dust explosions. Again, the destruction by a dust explosion and fire of an elevator in his territory may mean a longer haul to get his grain to market or even make it impossible for him to market his grain when he wishes. For all these reasons the farmer, as well as the grain producer, the elevator operator, and the miller, or user of grain and cereal products, has a vital interest in the work of the Bureau of Chemistry on the cause of dust explosions and the development of methods of preventing them.

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GREAT Plains Agricultural Development

The agricultural development of the Great Plains has been an important economic problem for 50 years. The United States Department of Agriculture and the State experiment stations of 10 States have been conducting extensive coordinated investigations of this subject for the past 20 years. Much information has been obtained, and many publications have been issued, but many important problems still remain unsolved. Miscellaneous Circular No. 81, "The Relations between Crop Yields and Annual Precipitation in the Great Plains Area," seems to present some of these problems in a new light, and to indicate methods for their solution. These facts and suggestions, supplemented by 45 years of experience and observation, may be summarized briefly as follows:

The disastrous experiences of hundreds of thousands of settlers in the Great Plains during the last 50 years have been due largely to (1) lack of experience with the soils, the climate, and the adaptation of crops in this region; (2) the absence of an economic justification for the bringing into agricultural production of large areas of raw prairie; (3) the adoption of a one-crop system of grain farming and the failure to develop the livestock industry in connection with grain production.

The premature development of political, social, mercantile, financial, and transportation organizations, that could have no permanent support except agriculture, in advance of the agricultural development of the region, has been another serious handicap to the early settlers in the Great Plains. These desirable but none the less exploitational organizations were supported in the earlier stages of the influx of settlers into this undeveloped region by issuing bonds and by the funds brought in by the settlers. The next source of revenue for their support was the money obtained from farm-loan companies. Much of the land was preempted by adventurers who mortgaged their land for all the money they could get from the loan companies. Many of these preemptors made no effort to bring their land into agricultural production, but the money they borrowed went into circulation and helped to support the parasites. When these mortgages came due, they usually were foreclosed. The mortgagor seldom received any returns from the foreclosure, the money being absorbed by the land agents.

Speculation Became Rife

The title to the foreclosed land also fell into the hands of land speculators. Thus began, in the early eighties, the most gigantic
organization of farm-land speculation that this country has ever experienced. Practically every individual over many thousands of square miles was interested, directly or indirectly, in the sale of farm land at the highest price obtainable. The slogan, “If you can't boost, don't knock” became a sentiment that was almost religious in its fanaticism, and was supported by powerful financial and political organizations. Inflation of land prices in utter disregard of the revenue-producing capacity of the land or the economic laws governing the increase in agricultural production was inevitable.

Such were the conditions in 1905 when the dry-land agricultural investigations were established in the Department of Agriculture. At that time the State experiment stations of the 10 States lying wholly or in part within the Great Plains had done but little investigational work in dry-land agriculture, and there was no coordination of the work of the several stations with each other. Charlatans of all descriptions, employed by land-selling agencies, were traveling over the country, each claiming to have discovered some new system that was to revolutionize the agriculture of semiarid regions, and to make possible the profitable production of crops where repeated efforts to do so had previously failed. Land exploitation was well organized by shrewd, capable, and unscrupulous men. The comparatively few legitimate farmers who still remained in the Great Plains with a fixed determination to develop permanent homes and a stable agriculture, eventually found themselves handicapped by inflated land prices, high taxes, and low prices for their products, and much misinformation as to farming methods.

The dry-land agriculture investigations of the department began in 1905, in a small way, by first enlisting the informal cooperation of the State experiment stations throughout the Great Plains. In 1915, 24 field stations had been established in this region. Owing to lack of funds, this number has since been reduced to 19, which are now in operation. The results from 23 stations, for an aggregate period of 303 crop years, have been used as a basis for the publication already mentioned. From a careful study of these data the following facts are deduced:

Soils Are Very Fertile

It is now known that a major portion of the soils of the Great Plains are of great fertility and well adapted to the growth of staple crops, and that the rough, broken sandy and stony lands are so interspersed amongst the tillable lands as to make them available for pasture for livestock. It is also known that the mean climatic conditions of the entire area are such as to make possible the development of successful agriculture throughout this vast region of over 450,000 square miles.

