

treatment for rust of cereals. It was thought that the presence of barberry in the immediate presence of grain fields was responsible for this affection, but it now appears that while barberry intensifies the rust and increases the loss, the absence of barberry does not mean the absence of rust. It would seem to be advisable to use as seed grain obtained from fields free of rust, to avoid excessive use of nitrogenous manures, such as barnyard manure or nitrate; to develop rust-resistant varieties of wheat, as has been done with considerable success in Australia; to avoid planting barberries; to drain the land thoroughly; to avoid the use of manure obtained by feeding stock rusty straw, and to burn or plow down the rust stubble before seeding, where such a procedure is practicable, as in the West.

THE INTRODUCTION AND BREEDING OF SUPERIOR VARIETIES OF FIELD CROPS AT THE EXPERIMENTAL FARMS, AND THE DISTRIBUTION OF THE SEED SO OBTAINED.

Dr. Wm. Saunders.—In 1886, when the Act of Parliament was passed under which the Experimental Farms were established, it was provided that they should test the merits, hardiness and adaptability of new or untried varieties of field crops, and disseminate among farmers, upon conditions prescribed by the Minister, samples of the surplus of such products deemed especially worthy of introduction. Accordingly, importations of the seed of important farm crops were made from widely varying sources, including Russia (the home of the Ladoga wheat), England, France and Germany. Trees, shrubs and plants were obtained from at home and abroad.

Among the samples of grain secured the first year were several varieties of wheat from India, many of which were early in ripening and of excellent quality, but as after five or six years' trial it was found impossible to make these wheats produce crops equal in volume to those already grown in Canada, the cultivation of most of them was gradually given up, though not before a number of crosses had been made of the earliest Indian wheats with vigorous productive sorts grown in Canada.

The most promising of the various sorts of grain secured by importation, crossing and otherwise, are grown in large fields at the several Experimental Farms, and a large proportion of the produce is sent every year to Ottawa, whence a general distribution in four and five pound samples is made throughout the Dominion, as per the annual spring announcements. It is remarkable how rapidly a supply of grain may be built up from one of these small samples. Take, for instance, oats. The four pounds if well cared for will usually produce three to four bushels. This, sown on two acres of land, will, at a very moderate estimate, give 100 and sometimes upwards of 200 bushels, but, taking the lower figure, the crop at the end of the second year would be sufficient to sow 50 acres, which at the same moderate computation would furnish 2,500 bushels available for seed or sale at the end of the third year.

The critical point is threshing. Farmers are expected to harvest, store and thresh separately the product of their plots, threshing by hand, with flail or otherwise. Cutting the heads by hand and placing them in sacks may be a convenient method in some cases. At the farm we thresh these sacks by beating with a stick. This spring 42,000 samples have been distributed from the Experimental Farms, making a total since the work was started of over 500,000.

While the great bulk of the farming community appreciates the benefits of this distribution, occasional complaints are made that the samples are too small, and that not less than two bushels should be sent to each applicant. But this would limit the distribution to comparatively few individuals, which would be very unfair and impolitic. The farms have also been criticised for not arranging to have seed grain available to farmers by purchase in lots of two bushels and upwards. The fact is this has been the practice at the Western Farms for many years past, and every season after the regular distribution of smaller samples has been provided for, all the surplus stock has been sold in quantities of from two to five bushels each. During the past season more than 200 farmers have been so supplied.

Improvement in the seed grain used in Canada has been brought about by three different methods: (1) The introduction of varieties grown in other countries; (2) the production of new sorts by cross fertilization, where an effort is made to combine the desirable qualities found in one or two different sorts; (3) the improvement of existing varieties by judicious selection. The first of these has been referred to above; we shall next refer to the breeding of new cereals, restricting our consideration to wheat.

The mature wheat kernel is a single seed, enclosed in tightly-fitting walls, which fold inward, forming a fold or groove upon its upper surface. The skin, which consists of three layers, when crushed and ground forms bran and shorts. The interior of the wheat kernel, which is composed of starch, gluten, etc., when ground furnishes flour in proportion of about seventy to seventy-five per cent. of the whole. The germ or embryo of the plant, in which the principle of life lies dormant, is found at the lower end of the kernel, and is surrounded by a supply of food material. When the grain is sown and conditions are favorable, the germ is awakened to life and begins to feed on the store of nutriment surrounding it. Shortly the roots protrude

and strike into the soil while the blade shoots upward to the light.

