unfortunately, done in many instances where breaking and backsetting would give much more satisfactory results, consists in the turning over of the sod as deeply as possible, usually from four to five inches. When the sod has rotted, the top soil should be worked and made as fine as possible. The use of harrow or disc will fill up all irregularities on the surface, and make a fine, even seed-bed.

'Whether the land is broken shallow or deep, it is necessary to have the work completed early, so as to take advantage of the rains which usually come in June and early July. These rains cause the sod to rot, and without them, or if the ploughing is done after they are over, the sod remains in the same condition as when turned, and no amount of work will make up for the loss.'

SUMMER FALLOWS.

'The true worth of properly prepared fallows has been clearly demonstrated in past years in every district of Saskatchewan.

'The work of preparing land for crop by fallowing is carried on in so many ways in different parts of the country, that perhaps a few words on some of the methods employed may be of use.

'It has been observed in some parts of Saskatchewan that the land to be fallowed is not, as a rule, touched until the weeds are full grown and in many cases, bearing fully matured seed. It is then ploughed.

'By this method, which, no doubt, saves work at the time, the very object of a summer-fallow is defeated. In the first place, moisture is not conserved because the

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land has been pumped dry by the heavy growth of weeds; and, secondly, instead of using the summer-fallow as a means of eradicating weeds, a foundation is laid for years of labour and expense by the myriads of foul seeds turned under.

The endless fields of yellow-flowered weeds, generally Ball Mustard (*Neslia paniculata*), testify to the indifferent work done in many districts, and, while no weed is more easily eradicated by a good system of fallows, there is no weed that is more easily propagated or takes greater advantage of poor work on fallows or in fall or spring cultivation.

As has been pointed out in my previous reports, early and thorough work on fallows is absolutely necessary to success, and I here repeat the methods and results of tests carried on for some years past.

First Method.—Ploughed deep (6 to 8 inches) before last of June; surface cultivated during the growing season, and just before or immediately after harvest ploughed 5 or 6 inches deep.

Result.—Too much late growth if season was at all wet; grain late in ripening, and a large crop of weeds if the grain was in any way injured by winds or spring frosts.

Second Method.—Ploughed shallow (3 inches deep) before the last of June; surface cultivated during the growing season, and ploughed shallow (3 to 4 inches deep) in the autumn.

Result.—Poor crop in a dry year; medium or good crop in a wet year. Not sufficiently deep to enable soil to retain the moisture.

Third Method.—Ploughed shallow (3 inches) before the last of June; surface cultivated during the growing season, and ploughed deep (7 to 8 inches) in the autumn.

Result.—Soil too loose and does not retain moisture. Crop light and weedy in a dry year. Packing after ploughing greatly improves the crop.

Fourth Method.—Ploughed deep (7 to 8 inches) before the last of June; surface cultivated during the growing season.

Result.—Sufficient moisture conserved for a dry year, and not too much for a wet one. Few or no weeds, as all the seeds near the surface have germinated and been killed. Surface soil apt to blow more readily than when either of the other methods is followed. For the past fourteen years, the best, safest and cleanest grain has been grown on fallow worked in this way, and the method is therefore recommended.

Fallows that have been ploughed for the first time after the first of July, and especially after July 15, have never given good results; and the plan too frequently followed of waiting till weeds are full grown, and often ripe, and ploughing-under with the idea of enriching the soil, is a method that cannot be too earnestly advised against.

In the first place, after the rains are over in June or early in July, as they usually are, no amount of work, whether deep or shallow ploughing, or surface cultivation, can put moisture in the soil. The rain must fall on the first ploughing and be conserved by surface cultivation.

Weeds, when allowed to attain their full growth, take from the soil all the moisture put there by the June rains, and ploughing-under weeds with their seeds ripe or nearly so, is adding a thousand-fold to the myriads already in the soil, and does not materially enrich the land.

During the past few years the term 'dry farming' has been applied to what was formerly known in the West as 'summer-fallowing.'



New Breaking.



Harrowing new Breaking.

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With the exception of the addition of the use of a soil-packer, there is no change in the methods formerly employed, when the spring rains and frequent cultivation were depended upon for the packing of the soil.

Packers are without doubt, most useful implements on the farm and where from any cause, the soil is loose, they should be used. They are, however, expensive implements and within the means of comparatively few of the new settlers. Fortunately, early ploughing and frequent shallow cultivation may be depended upon to produce equally satisfactory results.

