Historic, archived document

Do not assume content reflects current
scientific knowledge, policies, or practices.

Rev. ed.
follows

CIRCULAR No. 8.

United States Department of Agriculture,

OFFICE OF THE SECRETARY.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., November 20, 1900.

SIR:

For the purpose of organizing cooperative work in grass and forage plant investigations with the State experiment stations as required by law (House Bill No. 121, Fifty-sixth Congress, first session, making appropriations for the Department of Agriculture), Prof. T. A. Williams, Assistant Chief, Division of Agrostology, was directed by you, through my recommendation, to visit a number of southwestern and western stations. In order to hasten the arrangements contemplated, this trip was made before the close of the last fiscal year and the results secured, presented herein, are most gratifying. The publication of this report is hereby recommended, not only because it shows the widespread interest in the subject of grass and forage plant investigations, the varied and important problems involved in these investigations, and a system for taking up these problems which will commend itself, but also because it shows more clearly than ever before presented, the actual possibilities of cooperative work between the Department of Agriculture and the experiment stations and affords a hint of a power yet to be realized which the Department of Agriculture and the experiment stations thus allied may have in advancing, through all lines of investigation, the agricultural interests of the country. As a further result of these efforts to carry out the wishes of Congress in regard to grass and forage plant investigations, articles of cooperation have been signed by the directors of ten experiment stations and approved by you, for experimenting along lines indicated in the subjoined report.

Heretofore much cooperative work has been carried on between this Division and the State experiment stations in the cultivation of new and untried grasses (see Bulletin No. 22), and in the preparation of bulletins, as, for example, Bulletin No. 9, "Grasses of Iowa, Nebraska, and Colorado," by the botanist of the Iowa station, and Bulletin No. 13, "The Red Desert of Wyoming and Its Forage Resources," by the botanist of the Wyoming station; but not until the present season has any real effort been made to organize a systematic scheme of cooperation with stations. The formation, care and management of pastures; the best method of restoring the grasses on the great cattle ranges of the West; the crops best adapted to the vast areas of alkali lands of the interior; winter grasses for the South and Southwest; drought-resistant grasses for arid sections; the best soiling crops for the dairy farmer; grasses for sandy soils and binding drifting sands; and the development by selection of improved varieties of grasses and forage crops adapted to special conditions and uses are among the more important forage problems which have been discussed with the experiment stations; and in planning this work it has been sought to place with the several stations the line or lines of investigation which seem most imperative in each case. Our available funds are in no wise adequate to cover the entire field even when supplemented by the small amounts which the stations can use in grass and forage plant investigations. The joint work of the Division and stations is progressing favorably, however, and in what we have attempted to do in this direction your approval is already assured; and I trust a like approval of our efforts will be rendered by the House Committee on Agriculture.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

HON. JAMES WILSON,
Secretary of Agriculture.

COOPERATIVE GRASS AND FORAGE PLANT INVESTIGATIONS WITH STATE EXPERIMENT STATIONS.

INTRODUCTION.

In the accompanying pages is given a brief report of a trip made during the months of May and June under instructions from the Agrostologist in accordance with the letter of authorization from the Secretary, dated April 24, 1900. The purpose of this trip was to visit certain experiment stations in the West and to confer with the authorities thereof regarding the forage conditions and needs of the respective States and the possibilities of undertaking cooperative grass and forage plant investigations between the stations and the Department through the Division of Agrostology. In the course of this trip the experiment stations of the following States and Territories were visited in the order named: Missouri, Arkansas, Texas, New Mexico, Arizona, Utah, Washington, Idaho, Montana, Minnesota, and South Dakota. For the purpose of looking into investigations which are being carried on under the direction of this Division, stops were also made at Abilene and Channing, Tex.; Walla Walla, Wash., and Highmore, S. Dak.; and in order to get a better understanding of the prevailing forage conditions, stops were also made at Prescott, Phoenix, and Winslow, Ariz.; Las Vegas, New Mex.; Trinidad, Colo.; and Ogden, Utah. At each of the experiment stations conferences were held with the director, agriculturist, and botanist, and in some cases also with members of the governing boards. In every case great interest was taken in the work of grass and forage plant investigation, with an apparent readiness to join in cooperative work wherever such could be undertaken to advantage.