It should be constantly borne in mind, however, that soil and climate do not alone insure a profitable agriculture in this or in any other region. Next in importance to soil and climate is the assurance of a permanent market at profitable prices for the crops that are raised. This is an economic factor over which the individual farmer has no control, except in so far as it is affected by the kind and quality of the crops produced, and possibly by the local marketing facilities. Closely associated with this, is a knowledge of the
adaptation of crops to the local environment in relation to both the production and the sale of crops. The relations to each other of the crops grown in rotations also must be given thoughtful consideration. Of no less importance is the selection of the livestock to consume the roughage and the coarse grain produced, and to provide motive power. All of the above-mentioned factors may be grouped under the general designation of farm organization. Next comes the selection of the necessary implements for tillage, seeding, harvesting, and handling the crops grown under the conditions, and in the relations to each other in which they are grown. The extent to which the tractor, the motor truck, and the combine harvester are to be used will be important factors in the selection. The general character of the soil and the topography of the farm should be considered in this connection.

**Problem of Implement Use**

Having adopted a system of farm organization and selected the implements, the problem of how to use these implements in the most economical manner—how to accomplish a given purpose with the least possible expenditure of energy and money—presents itself. This is, perhaps, the most difficult group of problems to meet, for they are constantly changing and there is no solution of any of them that will be the same under constantly changing conditions. When and how deep to plow; when and how to summer fallow, and when to grow a cultivated crop in the rotation between crops of small grains; when to use the self-binder, when the header, and when the combine harvester, and scores of other problems of like nature must be met and solved on very short notice and in connection with combinations of conditions prevailing at that particular moment on that particular farm or field. Only long practical experience in that particular locality can fit a man to successfully cope with such problems.

In the eastern United States, where the land was originally heavily timbered, it usually required about three generations—a hundred years—to clear a farm of from 100 to 200 acres and bring it into full production. During all that time there was accumulating the results of practical experience on each particular farm. It is doubtful whether any member of the third or fourth generation that has grown up on such a farm ever fully realized that the traditions that he inherited were the most valuable part of his estate. It is still less probable that any owner of a virgin farm in the Great Plains could be convinced that it will take about a hundred years before he can reasonably expect his farm to arrive at full production through cumulative practical experience; but there are elements of probability in both these statements worthy of careful consideration by those who are interested in the agricultural development of the Great Plains.

The problem of the adequate capitalization of a farm in the Great Plains has been left until the last, when perhaps it should have been the first to be considered. There is a very general opinion that a man with small capital has a better chance of success in agriculture in the newer than in the older settled portions of the United States. Experience, observation, and investigation make this assumption appear of doubtful validity. It is true that raw land costs less per
acre in some parts of the Great Plains than improved farms in some parts of the eastern United States, but it is also true that the economic farm unit in the West is probably twice the size of that in the East. It is also true that all kinds of farm improvements cost more in the West than in the East. In fact, there are many farms for sale in the East at a price that would not cover the cost of the improvements now upon them, at present cost of material and labor. Freight rates, on both what a farmer sells and what he buys, are higher in the West than in the East. Farm labor is higher in the West than in the East, except near large cities.

Average Wheat Yields Large

Investigations show that, on an average, through a long term of years, larger yields of wheat per acre can be obtained in the northern Great Plains than the average for the wheat-growing States of the whole United States. In the southern Great Plains, the sorghums largely take the place of wheat and corn in the Northern and Eastern States. The opportunity for a direct comparison of crop yields are, therefore, not as good in the southern as in the northern Plains, but the evidence at hand indicates that there is little difference in the general crop-producing capacity of these two regions of the Great Plains, and that they both compare favorably with other portions of the United States. There is, however, this difference. In the Eastern States a complete failure of all crops is almost unknown, whereas in the Great Plains such failures are common, and in only about two years out of three are the yields sufficient to yield a profit. This makes it necessary for the farmer in the Great Plains to have sufficient working capital to tide him over these lean years.