CULTIVATION OF STUBBLE.

When farmers summer-fallow one-third of their cultivated land each year, as they should, one-half of each year's crop will be on stubble. For wheat, the best preparation of this land is to burn the stubble on the first warm, windy day in the spring, and either cultivate shallow before seeding or give one or two strokes of the harrow after seeding, the object being to form a mulch to conserve whatever moisture may be in the soil, until the commencement of the June rains.

The portion intended for oats or barley, should be ploughed four or five inches deep and harrowed immediately; then seeded and harrowed as fine as possible. Packing after seeding is advisable. In case time will not permit of ploughing, good returns may be expected from sowing the seed oats or barley on the burnt ground, and discing it in; then harrowing well.

FALL PLOUGHING.

With regard to fall ploughing it may be said that, as a rule, on account of short seasons and dry soil, very little work can possibly be done in the fall, but if the stubble-land is in a condition to plough and the stubble is not too long, that portion intended for oats and barley may be ploughed, if time permits. If possible burn stubble before ploughing.

It is, however, a mistake to turn over soil in a lumpy or dry condition, as nine times out of ten it will remain in the same state until May or June, with insufficient moisture properly to germinate the seed, and the crop will very likely be overtaken by frost.

As to the quantity of seed to sow and the depth of sowing, long experience has shown that the best results are had in Saskatchewan by the sowing of one and a half bushels of wheat per acre or two bushels of barley or oats. Sowing about two inches deep has given the most satisfactory returns, and the seed should be got in as early as is practicable, wheat as soon after 1st April as frost is out of the soil 2 inches deep. Oats and barley from 25th April to 10th May.

On heavy soil summer-fallowed previous year, 1½ bushels wheat and 2½ bushels oats and barley per acre will ripen a few days earlier than the above quantities.

FLAX PRODUCTION.

Of late years a great deal of flax has been grown in many districts in the province, and as this is the only sure crop for new settlers to obtain returns from their land the first year, a few pointers may be of advantage to many.

New Breaking.—Prairie sod broken and sown up to May 25th will give good returns. The sod is best broken 3 inches deep and disced enough to afford good covering for seed. Sow 30 to 40 pounds seed per acre, the former quantity on light soil, and the latter on heavy. If the sod has been turned over roughly, roll or pack before discing, if not rough, roll or pack after seeding.

Sow seed from 15th to 25th of May. It can be sown before and after these dates, but late spring or early fall frosts may seriously injure the crop.

One-year-old Breaking.—Flax can also be grown on land broken any time the previous year, but breaking done before the last of June gives much the best returns. Discing such land in the previous fall is advisable.

Summer-fallow.—In addition to growing flax on breaking, it does well on summer-fallowed land and fairly well on stubble land. Where fallows are sown, the land is better packed twice after seeding, and, where the soil drifts, ploughing 4 or 5 inches deep, and packing after seed is sown, is necessary to stop drifting, and to retain moisture.

Stubble land.—If preceding crop was on fallowed land, the stubble should be burned, the land then cultivated shallow, and seed sown. If the stubble was from 2nd or 3rd crop, ploughing 4 to 5 inches deep is advisable. Harrow and pack as soon after ploughing as possible, but do not sow before May 15th.

Harvesting.—Flax should be quite ripe before cutting and is not injured by remaining uncut after it has ripened.

Cutting.—For large areas, remove the knottèr on grain binder and allow the flax to fall in loose bundles on the ground.

In wet seasons it is safer to remove the knottèr entirely and permit flax to string out on the ground, this saves turning if the loose bundles get wet.

For small quantities, bind and stook the same as ordinary grain.

NORTHWESTERN SASKATCHEWAN.

The following note on the practice in vogue in northwestern Saskatchewan has been submitted by the Superintendent of the Experimental Station at Scott, Sask., Mr. R. E. Everest.

