analysis of zinnwaldite, and the mean of Riggs' three analyses of cryophyllite compare as follows:

	Zinnwaldite.		Cryophyllite.	
	Found.	Calculated	Found.	Calculated.
SiO_2	46.44	47.55	51.86	51.95
Al_2O_3	21.84	21.19	16.50	18.13
Fe_2O_3	1.27	....	2.98	....
FeO	10.19	13.60	6.65	7.52
MnO	1.57	....	0.21	....
CaO	....	....	0.04	....
MgO	0.18	....	0.07	....
Li_2O	3.36	2.84	4.89	4.71
Na_2O	0.54	....	0.79	....
K_2O	10.58	10.66	10.61	12.26
H_2O	1.04	....	1.29	1.41
F	7.62	7.18	7.08	6.94
	104.63	103.02	102.97	102.92

In general, it seems highly probable that the lithia micas are all characterized by the presence of the groups $AlF_2.X.R'_3$, $AlF_2.X.R''R'$, and $AlF_2.X.Al$; in which X may be either SiO_4 or Si_3O_8, and with the fluorine replaceable by hydroxyl in the process of vermiculitization. In the original form of the mica theory, the group AlF_2 was regarded as the equivalent of R' in a molecule of the muscovite type. It is now represented as belonging to a distinct molecule analogous to clintonite. So far as the evidence goes, this interpretation seems to be satisfactory; and it is an advance upon the earlier scheme in the direction of simplicity.

CHEMICAL NOTES FROM THE COLUMBIAN EXPOSITION.

I.

By J. H. Long.

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THE various exhibits of thé Exposition in Chicago are grouped under twelve heads or departments. Those specially interesting from a chemical standpoint are found in the departments of Agriculture (A), Mines, Mining and Metallurgy (E), Manufactures (H), Electricity and Electrical Appliances (J), and Liberal Arts and Education (L). Certain departments occupy special buildings. The exhibits in several departments are scattered through a number of buildings.

In order to convey a clear idea of what chemistry has done to make the Exposition interesting and instructive it will be found best to study the departments separately, and in the order given above. In most instances it is not my intention to go into details but to sketch in outline what is shown.

DEPARTMENT A.—AGRICULTURE.

We have here really three classes of exhibits, with interest for chemists. The first illustrates chemical methods applied to agriculture, the second the materials which chemistry has given to the farmer to increase production, and the third the results obtained both in the experimental station and on the farm. The application of chemical science to the solution of agricultural problems is of comparatively recent origin and several of the transatlantic countries had taken long strides in this direction before a beginning even was made in the United States. The work of Lawes and Gilbert, Boussingault, Koenig, Maerker and others, following the pioneer investigations of Liebig in time produced its effect this side of the ocean and the Fair at Jackson Park shows what has been done since enthusiasm in the United States was first aroused.

As long as great tracts of virgin prairie or timber soil lay at the disposition of the farmer for little more than the mere asking, and as long as crops of some sort could be raised on this soil with comparatively little labor it was useless to ask the husbandman to follow a rational system in his field or dairy. A few crops could be easily raised and these brought a fair price and there was but little outside competition; why, therefore, try anything new? But times change; fast steamers and cables under the sea have brought the people of the earth near together. The American farmer found new markets for his produce, but he found, also, new competition to meet and the men of science were called in to help him. Agricultural colleges and experimental farms have sprung up all over the country and the work in them has been stimulated by grants from the national government and by strong suggestive influences growing out of the association of agricultural chemists from all parts of the union. Forty-nine of these experiment stations are regularly endowed with an annual grant of $15,000 each from the general government, besides a greater or less sum from other sources, while other stations from time to time receive special endowments for special work.

The chemical division of the Department of Agriculture at Washington has done most excellent work and its exhibit attracts no little attention. This division has published thirty-seven bulletins, of which number 13 appears in parts, eight of which are out with probably four to follow. Several of these bulletins have become standard authorities on special topics. The Department has erected a model laboratory in the north-east corner of the government building and in it are shown apparatus and processes for numerous exact determinations. Some of the equipment is new and some was brought from the Washington laboratory. The interested visitor will find here among other things a large model Landolt polariscope (by Schmidt and Haensch) and an attachment for this or similar instrument for production of constant homogeneous light (see March number of this Journal).