On the other hand, investigations show that the average yields in the northern Great Plains, measured in terms of bushels of wheat per acre, are 16 bushels. If, however, the inhibiting factors other than deficient annual precipitation could be reduced to the same extent on the average throughout the entire period that they have been in some instances these average yields would be over 30 bushels per acre. It is a fact that some of these inhibiting factors, such as hailstorms, hot winds, and extreme drought at critical periods in the development of the crop, are entirely beyond the control of man. There are, nevertheless, many other factors, such as the loss of moisture from weed growth, faulty systems of tillage and crop sequence, poor seed, plant diseases, and insect pests that are more or less under man’s control.

It therefore seems reasonable to expect that the average crop yields of the Great Plains may in time be increased by better farming practices from the equivalent of 16 bushels of wheat per acre to 20 bushels, or an increase of 25 per cent. When this time comes, and there is a real economic demand for increased agricultural production in the United States at prices that will yield the farmers fair profits on their investments of money, labor, and managerial ability, the Great Plains will become one of the greatest food-producing regions of the world. In the meantime, the agriculture of the Great Plains should be allowed to develop naturally without artificial stimulation, and investigators and practical farmers now established in that region should continue to add as rapidly as possible to the
store of agricultural knowledge that is absolutely essential to the ultimate development of the undeveloped agricultural resources of the Great Plains.

E. C. CHILCOTT.

**Hay Standards and Inspection System**

Hay marketing is a comparatively simple business procedure when the seller and the buyer are together to barter and negotiate the transaction. The seller quotes his price, the buyer can examine the hay and use his own judgment as to its quality and condition for his purposes, and controversies are either settled then or the sale is not made.

If all hay marketing could be conducted under these simple conditions the hay producers, dealers, and consumers in the United States would have little need for hay standards. But, as a matter of fact, only a small percentage of the carlot shipments ever move directly from the producer to the distant consumer. The vast majority of all shipments pass through at least two middlemen. Many shipments pass through four or five middlemen before they reach the consumer.

**Hay Moved Long Distances**

In spite of freight rates on hay that are much higher than those which prevailed before the World War period, baled hay is hauled hundreds, even thousands of miles by the railroads of the United States. It is a farm-management truism that farmers and stock feeders should produce their own hay wherever possible in order to eliminate the freight and handling costs incidental to the purchase of baled hay; but specialized American agriculture and climatic limitations often provide exceptions.

The Cotton Belt States, for example, prefer to utilize their best lands in large measure for cotton and their soils and climates are not widely favorable to hay production. Thus these States purchase thousands of carloads of timothy, clover, and alfalfa from Michigan, Ohio, New York, Indiana, Kansas, Nebraska, Oklahoma, Arizona, New Mexico, and the Province of Quebec in Canada. Similarly thousands of car and truck loads of alfalfa move from Arizona, New Mexico, and the Imperial and San Joaquin Valleys of California into the thickly settled areas of southern California where land is too valuable for hay production. Baled hay is transported by water routes in considerable volume from the Sacramento Valley of California to the Atlantic seaboard, from San Francisco and Seattle to Alaska, Mexico, Hawaii, the Philippines, and the Panama Canal Zone, and from New York City and Norfolk to Cuba, Porto Rico, and the Panama Canal Zone.

**Contract is Essential**

In this hay commerce where the producer and consumer are widely separated and where country shippers, dealers, brokers, distributors, bankers, and carriers function in the marketing process, the use of the contract becomes essential to evidence the quantity, quality, and value of the commodity that is involved in any given transaction.