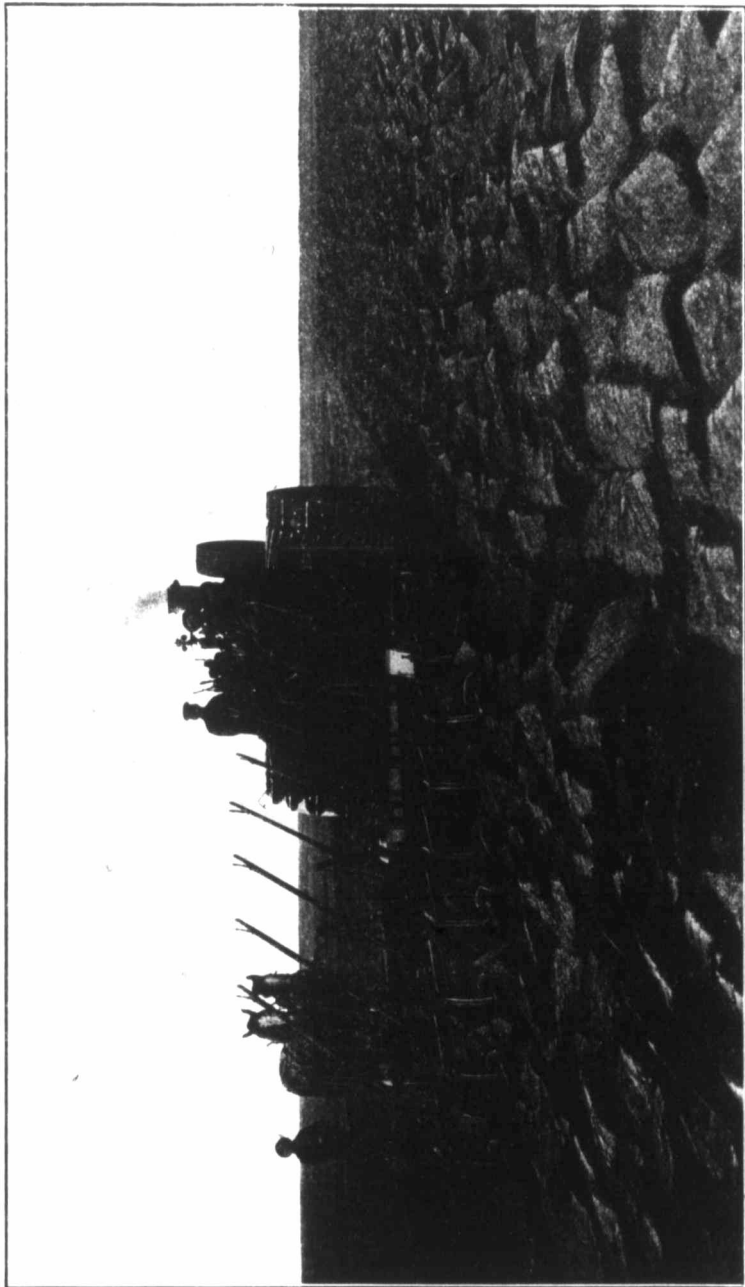
As will be noted, the excuse given by Mr. Everest for the practice of deep breaking commonly followed in his district, is scarcity of labour. No claim of superiority for deep breaking over breaking and backsetting is made.

In this part of Saskatchewan deep breaking is the method usually followed in the preparation of prairie land for grain crops. This method is best suited to our conditions, namely: A scarcity of labour and a short season for the work.

Method.—Turn the sod over thoroughly before the last of June to a depth of four or five inches, follow closely with the packer, then disc. The packer puts the furrow in place and the disc cuts the comb from the furrow which fills up the inter-spaces and forms a light mulch for the absorption and retention of moisture. Subsequent work with disc, scrubber, and drag harrow will put the area in condition for seeding the following spring.

SOUTHERN ALBERTA.

Mr. W. H. Fairfield, Superintendent of the Experimental Station at Lethbridge, Alta., finds that the methods advocated for Saskatchewan by Mr. Mackay are entirely applicable to Southern Alberta. He emphasizes the value of harrowing immediately after ploughing.



Breaking with Tractor.

'What Mr. Mackay says is applicable in every detail to Southern Alberta. If every homesteader settling here could have the importance of the advice given so impressed on him that he would follow it implicitly, the annual production of grain in this part of the province would be increased by many thousands of bushels. I cannot see that there are any conditions peculiar to this part of the Province of Alberta that demand treatment other than such as Mr. Mackay has outlined for Saskatchewan, with the possible exception of the following details:—

Prairie sod in Southern Alberta should be broken shallow and backset later on in the same season as recommended, but, if for any reason the land is to be broken deep, care must be exercised to see that the furrow slice or sod is not so thick as to prevent it being turned completely over and lying flat. For, if it is allowed to lap on the previous furrow, an air space will be left under part of each furrow slice, with the result that it will dry out rapidly and the process of rotting will be stopped. It is a help to roll or flatten down all breaking as fast as it is done.

