

grease or tallow from the plates, or by moving one plate over another with a twisting motion. Such injuries are seen to be ready centers of corrosion.

In order to determine what proportion of the imperfections brought out by the reagent were due to holes incident to cleaning and handling the plates after tinning, some regular coke sheets were obtained just as they emerge from the tin bath, still covered with the tallow used on the top of the bath. While the number of the holes was reduced, the improvement was not such as to warrant a radical change in the customary method of cleaning. This experiment, however, emphasizes the softness of the tin coating and the great care which must be given to handling tin plate if the centers of corrosion are to be kept at a minimum.

With this easy and accurate method of locating the pin holes or other points on the tinned surface where the iron base is exposed, it is hoped that something more definite may soon be learned regarding the cause of these imperfections and a possible method of preventing them be suggested.

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## THE CONSUMPTION OF NITRATE OF SODA IN THE UNITED STATES.<sup>1</sup>

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On November 10, 1904, I had the honor of calling the attention of the members of the Washington Chemical Society to the fact that as the statistics for the chemical manufactures had come to be taken by the Bureau of the Census they could be made use of in solving many problems of interest and value, provided only that they were properly used, and I pointed out that one of these problems was that of ascertaining the principal industries in which a given material was used and the extent of its use in each industry. The results of this process as applied should prove to be not only of general scientific and economic interest, but also of special value in legislation and litigation where the rule of "principal use" obtains; in determining tariffs and levying taxes; in fixing freight rates; in manufacturing and other operations where the question of substitution may arise; and in other special instances. In the investigation work of the census itself such data furnishes additional checks on the returns.

<sup>1</sup> Read at the Baltimore meeting of the American Chemical Society, December 31, 1908.

The application of this method<sup>2</sup> was illustrated by taking sulphuric acid as an example, since this is the substance of fundamental importance in the chemical industries, and there was presented, in tabular form, the results obtained. These results, after further checkage, have been published on page 23 of "Chemicals and Allied Products for 1905," this being Bulletin No. 92 of that census of manufactures.

Attention having been called to the proper use of the statistics of the census it may be well to state here that, where the chronology is of importance one should be careful to ascertain the period of time to which any given census statistics refer, because, in a census of manufactures, the data record transactions already completed at the time the investigation was made, and, because of changes in the law, as enacted by the Congress, the yearly periods covered may not be similar and the intervals between the successive censuses may not be of precisely the same length. In illustration we have the census of 1900, covering the operations for the year ending May 31, 1900, and the census of 1905, covering the operations for the calendar year ending December 31, 1904, except for the State of Michigan, where, for the purpose of coöperation with the State authorities, and to avoid duplicate enumeration in the same year, the statistics were collected for the year ending June 30, 1904.

Also it may be proper to point out the chance of error which may arise from making use of census data without consulting the text carefully so as to ascertain to what the data applies. Thus, if one wishes to obtain the statistics for the chemical industries of this country at the census of 1905 he might consult Table CX on page clxxi, of Part I, and find the value of the products given as \$1,031,965,263, or he might consult Table I, on page 398 of Part IV and find the value of the products given as \$323,997,131 or a difference of over \$707,000,000 in the value of products for the same period of time. But on investigating the tables and their accompanying text we find the first to cover the "Chemical Group" and to embrace a large part of those substances found in chemical technologies, while the second table treats only of those substances styled in the census classification, "Chemicals and Allied Products." Also, to take another example, we find from Table 8, page 404 of Part IV, that the sulphuric acid produced at the census of 1904 was 467,614 tons, while from Table II on page 405 of the same part, the sulphuric acid

produced is reported for the same census as 1,869,437 tons, both being for 50° Bé. acid. From inspection of the text we find there is no discrepancy between these figures, but that the first table treats only of the products of those establishments which are included in the census class of "sulphuric, nitric and mixed acids," while the second table gives the total sulphuric acid produced not only for sale, but for consumption also, by establishments of all kinds.