REVIEW OF CONDITIONS AND PROSPECTS IN THE SEVERAL STATES AND TERRITORIES.

The following is a condensed statement of the results of the conferences with the respective station authorities, both as to forage conditions and needs, and as to possible lines of cooperation:

MISSOURI.

After considerable discussion with Director Waters and other members of the station staff at Columbia, it became apparent that there were three problems of considerable importance in the State, in any of which it was possible to arrange cooperative work. The most important of these, and the one which interests by far the greater portion of the State, is the matter of the formation, care, and management of permanent meadows and pastures. There are

thousands of acres in the State covered at the present time with a scattering growth of timber, largely scrub oak, that are capable of producing excellent pasturage and bringing in annually many times the income which is received from them under the present conditions. One of the important questions is how to convert such lands into pastures in the cheapest and most practical way. Another problem, and one in many respects closely connected with the preceding, is that of finding suitable grasses for the Ozark region in the southwestern part of the State. The third problem, and one much more local than either of the other two, is that of finding suitable grasses and forage crops for the overflowed region in the southeastern corner of the State. All things considered, it would seem that the question which best lends itself to cooperative investigation, and the one of paramount interest to the people of this State, as well as to the entire Mississippi Valley, is that of the formation, care, and management of meadows and pastures.

ARKANSAS.

From the standpoint of grass and forage plant investigations this State presents some peculiar problems, not so much on account of the kinds of forage crops needed, but because of the agricultural conditions and practices which prevail throughout the greater part of the State. There is less need under the present system of agriculture for permanent meadows and pastures than for forage crops that can be grown without interfering with the regular crops, of which cotton is the principal one, and that will improve the condition of the land, which in many sections is seriously depleted because of continual cropping. The problem in the cotton-growing section is, if anything, more of an educational than an experimental one. The people have grown this crop so long that they are very loath to undertake the cultivation of any other, and it is only the depletion of their lands that is forcing them to a consideration of the possible improvement of these by means of annual forage crops, such as cowpeas, vetches, and clovers. The northwestern section of the State is largely devoted to fruit growing, with conditions similar to those obtaining in southwestern Missouri. In this region the principal need is forage crops that can be grown in the orchard for soil cover and for the improvement of fertility. At the State experiment station excellent results have already been secured with orchard grass, smooth brome, tall meadow oat-grass, and meadow fescue for meadows and pastures in the better class of soils, and with Bermuda in the sandy pine lands. There is, however, so far as the greater part of the people is concerned, relatively little inclination to attempt to grow permanent meadows and pastures. In the opinion of Director Bennett the most immediately important problems for the

State are: (1) Short-lived and quick-maturing annuals, especially legumes, for the production of forage in summer and for the improvement of the cotton lands; (2) winter annuals, such as the vetches and clovers, that will produce late fall and winter and early spring forage, will improve the lands, and will not interfere with the regular crop of cotton; (3) cover crops for orchards in the fruit-growing sections. It would seem that in this State the great question is not only to find crops that can be grown, but to encourage the raising of more stock, which, in turn, will increase the demand for forage and bring about more general rotation of crops on the farm.

TEXAS.