In the district of the Chinook winds special emphasis should be laid on the importance of harrowing land as fast as it is ploughed, in fact, of the advisability of attaching a section of the harrow to the plough. Special attention should also be called to the mistake so often made of ploughing in the fall when the soil is in a lumpy, dry condition. In regard to the depth of seeding, it is well for a farmer to force the seed down till it is in contact with the moisture, even if it is over two inches below the surface.'

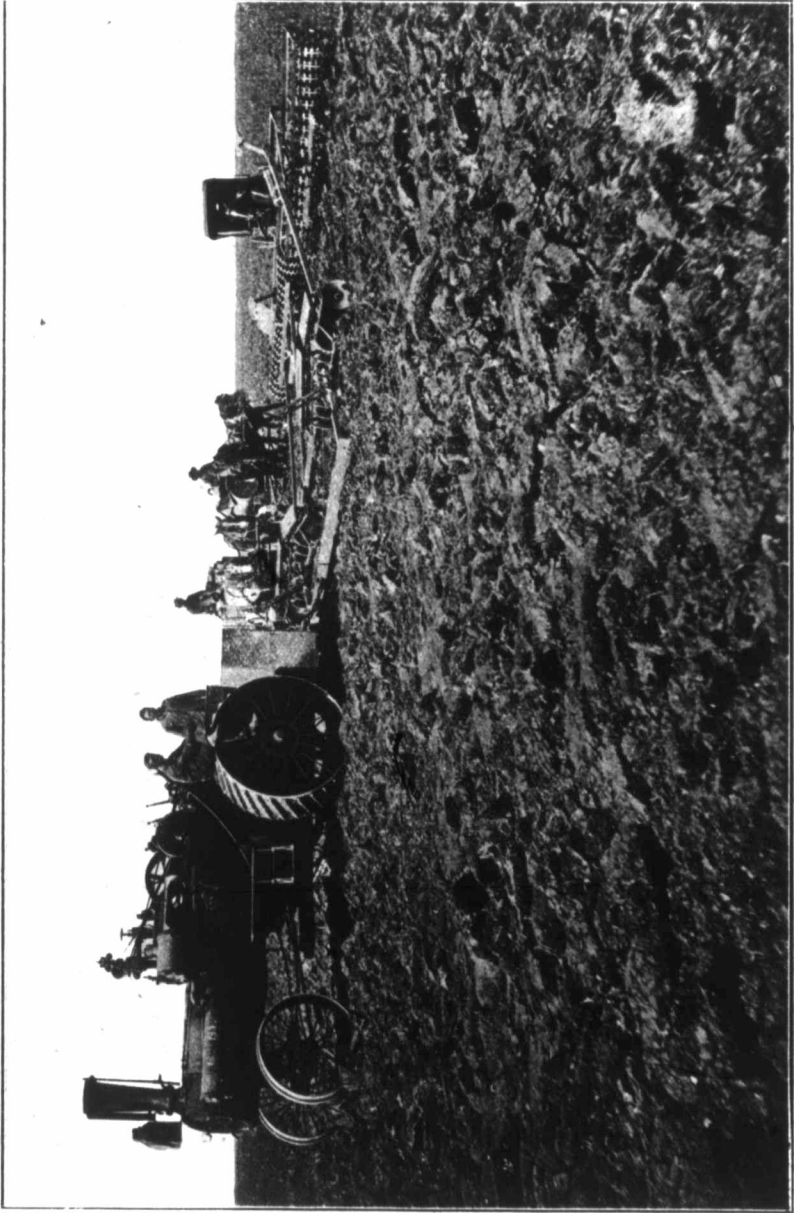
NORTHERN ALBERTA.

Mr. G. H. Hutton, Superintendent of the Experimental Station at Lacombe, Alta., gives some valuable points as to the breaking and later treatment of brush land.

'Generally speaking, the Experimental Station at Lacombe covers conditions in all territory north of Township 24 west of the 5th Meridian, and all territory north of Township 30. In those districts in Central Alberta which are strictly prairie country, the general recommendations outlined elsewhere in this bulletin will apply. In those districts which are not strictly prairie, but which are commonly designated as brush country, *i.e.* country in which there is a fair proportion of prairie and also patches of willow brush or timber, slightly different recommendations may be made.