There is a broad and general law underlying reproduction in nature, that "like produces like." The seed contains in embryo the perfect plant; its details and characteristics are all enfolded in its substance, awaiting favorable conditions for germination, which, once started in suitable soil, results in a gradual unfolding of the mature specimen. During the formation of the seed the characteristics of the future plant are laid down.

If we examine the structure of a wheat head we find it is formed of a number of spikelets, supported by a central stalk, bent zigzag, forming a series of notches and bearing a number of flattened spikelets, one of which grows on each notch. Each spikelet consists of a number of florets, usually five or six, arranged in a fanlike form. The lower flowers mature first, the second pair follow later, and those at the top last. The first two flowers in each spikelet are usually fertilized and matured without mishap. The others sometimes partially or wholly fail through unsuitable weather, and in that case the weight of the crop is light. If the spikelets are well filled the crop is generally a satisfactory one. Wheat is usually self-fertilized, the pistillate and staminate portions of the flower being near together, within the chaffy enclosure.

The pollen consists of a multitude of very minute round bodies, which when dropped on the succulent pistil send out from their substance a tiny thread, which penetrates the pistil and passing downward through its substance reaches the ovary near the base, penetrates the ovule and fertilizes it. This act of fertilization impresses the seed with its future characteristics, and as the seed grows these are embodied in its substance, and to a considerable extent transmitted to its progeny. When wheat is fertilized by its own pollen the kernels resemble one another very closely, although occasional differences may occur through variation; but where cross-fertilization is effected, the character and structure of the grain is so modified as to partake more or less of the characteristics of both parents. This variation, or sporting, is often continued through several generations, until finally the types become fixed and the varieties reproduce themselves with little or no change.

In artificial fertilizing of wheat, the head should be selected and worked in soon after it has pushed out from the sheath. The floral chambers are covered with two layers of chaff, the outer one of which is torn off, or bent back with a pair of finely-pointed forceps, and the inner one pulled back by seizing it near the tip and bending it downwards, exposing the flower to view. The anthers are then carefully examined, and any spikelets containing anthers mature enough to offer the possibility of any pollen having been shed are torn off and thrown away, and other flowers opened until some are found with the stamens green but almost mature. These are removed with much care, so as to prevent injury to the pistil, and the flower covered by replacing the inner coating of chaff in its natural position. After a sufficient number of flowers have been operated on, the other portions of the head are torn off. From previously collected heads of the variety which is to serve as the male, flowers are sought containing anthers fully matured and covered with pollen. Then the individual flowers prepared for fertilization are re-opened in succession, and the soft feathery pistil is gently touched with one or more of the pollen-bearing anthers from the other variety, until a perceptible quantity of the powder has been applied, when the flower case is again closed. After all the flowers in a prepared head have been operated on it is wrapped in thin paper, tied on so as to prevent access of any other pollen. The covered head is then tied to a piece of stick or bamboo cane, and remains untouched until harvest time. Each kernel when sown the following spring will form the starting point of a new variety, or, indeed, of a number of new varieties.

The single plant from any of these kernels grown the first year will produce heads all alike, and these will usually resemble closely the variety on which the kernel has been produced, though occasionally it will take after the plant from which the pollen has been gathered. If the cross has been successfully made, the grain obtained from the plant of the first year's growth when sown the next season will usually produce several different forms, some resembling one parent and some the other, while other plants will produce heads more or less intermediate in character. After selecting the desirable type or types, all others are discarded, and after several seasons of careful selection the type usually becomes fairly permanent. Variations, which occasionally occur, should be separated.

For the first few years our work in cross-breeding was done chiefly by myself, but during the next ten or twelve years able assistance was rendered in cereals by Mr. W. T. Macoun; also by Dr. A. P. Saunders. More recently the bulk of the cross-breeding has been done by Dr. C. E. Saunders, who has been wonderfully successful, not only in cereals, but in fruits and other lines. Since the appointment of Dr. C. E. Saunders as experimentalist in 1902, a large number of additional crosses have been made, and much attention paid to the work of purifying and selection of seed. Much time has been given to the selection of single kernels quite true to type, which have been picked out in sufficient quantities to sow good-sized plots. Much attention has been paid to earliness in ripening, and the best of the earliest wheats now being propagated will ripen fully two weeks earlier than Red Fife, and are of excellent quality, though, of course, not expected to be so

productive. Several selected strains of Red Fife have been found which ripen three or four days earlier than the regular form, and further efforts are being made in this direction.