On account of its large size and the great variety of soil and climatic conditions included within its boundaries, Texas presents a variety of forage problems, some of which are exceedingly complicated. The stock industry is by far the most important one in the State and is carried on in all the different ways, from the open ranging of large herds in the western part of the State, the large areas of fenced lands in the middle and northern parts, to the more intensive methods of the closely settled sections in the southern and eastern parts. In this State are to be met the problems of range improvement, drought-resistant forage crops, annuals for rotation with the cotton crop, winter annuals for winter and spring pasturage, formation, care, and management of permanent meadows and pastures, and crops suitable for alkali soils and for the overflowed lands of the coast and river bottoms. At the station at Abilene, much has already been accomplished in demonstrating the practicability of improving the fenced ranges and in testing drought-resistant grasses and forage crops. At the State experiment station the value of alfalfa and the sorghums has been well demonstrated, an excellent plan of cooperation between the station and the farmers of the State has been devised and put into successful operation, and a considerable amount of preliminary work has been done in the improvement of the native pastures by the use of Bermuda grass, bur clover, and other introduced varieties. The State is so large and the problems to be met so great and so numerous that it is a difficult matter to select any one line of investigation for Departmental and station cooperation without feeling that other lines of perhaps equal importance are demanding attention. After a long conference with the director and the agriculturist of the station, there seemed to be four lines of investigation along which cooperative work might be arranged, and they are here given in what seems to be, under the present conditions, their relative importance. The first question is that of the improvement of meadows and pastures, particularly in the middle

and southern portions of the State, including annual and winter-growing varieties of grasses and forage plants, as well as the more permanent perennials. The diversity of soil and climatic conditions included make it necessary to consider this question from a number of different directions, although the general problem may be the same. In part, this work has to do with the actual formation of meadows and pastures, and in part with the changing of the natural fields to better and more productive ones through the addition of improved and hardy varieties. The second question has to do with drought-resistant grass and forage crops, and is essentially the same here as in the other southwestern States; so likewise the third problem—that of range improvement; and also the fourth—alkali-resistant crops.

After going over the whole matter in detail with Director Connell, and conferring also with our special agent at Abilene, and many stock raisers and farmers in different sections of the State, I am confident that the most important problem, and the one in which most good can be accomplished by cooperative investigation, is that of the improvement of meadows and pastures. Moreover, the conditions are especially favorable for the undertaking of such work, since there is, as already mentioned, a well-organized plan of cooperation between leading farmers and stockmen and the State station; and, by the distribution of suitable seeds to these parties, to be tested under the supervision of the station authorities, the investigations can be undertaken immediately and with every promise of early results.

NEW MEXICO.

This Territory presents a number of serious forage problems, but the conditions have been such that the local institution has been unable to undertake the work systematically. The authorities, however, are thoroughly awake to the need of carefully investigating these problems and are very desirous of securing the cooperation of the Department. Unfortunately on account of lack of funds and facilities they are not well prepared to undertake these investigations, and the local conditions are such that work has to be done under serious difficulties. Little has been done in the way of cooperation with the ranchers, and relatively little preliminary investigation of the range conditions has been made. The problems which at once impress themselves upon one looking over the field in this section are: (1) range improvement, (2) drought-resistant grasses and forage crops, (3) alkali-resistant forage crops, (4) forage crops for the production of late winter and spring feed, and (5) leguminous crops for soil cover for the orchards in the fruit-growing sections (relatively local). Under the present conditions there is little possibility of being able to do much in cooperation with the farmers and ranchmen

except, perhaps, in the matter of range improvement, cover crops for orchards, and alkali-resistant crops. In certain of the sections where these problems are paramount the farmers and ranchmen are alive to the need of such investigations and would probably join heartily in any work that could be undertaken. The station authorities themselves are desirous of cooperation in any or all of the lines mentioned, and at the present time are best prepared to undertake the work along the line of range improvement and the testing of drought-resistant crops, experiments with legumes for use as cover crops, and alkali-resistant crops.

ARIZONA.

