SOIL SURVEY PROBLEMS OF THE CANADIAN WEST.

By Roy P. Hansen, Prof. Soils and Crops, University of Saskatchewan.

While I was called upon to speak to you on Soil Survey Problems of the Canadian West, I intend to confine my remarks particularly to conditions in Saskatchewan, the central of the three Prairie Provinces of Western Canada. Agricultural conditions are very much alike in Alberta, Manitoba and Saskatchewan, so that most of what I have to say will apply equally to the three provinces.

It is astonishing how little the conditions, both climatic and agricultural, of our Prairie Provinces are understood by the people to the South of us. Soil survey problems with us are the result of our peculiar conditions, and in order, therefore, to present these problems to you, it will be necessary that you understand something of those conditions.

The Province of Saskatchewan extends from the 49th to the 60th parallel, the states of Minnesota and North Dakota being immediately to the South. The area is 251,706 square miles, equal almost to that of Texas. Of this the Department of the Interior has calculated that 94,000,000 acres are suitable for agricultural purposes, though this appears to be a somewhat liberal estimate. The cultivable area is estimated at about 58 to 60 million acres or a little over one and a half times the total land area of Michigan. Of this 58 to 60 millions of acres, only 23 millions are at present under cultivation.

The great bulk of our cultivable land consists of open prairie similar in all respects to the Great Plains Region, of which indeed it is but a continuation. Immediately north of the prairie is a narrow strip, 70 to 100 miles wide, known as the Park Belt, so called because it resembles a park. The prairie is here interrupted with scattered poplar scrub and bluff, but most of the land can be brought under cultivation without much clearing. North of the Park Belt lies the forested areas, the trees consisting mainly of poplar and some tamarack, and farther north the jack pine, spruce and balsam.

The total precipitation varies in the province from about 13 inches to 21 inches, with a general average of 15 to 16 inches. The driest part is believed to be the south-west corner; actual averages show the area between Medicine Hat and Lethbridge in Alberta to be the driest area in Western Canada and the average annual rainfall increases in all directions from this centre. At Winnipeg, for example, the rainfall is 17 to 19 inches. The northerly portions of the province of Saskatchewan may show some increase in precipitation over the southerly parts, but the factors of hot winds and evaporation probably are actually more important from the standpoint of crop production.

The growing season in the north is three or four weeks shorter than in the south. For example, the average length of season as measured by 3° of frost at Prince Albert is 117 days, as compared with 152 days at Maple Creek.

Wheat seeding is general in the average season during the last week in April, and wheat comes to maturity about the middle of August--at Saskatoon August 18th. Wheat requires a season of 100 to 110 days, depending upon the variety and other conditions; oats require 90 to 95 days.

Sufficient to say, the normal rainfall is enough to produce abundant crops, providing we get the average amount, and providing the distribution is normal. Likewise, the growing season is long enough, providing the season is normal. As regards both precipitation and growing season, conditions are ideal for the production of spring wheat, or, I might say, spring grains, to include oats, barley and flax. As evidence of the quality of our spring grains, I need only refer you to the prizes in spring grains at the International Show that have fallen to the Prairie Provinces. In 1919 Saskatchewan alone won the first six places in wheat, including sweepstakes, and in all 14 prizes out of the 25 offered. Last year we again captured the sweepstakes. The Prairie Provinces have been prominent winners with oats and barley, as well as with wheat. Last year, first in oats fell to Alberta.

It so happens that 50 to 60 per cent of the precipitation falls during the months of May, June, July and August, in other words, the growing season when the moisture is most needed. The fall season is normally dry, facilitating the harvest and producing an excellent quality. In 1920 wheat production in Saskatchewan amounted to 113,135,000 bushels, oats 141,549,000 bushels. Estimated production for 1921 for wheat is 174,400,000 bushels and oats 181,724,000 bushels, with an average yield of 14.9 bushels per acre for wheat and 37.2 bushels per acre for oats.

With this somewhat lengthy introduction, I turn to our problems.

Owing to a combination of circumstances, some natural and unavoidable and some resulting from our present system of farming, agriculture in some parts of the province has been unprofitable and unsatisfactory. In the first instance ours is and has been in the past a one-crop system of farming. As already pointed out, our conditions are ideal for the production of spring grains. The market demands and better price for wheat has made Saskatchewan a spring wheat country. Owing to insufficient moisture to produce a crop every year, the practice of the bare summerfallow is general. The common plan or rotation, if it may be called such, is summerfallow followed by two crops of wheat. Oats sometimes replace wheat as the second crop, though oats are grown mostly for home consumption. In some districts however, the acreage devoted to oats approaches or exceeds that of wheat. It is hardly necessary for me to point out the hazards of such a system. It was a necessary evil for our early settlers since, for the most part, they lacked the cash to do otherwise. Now that the system is established, it is very difficult to remedy it. The cure, as you can readily see, consists of diversified farming and crop rotation, but this is difficult to bring about as it is one thing to suggest a remedy and quite another to put it into practice. In Canada, as perhaps may be true elsewhere, the farmers do not always do everything that we may advise, which is sometimes very fortunate for our agricultural industry.