The foundations for future progress are being thoroughly laid. Ready methods have been worked out by the experimentalist for determining approximately the relative quality of wheats, even where only a few kernels are available, so that inferior milling sorts may be promptly discarded. Researches are also aided by a roller process mill, by means of which the proportion of the different grades of flour in a given sample of wheat can be determined and its milling value ascertained, though no more than a pound or two of the grain is obtainable. A small baking plant completes the testing facilities.

Improvements already in sight as a result of our work are most encouraging. The gain made, with some of the new wheats of high quality, of two weeks over Red Fife in date of ripening will be of immense advantage in the Canadian Northwest, while the improvements made in other sorts of wheat, and in other cereals, lead us to look for great progress, and in future, under the charge of a thoroughly trained worker, advancement will, I believe, be rapid.

N. B. Agricultural Outlook.

In New Brunswick, as in the other Maritime Provinces, we are just beginning to feel a little satisfaction after a most discouraging spring. A few days of warm sunshine and genial showers have brought life and growth where there was nothing but stagnation and threatening death. There has been such an unnatural chill in the air! We have had two warm periods lately, of hardly a week each, but they seem to have done a good month's work, and to have placed us not so far behind an ordinary season, as we appeared to be at one time. All grain crops and potatoes are now looking well. Grass is unequal, but now making rapid growth. There was no winter-killing, and grass is, in general, thick on the ground. This is no fruit district, but every farmer has from a dozen to a hundred apple trees. Blossoms were late of coming out, and I think most escaped the frost. Quite a number of trees all over the country have been destroyed by mice, which seem to have been unusually numerous and destructive. All growing trees should be protected from mice, and there are many ways of doing so well within the reach of all. The cattle of all careful farmers came through the long winter and cold spring in good condition for making the most of the grass and a prosperous season for the farmer. A good many fail to give, cows especially, the needed care, and the income of such is uncertain and often very restricted. In Victoria County almost every farmer keeps sheep, and has from a dozen to three or more dozen of lambs to sell at this season. In this neighborhood we have been very careful in breeding, and have attracted buyers from the other side of the line, who are willing to pay better prices than we can get in the home market.

We have not found the butter or cheese factory a paying business in this part of the country. The land is considerably broken up, roads hilly, settlements and settlers scattered, so that we have no chance but follow mixed farming. In consequence, we are all in search of the animal known as the general-purpose cow. This is a pregnant question all over the Maritime Provinces, and one which breeds much controversy. Dairymen hold that there can be no such animal; that there can be no "happy mean" between the milk and the beef animals. There was a time when the pig seemed a creature intended more for bristles than meat. The breeder took him in hand and made a mountain of grease of him; then when the market called for it we got the fine mixed meat the packer likes. With the long, slick hog as an ideal, we are all the time getting nearer a fixed type—and that in several breeds. May we not hope to reach our ideal in a dual-purpose cow?

I have seen the wild cattle of Britain in their pristine state. They stand in about the same relation to the cattle of to-day that the hog of bristles does to the well-bred hogs of to-day. Our present fine dairy cows, and Shorthorn and Aberdeen-Angus bees, have been evolved from such animals. We are not through with them yet.

W. L. McPHAIL.
Victoria Co., N.B.

Fair Dates for 1905.

Winnipeg Industrial	July 20-28
Western Manitoba, Brandon	Aug. 1-4
Canadian National, Toronto	Aug. 26-Sept. 12
Eastern Exhibition, Sherbrooke, Que.	Sept. 2-9
Western Fair, London, Ont.	Sept. 8-16
Central Canada, Ottawa	Sept. 8-16
New York State, Syracuse	Sept. 5-10
Ohio, Columbus	Sept. 4-8
Minnesota, Hamline	Sept. 4-9
Wisconsin, Milwaukee	Sept. 11-15
Indiana, Indianapolis	Sept. 11-15
Michigan, Pontiac	Sept. 11-16
Nova Scotia Provincial, Halifax	Sept. 13-21
W. Michigan, Grand Rapids	Sept. 18-22
Kentucky, Lexington	Sept. 18-23
Fredericton, N. B.	Sept. 21-27
Charlottetown, P. E. I.	Sept. 26-29
Illinois, Springfield	Sept. 30-Oct. 7
Dominion Exhibition, New Westminster, B.C.,	Sept. 27-Oct. 7
Sussex, N. B.	Oct. 2-6
Lewis & Clark Exposition, Portland, Oregon:	
Live stock	Sept. 19-29