The conditions in this Territory are very similar to those prevailing in New Mexico, the open ranges in many sections being so badly injured by drought and over-grazing that there are very few perennial grasses remaining of any value, and the only really good forage that the ranges afford is that furnished by the quick-growing annual species which spring up after the summer rains. These, however, disappear in a short time with the result that from late autumn until well into the succeeding summer about all the forage the ranges afford is that from various plants of weedy habit, particularly the *Compositæ* and *Cacti*, and a few shrubs and other plants forming the more persistent vegetation of the arid regions, composed principally of *Larrea*, mesquite, and various species of *Acacia*. Throughout a large part of the Territory, particularly the southern half, the most important forage problem is to provide food for stock during the period from the disappearance of the annual grasses to the beginning of the rainy season. The most trying time of this period is during the late spring and early summer, when stock suffers not only from scarcity of food but also from lack of suitable water. There are two lines of investigation which seem likely to afford relief from the present conditions in this section: One through the improvement of the ranges by the encouragement and protection of the few remaining perennial grasses, and reseeding with hardy native or introduced varieties; and the other, by the introduction and cultivation of hardy annual crops and succulent perennials, such as the spineless cacti. The authorities of the Arizona station are thoroughly alive to the need of these investigations and at the time of my visit had already made extensive preparation for taking up the work. Through Director Forbes a proposition for cooperative work was made which seemed so satisfactory that, in view of the urgent need of beginning investigations at the earliest possible moment and the preparations already made by the local station for undertaking the work, I thought it advisable to forward at once my recommendations regarding the plan of cooperation without waiting until my

return to Washington. The proposed investigation takes up more particularly the question of range improvement in the arid regions and incidentally the testing of spineless cacti and other drought-resistant plants that promise to be of value in the section. In order to secure anything like satisfactory results it will be necessary to carry on these investigations for a term of years and the plans should be made accordingly. There are other problems of great importance in this Territory, but all are much more local in nature than that of range improvement. In some sections, as in the region about Phoenix, the dairying industry is coming to be one of considerable importance and there is a demand for a greater variety of crops suitable for dairy stock. At the present time alfalfa with the addition of certain cereals, such as barley, wheat, and oats, affords practically all of the forage. The relatively large area of alkali lands occurring in this Territory makes the question of forage crops resistant to alkali one of vast importance, ranking next to the question of range improvement.

An important thing to be considered in connection with the proposed investigations in the matter of range improvement is that the region in which the investigations are to be undertaken is quite representative not only of a large part of Arizona, but also of Nevada, New Mexico, Utah, and western Texas.

WYOMING.

This station has already done a considerable amount of work in cooperation with the Division of Agrostology, particularly in investigating the condition of the ranges and testing drought-resisting grasses and forage plants, seed of which was furnished by the Division. The authorities thoroughly appreciate the value of cooperation in grass and forage plant investigations, and are desirous of joining the Department wherever work can be undertaken to advantage. Naturally in a State devoted so largely to grazing the range problem is a most important one. However, experiments now in progress in connection with the South Dakota Experiment Station at Highmore will apply equally well to the larger part of Wyoming, and it would seem desirable to join this station in the investigation of some other problem. Next to the question of range improvement, the problems calling for investigation in this section, stated in their order of relative importance, are: (1) Drought-resistant crops, (2) alkali-resistant crops, and (3) crops suitable for growing at relatively high altitudes. The Wyoming station is well situated for taking up any or all of these problems. The station authorities are particularly anxious to take up the question of alkali-resistant forage crops, and it would seem desirable to arrange for experiments along this line at an early date. The botanist and the agriculturist

of the station are very desirous of working in close cooperation with the Division, both in the study of the natural grass flora and in the various cultural problems that are demanding solution. The agriculturist is expecting soon to take charge of similar work at the Colorado station, and solicits the cooperation of the Division in grass and forage plant work in that State, as well as in Wyoming, particularly along the line of drought-resistant crops and those suitable for alkali soils.

UTAH.

The forage problems of this State are similar to those of Colorado, Wyoming, and Idaho on the one hand, and of Arizona and New Mexico on the other. The general problem of range improvement is, of course, an important one, as in all of the range States and Territories, but it is modified somewhat in Utah on account of the large amount of sheep ranging that has been practised in recent years. In some sections of the State, notably in the rougher mountainous portions about Bear Lake, the competition for range is becoming so strong that the sheep men, instead of depending entirely upon public lands for their forage supply, are buying up or leasing tracts of considerable size and fencing them in to insure forage for their flocks in time of scarcity. These men are beginning to look about for some means of increasing the productiveness of their reserved ranges, and the problem is one that might well engage the attention of the station and the Department as one phase of range improvement. Already the station, through Director Foster, has done considerable work on alkali soils in cooperation with the Department, and he is desirous of joining with the Division of Agrostology in the investigation of alkali-resistant forage crops.