What is true of products is also true of materials used in manufacture. They may appear in different reports represented by different numbers and yet each of the statements may be correct. Such a condition of affairs may be repeatedly met with in the Reports on Chemicals and Allied Products, and it is here especially, that the text should be scrutinized, since each of the Special Reports for 1900 and 1905 embraces nearly two score of classes and some thousands of industries and, in order to present the true condition of each of several industries, it has been necessary to duplicate some of the data.

Thus if we examine the statistics of the class styled "Fertilizers," we find nitrate of soda enumerated as one of the materials used in this manufacture, and that it is used in this industry not only as a direct component of mixed or compounded fertilizers, but also in the manufacture, within fertilizer factories, of sulphuric acid by the chamber process. Again if we examine the report on the class styled "Explosives," we find that nitrate of soda, as a material used, is used not only as a component of blasting powder and of dynamite, but also in the manufacture, within explosive factories, of nitric acid and also of saltpeter or potassium nitrate. In order then to completely set forth the sulphuric acid, or nitric acid, or saltpeter industries, the quantities of these substances produced in fertilizer or explosives establishments, and of the materials used in their production, must be reassembled and presented anew.

Two methods for presenting the statistics of the consumption or distribution of the materials of manufacture are thus indicated. (1) By the classes of products in the manufacture of which the material is consumed both directly and indirectly. (2) By the products in the manufacture of which the material is consumed directly only though some of these products may constitute the raw material of further manufacture. The data under the first category is that which is reported by the establish-

ments in gross, and may be taken directly from the published census tables. The data under the second category must, on the other hand, be obtained by analyses of the data returned for each class, assigning the proportion of the material consumed in the manufacture of each intermediate and each final product, and then assembling that consumed in the direct manufacture of each single product.

Proceeding in this manner for nitrate of soda, I find:

(1) NITRATE OF SODA CONSUMED IN THE UNITED STATES BY ESTABLISHMENTS CLASSES AS FOLLOWS:

Class.	1900. Short tons.	1905. Short tons.
Fertilizer industry.....	19,518	42,213
Dyestuffs " .....	223	261
General chemicals industry .....	35,990	38,048
Glass industry.....	10,770	11,915
Explosives industry.....	88,924	133,034
Sulphuric, nitric and mixed acids ind. . .	27,406	29,301
	182,431	254,772

(2) NITRATE OF SODA CONSUMED IN THE UNITED STATES CLASSED BY PRODUCTS IN WHICH IT IS DIRECTLY USED..

Products.	1900. Short tons.	1905. Short tons.
Compounded fertilizers.....	13,058	34,795
Dyestuffs.....	223	261
General chemicals.....	30,287	31,324
Glass.....	10,770	11,915
Explosives.....	76,696	100,985
Nitric acid.....	30,213	50,301
Saltpeter.....	5,703	6,724
Sulphuric acid.....	15,481	18,467
Total.....	182,431	254,772

An attempt has been made to check these totals by comparing them with the quantities of nitrate of soda reported by the Bureau of Statistics as having been imported for consumption in the United States during the fiscal years 1899 and 1904 and 1905, taking the average of this latter two-year period. These quantities are reported in long tons, while the census quantities are given in short tons. As reduced we have 206,357 short tons as being available at the Census of 1900 and 322,709 short tons as being available at the Census of 1905. There is therefore 23,926 short tons of nitrate of soda for 1900 and 67,937 short tons for 1905 not accounted for in the tables which may be charged up to all other uses and products, such as enameling, metallurgical flux, pickling and the manufacture of minor chemicals. These last figures must be regarded as mere approximations, since stocks of nitrate are frequently hoarded and then brought out when there is a specially active demand for them, and it may therefore happen that the consumption in this country for a given year may exceed or fall below the imports for that year.

