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OF THE

CHIEF OF THE DIVISION OF CHEMISTRY

FOR

1897.

BY

H. W. WILEY.

[FROM THE REPORT OF THE SECRETARY OF AGRICULTURE.]



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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CONTENTS.

	Page.
The work of the year.....	1
Study of typical soils.....	1
Study of foods.....	2
Cooperation of the Association of Official Agricultural Chemists.....	3
Miscellaneous.....	3
Proposed work for the fiscal year ending June 30, 1899.....	4

REPORT OF THE CHIEF OF THE DIVISION OF CHEMISTRY.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., August 31, 1897.

SIR: I have the honor to submit herewith for your consideration the executive report of the Chemical Division for the fiscal year ended June 30, 1897.

Respectfully,

H. W. WILEY, *Chief.*

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The character of the work carried on in the Chemical Division of the Department of Agriculture during the fiscal year ended June 30, 1897, is shown in the following summary.

STUDY OF TYPICAL SOILS.

The value of the study of the typical soils of the United States has been enhanced by securing from the celebrated experiment station at Rothamsted samples of a few of the soils whose history has been carefully noted at that station during the past fifty years. These samples were kindly furnished by Sir J. Henry Gilbert, who, in conjunction with Sir John Bennett Lawes, has had charge of the experimental work at that station for the past sixty years.

A direct comparison has been instituted between these soils, whose history has been known for so long a period, and the typical soils which have been secured from various parts of this country.

The character of the work has not varied greatly from that of previous years, but some important changes in the details have been instituted. During the previous years the amount of moisture in the soil at any given time was determined chiefly by an inspection of the surface, with occasional weighing of the pot. This method, under constant supervision of an expert, is capable of securing the best results. Often, however, it happens that this supervision of the work, which has been under the immediate direction of the chief of the division, is interrupted by reason of his absence. In such a case it has been deemed advantageous to have a more rigid control of the quantity of moisture present. To this end weekly weighings of the pots have been made, so that the quantity of moisture which has been evaporated during the seven days is directly determined. Knowing the quantity necessary to produce complete saturation of the soil, a simple calculation will show the amount to be added in order that the amount of moisture in the soil shall be between 60 and 70 per cent of the total quantity necessary for its complete saturation.

The method of weighing has been improved by an ingenious mechanical device which renders it possible for one person, without assistance and without undue physical exertion in the way of lifting the pots, to weigh the whole number, viz, 176, in about four hours.

Important improvements in the method of applying the moisture have also been inaugurated, which have been the result of the experience of the past few years. The use of glass measuring vessels has been discarded, and a large number of tin vessels of conical shape, holding 2 pounds of distilled water, have been employed. By these improved means it is quite possible to add one portion of water to each of the pots in the course of two hours.

The general control of the crops growing on these soils has been continued as in previous years. Oats and beans are grown during the first half of the season in duplicate samples of typical soils. After the harvest of these crops the soil in the pots is again prepared for planting and a crop of buckwheat grown thereon. By this method two crops are secured during each season, thus increasing the value of the experimental work by duplicating the data obtained.

A careful study is made of the total amount of dry matter produced in each pot and the quantity of nitrogen, phosphoric acid, and potash removed from the soil by each crop is determined. The data of four seasons are now at hand and, while it is not claimed that these data are sufficient to establish all the points in question, they are at least sufficiently extended to warrant the preparation of a preliminary report, which is now under way. This report will contain statements in regard to the composition of the soils, their physical character, their water-holding capacity, their content of humus, and the percentages of nitrogen, phosphoric acid, and potash contained therein, both as regards total content and in respect of the quantities removed by different solvents.

These data will be illustrated not only by analytical tables but also graphically in such a way as to show in the most evident manner the relation which exists between the physical and chemical composition of the soil, its content of moisture, and the quantity of dry organic matter produced.

STUDY OF FOODS.

The principal part of the work in the investigation of foods during the fiscal year has been devoted to a study of cereal products. This study has naturally followed that of the previous year on the composition of the cereals themselves. In the study of the cereal products the direct products of milling have received first consideration. The composition of different varieties of flour and meal and of the by-products of milling has been carefully established by elaborate chemical investigations.

To the ordinary chemical work has been added a study of the calorific power of the different products as determined by the direct combustion in oxygen. Valuable data in regard to the heat-giving properties of foods have thus been secured, and it has also been ascertained that the combustion is a valuable check upon the accuracy of the chemical analyses. When the calorific power of the principal constituents of foods, viz, proteid matters, starch, and fats, has been determined, it follows that the calorific power of a cereal can be determined from the analytical data, provided they have been accurately obtained. When, therefore, it is found that the calculated calories from the analytical data differ materially from the determined calo-

ries by direct combustion, it is evident that an error has been committed, either in the analysis or in the combustion. In that case a repetition of the analysis or the combustion is usually required to discover the source of the error and permit of its correction.

The work of investigating these food products has been particularly complicated. It has covered the whole range of flours, meals, milling by-products of every description, biscuits, cakes, and prepared cereal foods. The analytical data and comments thereon have been prepared in manuscript form and will soon be ready for transmission to the printing office. This work will complete the systematic investigation which has been carried on so long by this Division, beginning in 1883 with a study of the cereal products in the United States and continued without intermission up to the present time. The amount of analytical labor which has been executed in this work has been very great and the success which has attended it has been due largely to the industry and application of the analysts engaged therein.