IDAHO.

From the geographical position of this State, the forage problems are much less peculiarly its own than in other of the Northwestern States. In eastern and southern Idaho the problems are essentially the same as those of northern Utah and western Wyoming, while in western Idaho the conditions are practically identical with those of eastern Washington and northeastern Oregon. Over the larger part of the State the problems of most importance are, as already mentioned for northern Utah, range improvement, drought-resistant forage crops, and forage crops suitable for alkali soils. As in Utah, the land along the streams is irrigated and, where not too strongly impregnated with alkali, affords good yields of alfalfa and other of the more commonly cultivated crops of the region; but over a large part of the southeastern section irrigation is either impossible or impracticable, and here the question of drought-resistant crops is an

all-important one. Under present conditions, however, and largely because of the distance of this section from the State station, it does not seem very likely that cooperative work along this line could be arranged to advantage with the station authorities. Moreover, investigations carried on in connection with either the Utah or Wyoming station would apply as well to this region. In the northern portion of the State there is a large farming community surrounding Moscow, the location of the State experiment station; and here, perhaps, the most important question is that of meadows and pastures suitable in either short or long rotations for the mixed or diversified farming which is coming into practice in this section, since the lands are beginning to show "wheat sickness," from continued cropping with that cereal. This question is also one of considerable importance in eastern Washington and northeastern Oregon, and is, perhaps, the most available for cooperative effort between the Idaho station and the Department.

WASHINGTON.

This State, from its large size and its varied soil and climatic conditions, offers a number of important and perplexing problems. Much good work has already been done by the State institution, both in the testing of hardy, introduced varieties and in the study of native species. A great deal of this work has also been done in cooperation with the Department through the Division of Agrostology. At North Yakima and Walla Walla some good work has also been done under the auspices of the Division in the testing of drought-resistant grasses and forage crops, and also the behavior of certain crops under irrigation.

Probably the two most important forage problems for Washington as well as the adjoining portions of Oregon and Idaho, are (1) the improvement and renovation of the ranges: and (?) forage crops for rotation in mixed farming in the wheat-growing region, particularly in the Palouse country. Other problems of importance are alkali-resistant forage crops, drought-resistant forage crops, and sand and soil-binding grasses, the last, perhaps of less importance here than in Oregon, since in the latter State, in addition to the Columbia River region, there are vast sand areas along the immediate Pacific coast where this question is a pressing one. After a conference of several days with Director Bryan, Professor Spillman, and several members of governing board, in which the various forage problems of the State and the Northwest generally were discussed in much detail, the opinion prevailed that the best line of cooperation between the Washington station and the Department would be in connection with the problem of range improvement. This question is not only

the most important for the State and region, but there are many localities in which investigations can be conducted that will apply well to all the sagebrush-plains regions of Washington, Idaho, and Oregon. This work can, perhaps, be undertaken better with the Washington station than with those of the other States, while, on the other hand, other problems that are encountered by the farmers and stock raisers of Washington can be as well or better met and answered in the other States, as has already been suggested under the discussion of cooperative work possible with those stations. Owing to the lack of time, no visit was made to the Oregon station. But I was given to understand that this station would be glad to join the Division in cooperative investigations; and, as already suggested by you, the subject of sand and soil binders would be a good line of work to be undertaken in this State. Oregon is particularly well situated for the investigation of this problem, and urgent requests for its consideration have been made to the Secretary by members of Congress and private individuals.

MONTANA.