The results set forth in the tables, though not exhaustive are of interest, especially in the item of fertilizers, for there is a wide-spread belief that nitrate of soda is most largely consumed in agriculture, yet such does not appear to hold true in this country. But the conditions which obtain in this industry in the United States vary widely from those which obtain in European practice, for, in the United States, besides nitrate of soda and ammonium sulphate, large quantities of other nitrogen-containing substances are used in compounding fertilizers. Thus the statistics of the census of 1905 show that in that census year there was used for this purpose, besides the nitrate of soda, 10,540 tons of ammonium sulphate, 923,305 thousand fish, 125,888 tons of ammoniates, 1,160 tons of saltpeter, \$2,376,448 worth of cotton-seed meal and \$5,094,149 worth of bones, tankage and offal.

The menace to an extension in the use of nitrate of soda in the United States is found:

(1) In the increased use of by-product ovens for coking coal, it having been shown<sup>1</sup> that but 3,317,585 tons of the 37,376,251 tons of coal coked in this country in the census year 1905 were coked in by-product ovens and that if all had been so treated there would have been produced 359,560 tons of ammonium sulphate instead of 15,773 tons which was the actual yield from this source.

(2) In the substitution of contact processes for chamber processes in the manufacture of sulphuric acid.

(3) In the discovery of calcium cyanamid or lime-nitrogen because an extensive plant is now being erected at Niagara Falls for its production, and

(4) In the introduction of electric processes for the manufacture of nitrates from atmospheric nitrogen.

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## CHANGE IN THE COMPOSITION OF UNGROUND CEREALS DURING STORAGE.<sup>2</sup>

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The purpose of this investigation was to find out if there is any change in the chemical composition of cereals and to what extent these changes take

place when they are stored in their natural state (unground) for a period of months or years. Where many hundreds of samples are to be investigated it is not always convenient to analyze all of the samples when fresh, and as a result some samples are analyzed after they are months and in some cases even a year or more old.

It would seem possible that a deterioration or a transformation of some of the organic compounds such as carbohydrates or proteins might easily take place either due to the direct loss through respiration of carbon dioxide producing simpler compounds or to an actual conversion of one compound into another, such as starch into sugars due to enzymic action.

The authors are not aware that very much work along this line has been carried out in the past. The effect of ageing has been studied in connection with the gluten content of the grain<sup>1</sup> (good wheats maintaining their gluten content better than poor wheats), but as far as we know the study has not been applied to the different combinations of nitrogen in the grain such as the proteins and amids nor to the content of sugars.

In the fall of 1906 large samples were collected of the season's crop of four cereals, *i. e.*, field corn, Swedish select oats, Kubanka wheat and Minnesota No. 6 barley, all grown at the State Experiment Station at Brookings, South Dakota, and were sent to the Bureau of Chemistry for experimentation. Small samples of these were ground and analyzed immediately for the following substances: Water; ash;  $P_2O_5$ ; total nitrogen; albuminoid nitrogen; 70 per cent. alcohol-soluble nitrogen; 5 per cent.  $K_2SO_4$ -soluble nitrogen; water-soluble nitrogen; water-soluble nitrogen coagulable on heating; water-soluble nitrogen precipitated by cupric hydroxid (Stutzer's reagent); invert sugar; cane sugar as dextrose; weight per 1000 kernels; and weight per bushel. All results with the exception of the last two have been calculated to the *dry basis*. The samples have been ground and analyzed at intervals of six months and the results compared. In the fall of 1907 additional samples of wheat, oats and barley were collected at College Park, Maryland, at the Experiment Station. Rye was also taken as an additional cereal. The record of corn is a continuous one for two years involving five separate periods of analysis. A sample of ground corn was allowed to stand for one year and its

<sup>1</sup> Bulletin No. 65. Census of Manufactures, 1905. Coke.

<sup>2</sup> Read before the Baltimore meeting of the American Chemical Society on December 30, 1908 and published by permission of the Secretary of Agriculture.

<sup>1</sup> "La Dégénérescence des Blés," L. Vuafart, *Jr. Agr. Prac.*, 1908, No. 40, page 429.