Our second difficulty is drought and this has been more marked owing to the first fault, the one-crop system. Particularly in the far south-west corner, the years since 1915 and 1916 have been dry ones. Some districts have experienced four or five successive failures, owing to lack of moisture. Perhaps I should not say drought, as some of these years showed an average annual precipitation, but the distribution was such that spring grains were a failure, and as nothing but spring grains were seeded, the results were disastrous. In some instances the rainfall was decidedly subnormal, but this is a hazard of all dry farming areas. But the danger of drought can be in a great measure overcome by proper rotations, which enable the moisture to be utilized to best advantage when the distribution is abnormal. For example, at Saskatoon we have

found that fall and spring rains insure crops of grasses, alfalfa, sweet clover, and perhaps the intertilled crops. Given the normal distribution of rainfall our spring grains yield well. Late rains give us harvests of hay, corn, forage, sunflowers and roots. In other words, we feel that with proper rotations which spread the risk, we need not suffer from drought, except in seasons of decidedly subnormal precipitation.

A third source of concern is the problem of soil drifting. This is the result of the dissipation of organic matter from our soils, assisted by our light rainfall, prevailing high winds in the early spring, and exposure of large acreages of bare summer fallow. The difficulty is not so serious except on lighter soils, but is likely to become more serious as time goes on. Here again the problem is one of educating the farmer into the practice of crop rotations and proper methods of soil management.

A second factor related indirectly at least to profitable farming, is the question of land settlement. In our settled areas the cheapness, the level or gently undulating topography, and the ease with which large areas may be brought under cultivation has lead to an extensive type of farming. Not that all large farms are mismanaged, but the tendency is in that direction. Our farmers generally attempt to work more land than they can properly handle, and frequently--perhaps I should say very commonly--the land is abused. Smaller farms and better management are inevitable. There is room for thousands of new settlers in our already settled areas.

Associated with this question, is the question of unoccupied land. The Intelligence Branch of the Department of the Interior by investigation found in our settled areas about 10 millions of acres of land unoccupied. This land is held chiefly by speculators in the United States and Canada, by the Canadian Pacific and Canadian National Railways and by the Hudsons Bay Co. More intensive settlement in the settled areas would assist materially as it would bring the markets closer to the farmers and assist in the many ways familiar to us all.

The problem of lands open for homesteading has been covered in a previous paper and I need add only a word. So far as Saskatchewan is concerned, the land available for homesteading has now been pretty well picked over. The difficulties with such lands are, cost and time of clearing, distance from market and, as is especially the case in the far north, inferior soil. The prospective homesteader should pick his land carefully and the land classification conducted in the north country by the Department of the Interior should assist him in his choice, or at least warn him of inferior land. The Provincial Soil Survey will confine its efforts for the present at least to the settled areas.

The Provincial Soil Survey in Saskatchewan was the outcome of a meeting of agricultural representatives called by the Minister of Agriculture. This meeting was held in June of 1920 at Swift Current, a city in south-western Saskatchewan, where conditions had been unusually severe. The actual work was begun last spring, when we began operations with one field party. Our method was somewhat between the reconnaissance and the detailed survey. We did not undertake a preliminary reconnaissance, and whether this was wise or unwise, I am not in a position to say. Since our agriculture is and will always be extensive in scale, we felt that a detailed survey was not necessary. We compromised, therefore, by travelling the roads north and south, one mile apart, and some of the east-west roads where necessary. Practically all of our work was done from the car. Our difficulties have been several. We lacked a laboratory

for analytical work, and this need has only recently been filled. We lacked trained assistants, both in the field and laboratory. I had two students with me in the field. This is all we had to start with. We spent three months in the field and were then driven in by a snow-storm. By the time the roads became again passable, the University had opened and no further work was attempted. But the season's experience was worth a great deal, and we hope to renew our efforts next year, better equipped and more completely manned.

I might also add that geological information upon which to base our work is lacking. Geological surveys, such as have been conducted in the various states, have not as yet been attempted in the Prairie Provinces.

However, with all the faults of commission and omission we plan to go ahead. We seek practical results; our main effort shall be to direct agricultural practice into more profitable and permanent channels. It seems hardly necessary to enlarge upon this. The little booklet on the Value of a Soil Survey, published by this Association, covers this very well.

Purposely I have not gone into detail regarding soil problems, because this is uncertain ground. Not enough work has been done as yet to reach any definite conclusions. The soil survey, it is hoped, will open up these problems and assist in their solution.

It is planned to follow up the survey with experimental work. We have already an established experimental farm in connection with the University. We hope at some future time to establish substations to represent the various conditions of soil, climate, etc.

The county agent movement has not begun in Saskatchewan but it is a probable development of the near future. The relation of these things to the soil survey is obvious to the people here assembled.

In summing up I want to point out that our problems come under two heads: first, to advise and to encourage systems of farming which reduce to a minimum the hazards of our present system (this of course is a problem of tremendous proportions, since it effects all phases of all agricultural activity); and second, to encourage settlement and development of our unoccupied land, not by misrepresentation but by the setting down of actual facts and conditions.