The forage problems in this State are essentially the same as those already discussed for Idaho and Wyoming, the most important being those of the improvement of the cattle and sheep ranges and crops resistant to drought. As in Wyoming, the question of crops suitable for meadows in relatively high altitudes is one of considerable importance, the demand for such crops having increased very rapidly during recent years. Another question which is becoming more and more important as lands are being brought into cultivation is that of alkali-resistant crops. Through injudicious irrigation, seepage from canals, and other causes, considerable areas of land which have heretofore given good crops of grain or alfalfa have become so strongly impregnated with alkali that expensive special treatment of the soil has become necessary, unless crops can be found sufficiently resistant to the alkali to flourish under the present conditions. The State station has already demonstrated the practicability of growing clover, timothy, redtop, and other of the more commonly cultivated forage crops in the more favored sections, but there is much to be done in the solution of the above-mentioned problems in this State. Experiments already under way in South Dakota and other of the range States of the Northwest are equally applicable to this State and it would seem hardly advisable to undertake this line of investigations here. The station authorities are prepared to test drought-resistant crops and doubtless much can be done in this direction through the distribution of seeds of promising varieties from the Department. The authorities here realize the importance of cooperative investigations and are eager to join with the Department in any lines that may seem advisable. The agriculturist and botanist of the Station

are particularly anxious to undertake the investigation of alkali-resistant crops, and the botanist is also very desirous of cooperating with the Division in the investigation of the geographical distribution of the grasses of the Northwest, a subject which might well be undertaken here as the station is well prepared for such a line of investigation and the character of the grass flora of this State is such as to lend itself admirably to the work. The character of the problems to be met in this State and the variety of the soil and climatic conditions that prevail render it highly probable that one of the best means of solving some of the questions will be found in the use of selected and improved varieties of grasses and forage crops adapted to the special local conditions. On this account the station authorities are much interested in the question of developing new and hardy varieties of grasses and forage crops and are desirous of cooperating with the Department along this line of investigation.

MINNESOTA.

Probably no other one of the northwestern experiment stations has done so much toward solving the various forage problems found within its borders as the Minnesota station. The station has been fortunate in having abundant funds and facilities that could be devoted to this work, and, through its various substations and cooperation with the farmers in different sections, much good work has been accomplished. Professor Hays, the agriculturist of this station, has probably done more in the selection and breeding of new and hardy varieties of grasses and forage crops than any one else in the United States, and has also accomplished some excellent results along the line of the management of meadow and pasture crops. The work of this station is conducted upon a broad and liberal basis, and the authorities are desirous of the closest cooperation with the Department. The lines which lend themselves most readily to cooperative effort at the present time are the selection and improvement of new and hardy varieties of grasses and forage crops and the formation, care, and management of pastures; and, since this station has already done such valuable work in these directions, particularly along the first-mentioned line of investigation, it seems highly desirable that arrangements should be made whereby the Department, through this Division, can join in such work.

SOUTH DAKOTA.

The South Dakota Experiment Station has been an able second to that of Minnesota in grass and forage plant investigations, and has already solved in a satisfactory manner some of the most important problems confronting the older-settled portions of this State. It was with this station that the Division of Agrostology undertook its first

cooperative experimental work, and the plan of cooperation adopted in this instance has been the basis of subsequent work. The investigations undertaken with this station deal with problems that can not be satisfactorily met at the home station from the fact that the soil and climatic conditions are quite different from those which prevail over the western portion of the State, which is quite typical of a large part of the northwestern range region. At the request of the South Dakota Experiment Station, the Division of Agrostology early in 1899 joined with it in investigating the question of improvement of the northwestern ranges and testing drought-resistant grasses and forage crops. Up to the present time the work has been very satisfactory in plan, in results, and in promises for the future. The practicability of improvement of the natural grass lands through rest and special treatment is being demonstrated, and much is being done to show the farmers and stockmen what can be accomplished by the cultivation of drought-resistant forage crops, particularly quick-maturing annuals for the production of forage to supplement the natural ranges and pastures.

SUMMARY.