'Brush Country Methods.—In brush country, deep breaking is the only practical method. By breaking to a depth of five or six inches, the breaking plough gets under the roots and it is not so easily thrown from the ground. When plenty of power is used, as a five or six-horse team, or a heavy four-ox team, a furrow eighteen to twenty inches wide and five or six inches deep may be turned. Such an outfit, where the coulter is kept in condition, will pass through remarkably heavy brush, cutting the roots clean and turning the furrow over flat. The ploughs most favoured by the writer for breaking brush land are the 'Van Slyke' and the 'John Deere Wisconsin Grubber.' With good power, one man can break and prepare for crop one hundred acres of heavy brush land in one season. After being broken, the land should be packed or, if a packer is not available, it should be given a discing. The packing or discing firms the freshly-turned furrow and hastens the rotting of the sod. A second crop without backsetting is advised where land has been heavily covered with brush and the job of breaking has been well done. Thorough discing will prepare such land for a second crop.

'Summer-fallow is not advised for the brush country, the objection being that the first crop after summer-fallow grows too rank, almost invariably lodging and fails to fill as well or ripen as early as a crop on land not summer-fallowed. Stubble



Discing, Harrowing and Packing, new Breaking.

land not seeded down should be fall-ploughed five or six inches deep and packed or harrowed as it is turned. If fall ploughing is not possible, then the same depth of ploughing in the spring followed immediately by the packer or harrow will give good results.

Mixed Farming.—In all that territory included in the general term 'brush country,' climatic and soil conditions are such as to make it most desirable as a mixed farming country. For this district some such rotation as the following, modified or expanded to suit particular cases, is suggested:—

- 1st yr.—Hay.
- 2nd yr.—Pasture.—Manure in autumn 12 tons per acre.
- 3rd yr.—Pasture.—Break and disc July or August.
- 4th yr.—Wheat or oats.
- 5th yr.—Oats.
- 6th yr.—Barley—seeded down:—
 - Timothy, 4 lbs.
 - Alsike clover, 4 lbs.
 - Red clover, 4 lbs.'

MANITOBA.

Mr. W. C. McKillican, Superintendent of the Experimental Farm at Brandon, Man., calls attention to some differences in the conditions prevailing in Manitoba, as contrasted with Saskatchewan conditions and to the consequent variations in the procedure which should be followed with new land in the former province.

MODIFICATIONS FOR MANITOBA.

The methods advocated by Mr. Mackay for Saskatchewan are largely applicable to Manitoba, particularly to new land in the southwestern part of the province where conditions are similar to Saskatchewan. The method of handling prairie sod by breaking shallow early in the season and backsetting deeper at a later date is quite the best here as well as in Saskatchewan. The practice of putting crop on newly broken prairie sod cannot be too strongly condemned; the latter should always have a season in which to rot.

Summer-fallowing.—The method of summer fallowing called 'Fourth Method' by Mr. Mackay, gives the best results in Manitoba. Ploughing early is quite as important in Manitoba as it is in Saskatchewan.

There are, however, large districts in Manitoba where the need or advisability of summer-fallowing is not very great. Generally speaking, the portions of the province north of Range 16, that bordering on Lakes Winnipeg and Manitoba and that east of the Red River, are not suited to summer-fallowing. There may be drier localities within this territory where fallowing is permissible; but, in the greater part of it, the result of summer fallowing is too great a conservation of moisture, giving a heavy growth of straw that falls down and fails to mature the grain. For this territory, barley or green oats may be used as a cleaning crop. These should be sown late and cut before any weeds can ripen. Grass and clover crops can also be used to good advantage in the place of summer-fallow in a rotation.

Crop rotation.—In the older parts of Manitoba, the system of grain and summer fallow can no longer be considered as a complete or wholly satisfactory

system. The spread of weeds and the increasing difficulty with soil blowing show the necessity of a scientific rotation of crops. Such a rotation should include grasses to renew the vegetable fibre in the land, clover or alfalfa to restore fertility and, if possible, potatoes, roots or corn should be used as a cleaning crop instead of summer fallow.

Stubble burning.—Stubble burning is not advisable in Manitoba, whether it be in Saskatchewan or not. It is a waste of valuable vegetable matter that is very seldom justifiable. Unless the soil is unusually dry the stubble should be ploughed under and thoroughly packed down with the soil packer. Fall ploughing is not as impracticable in Manitoba as Mr. Mackay says it is in Saskatchewan. There is often sufficient moisture for fall ploughing, and when this is the case better results are obtained in most districts than could be secured from spring ploughing.