COOPERATION OF THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The excellent results which have been obtained by the active cooperation of this Department with the Association of Official Agricultural Chemists have been recognized and acknowledged in all quarters of the world. Especially in the United States have these results been of inestimable value in unifying and coordinating the methods of analyses employed in the various experiment stations and other laboratories of the country. A comparison of the methods of procedure at the present time with those which were in vogue fifteen years ago would serve as an unanswerable argument in favor of the continuation of the cooperation which has been so harmoniously established and maintained.

In the active work incident to this cooperation the Chemical Division has taken a prominent part. All of the subjects which are assigned for investigation by the Association of Official Agricultural Chemists are fully and patiently studied by the chemists of the Department. The contributions which have been made in this way from the Division of Chemistry have done much to secure the high standard of analytical work which now obtains in the United States among our agricultural chemists. So firmly has this standard been established and so excellent have been its merits that it has commanded the approval and support of commercial chemists and those engaged in original investigations.

At the Second International Congress of Applied Chemistry, which was held at Paris at the beginning of the fiscal year mentioned, the bulletins containing the methods of analysis of the Association of Official Agricultural Chemists were officially recognized, and it was voted to make them a part of a comparative study of international methods which was inaugurated by this Congress. The Department of Agriculture has, through its cooperation with the Association of Official Agricultural Chemists, inaugurated a movement which it is believed will soon be consummated in an international agreement covering all points of analytical operations in agricultural chemistry.

MISCELLANEOUS.

The miscellaneous work of the Chemical Division has been, as in previous years, of a varied character. One of the chief items in this

class of work during the fiscal year has been the recommencement of the investigation of sugar-producing plants in the United States. The possibility of the establishment of an indigenous sugar industry was pointed out by this division as long ago as 1884. During the past four years the active participation of the Department of Agriculture in this work has been suspended. The recommencement of these investigations has been recognized with peculiar pleasure by the farmers and capitalists who have been striving to establish the beet-sugar industry in the United States. The work of investigation has been undertaken practically at the point where it was left in 1894.

The chief immediate object of the work is the establishment of stations for the growth and improvement of the sugar beet, with the object of establishing in this country farms for the production of beet seed of high grade. It has already been established by our investigations that domestic seeds produce a hardier plant and a larger percentage of sugar than seeds of foreign origin. The great importance, therefore, of the growth of indigenous seeds is at once apparent. It is the object of the Chemical Division to establish, by chemical analysis, the right beet to serve for the production of seed, and to plant for the production of seed only those beets which, by chemical analysis, have shown sugar-producing properties of an exceptional character.

PROPOSED WORK FOR THE FISCAL YEAR ENDING JUNE 30, 1899.

By reason of the restricted appropriations afforded the Chemical Division for the fiscal year ending June 30, 1898, it will not be possible to extend the scope of investigations much beyond the plan followed in the previous fiscal year. The investigation of foods will be continued, the special subject under consideration being the composition and character of infants' and invalids' foods. This subject is of such a wide scope that it will be all the work which it will be possible to do in this line during the year.

The work in the typical soils of the United States will be continued along the lines already followed for the purpose, either of ascertaining new facts in regard to the relation of soil to crop, or of confirming the results of investigations already made, or of correcting them in order to make them conform to the new discoveries which may be made.

The work in the investigation of sugar-producing plants contemplates the analysis of samples grown by farmers in different parts of the country from seeds furnished by the Department. From arrangements which have already been made by these farmers, it is indicated that 5,000 or 6,000 samples of beets will be sent to the Department for analysis during the months of September, October, and November. Preparations have been made for the accomplishment of a large amount of chemical work, and it is hoped that valuable information may be secured thereby in regard to the quality of soil and climate in different localities where beets can be produced with a high content of sugar. A study of the composition of beets grown from high-grade seeds, under the direction of the Chemical Division, will also be conducted. These beets have been grown at six of the experiment stations of the country, so distributed as to represent a wide range of climatic conditions.

In the miscellaneous work of the division it is also proposed to continue the investigations which have been undertaken, not concluded, in regard to the methods of determining starch in cereals and other

starch-containing plants. This is one of the most difficult operations in analytical agricultural chemistry, and has been the subject of wide discussion in all parts of the world.

An investigation of the disposition which is made of street sweepings and other refuse of cities has been undertaken by this division and will be prosecuted vigorously during the coming year. The division has placed itself in communication with all the cities of the United States having a population of 10,000 and over. It has also perfected arrangements for obtaining information in regard to disposition of street sweepings and sewage in the largest cities of Europe. The importance of this work is twofold. First, from a hygienic and economic point of view, in regard to the best method of disposing of this refuse, and second, from a manurial point of view, in regard to the value of these materials for fertilizing purposes. In cases where garbage and street sweepings are burned a study of the resulting ashes will be made for the purpose of determining their fertilizing value. It is hoped that a material advantage will accrue from this investigation, both to the cities, in respect of the method of disposing of the refuse, and to the farmers, in respect of securing a new fertilizing material at a low price.