In brief, this series of visits to the stations demonstrates clearly not only that there are many problems which can be studied much better through station and Departmental cooperation, but that the station authorities themselves appreciate the desirability of such cooperative work and are eager to enter into it. It is recognized that in these general problems, while the stations are able to work out the details of experiments and matters of relatively local bearing, there is a most important phase of the investigations that can be much more satisfactorily handled by the Department; and, in order to secure the best results to the country at large, it is highly desirable that there should be the closest cooperation between station and Departmental investigators. In addition to the assistance which the Department can render the stations in solving these special problems through the detailing of its experts for field investigations, and supplying seed for experiments, this cooperation will have a most important bearing on the work of the stations in encouraging greater concentration on lines of greatest importance to the people and in rendering more readily available to the station workers the experience and training of the Departmental experts.

Consultation with the station authorities has emphasized the desirability of cooperation along a number of lines of investigation, the following being perhaps the most important at the present time, and including every section of the country:

1. The formation, care, and management of pastures, including the selection of the best varieties, methods of preparing the soil and

of planting the seed, and after-treatment of grass lands, including grazing, rest, fertilizing, and cultivation.

2. Range improvement, or the best methods of bringing up the natural grass lands of the great range regions of the country and maintaining them in the condition of greatest productivity, including the improvement of the native grass cover by reseeding, alternation of rest and grazing periods,, scarifying, etc.

3. Alkali-resistant crops, particularly those best adapted to furnishing forage that can be used to supplement the native ranges.

4. Cover crops for soils liable to wash, which will at the same time afford a supply of forage or can be turned under for green manure.

5. A continuous soiling series for use in sections where the dairy-industry is paramount.

6. Winter pasturage for the South and Southwest.

7. Sand-binding grasses for the Coast regions and along the Great Lakes.

8. Meadow crops for higher altitudes particularly in the Rocky Mountain States, where, although pasturage is abundant, crops that will produce profitable amounts of hay are greatly needed.

9. Supplementary forage crops, particularly those with a short season of growth, that can be grown in rotation with wheat, cotton, and other primary crops, either for forage or for the improvement of soil fertility.

10. Drought-resistant crops for arid sections.

11. The selection and development of improved varieties of grasses and forage crops adapted to special conditions and uses.

As a result of visiting the State stations, and through correspondence, it has been ascertained that cooperative work can be arranged for the investigation of each of these problems with one or more stations most advantageously situated, and there is no question as to urgent need of such investigations. In some cases arrangements have been practically completed for undertaking work along certain of these lines, such as the formation, care, and management of pastures and meadows, range improvement, and soiling crops, but the funds provided are too limited to justify the undertaking of more than a relatively small portion of the investigations needed. In fact the entire amount of funds could be spent to advantage in the investigation of almost any one of the problems, and would then be found too meager for the purpose.

In many cases this cooperative work can be carried on, as has been done in a limited way in the past, through the distribution of seeds of desirable varieties, and this should be undertaken wherever possible. It is very desirable, however, that the work should be organized on a more systematic basis than heretofore, particularly in order

that station men may give more careful attention to the study of the varieties sent out. In the first place, where varieties are distributed for general cultivation, only those should be sent to the stations that give reasonable promise of success, it order that there may be no waste of time and energy in testing useless sorts; and, in the second place, the importance of these tests should be thoroughly realized by the station men, and more careful attention should be given to the work. It is highly desirable in the case of these varieties to distribute seeds in rather larger quantities than heretofore and to fewer stations, selected with special reference to the suitability of the prevailing soil and climatic conditions for the proper development of the varieties. Another line of cooperative investigation, which is of highest importance and which can be undertaken at the present time with relatively little outlay of funds, either on the part of the Department or the station, is that of the selection and development of improved varieties of grasses and forage crops. The Department, by serving as a medium for the distribution of seeds and unifying and systematizing the methods of observation and study, as well as the results obtained, can play a most important part in this work, and this is urged as a most fruitful line of cooperative effort.

Respectfully,

THOMAS A. WILLIAMS,

In Charge of Experimental Work.