Also apparatus for sampling and analysis of mother beets; apparatus for evaporation of liquids at low temperatures; apparatus for recovery of alcohol; apparatus for cutting green fodders for analysis; a laboratory work table of special design with drainage toward the center; steam vacuum and pressure pumps and several small pieces of apparatus recently designed.

As is well known the laboratory has given much attention to the sugar question, thanks to the lively interest shown by the chief chemist of the Department, Dr. H. W. Wiley, and the exhibit is especially full in appliances employed in the researches in this industry.

In the Agricultural Building the laboratories of the experiment stations have united in making a collective exhibit of considerable interest, but popular, rather than scientific in many features. A model laboratory of an experiment station is shown with practically all the apparatus needed for regular work. There is a good collection of apparatus employed in the analysis of milk and in the examination of water by quick processes. Maps and photographs show the location and character of the important agricultural chemical laboratories of the country, while literature for free distribution gives information about the work of the leading stations. Once a year the Association of Official Agricultural Chemists holds a meeting, usually well attended by representatives from the laboratories in all parts of the country, at which old and new methods are discussed and at which the "official" processes for various determinations are decided on. The labors of this association have been productive of the highest good and the annual volume of proceedings finds many readers outside of the society. Much of the regular work of the members of the station staffs is published in the *Experiment Station Record*, which is issued at Washington under the auspices of the U. S. Dept. of Agriculture, with Mr. A. W. Harris as Director of Stations. The *Record* is now in its fifth year; it contains original chemical work from home stations, reviews of work done abroad in laboratories and practical results from harvesting of crops.

In the French section of the agricultural building there is a display illustrative of work done in some of the schools and stations of France. There are pieces of apparatus, models, charts, diagrams, maps, and photographs, a large number of books and reports for examination and some literature for distribution.

Dr. Ernest Milliau of the Marseilles Technical Laboratory makes an exhibit of charts in illustration of his methods of testing oils and fats. (See paper in March number of this Journal).

The agricultural schools and stations of Germany and England do not appear to be represented by any independent exhibits. According to the official German catalogue, which should be taken as a model for similar publications because of its concise accuracy and the variety of its information, there are in Germany at the present time fourteen institutions of the highest class in which education in the science of agriculture is given. These comprise the universities and several special institutes. There are thirty-three intermediate schools and 150 in which instruction of an elementary character is given, mainly to sons of peasant farmers, through the winter.

Agricultural chemists will be interested in the display of mineral fertilizers found in the Mining and Agricultural buildings.

In the former are good exhibits of phosphate rocks from Florida and South Carolina, while in the latter are several exhibits of natural and manufactured fertilizers from various sources. The most striking of these is the exhibit of the German Kali works or Stassfurt industry. The main feature of this is a collection of native and recrystallized products from the Stassfurt region, some of them being specimens of rare beauty. The product of the Stassfurt mines is now controlled by a syndicate of nine firms and has grown rapidly in value from a small beginning in 1857. Salt has been produced in the Stassfurt region for the last two hundred years by the evaporation of brine, but this industry had sunk to one of very small importance, when in 1857 borings showed the existence of extensive deposits of potassium and magnesium salts at a depth of 1000 feet or more. These salts were supposed, at first, to have but little value but they have become of the highest importance in chemical industry and in agriculture. The exhibit is arranged in eight groups:

1. Rock-salt of lower stratum, impure.
2. Rock-salt of upper stratum, pure.
3. Carnallite.
4. Kieserite.
5. Sylvin, with $NaCl$ or $MgSO_4$.
6. Kainite.
7. Schoenite.
8. Boracite.

These groups are divided according to the predominating minerals and do not simply contain pure crystals of each species. With rock-salt of the first group anhydrite, polyhalite, sulphur and glauberite are found and are here shown. The rock-salt of the second group from the upper stratum, although nearly chemically pure, is frequently beautifully colored, crystalline and clear. The carnallite of the third group is found pure and mixed with bischofite, kieserite and other minerals. The kieserite of the fourth group occurs pure and mixed with several other compounds. The sylvin of the fifth group and the kainite of the sixth group are exceedingly interesting exhibits as they contain a number of beautifully colored varieties, some of which are rare. In the seventh group two specimens of schoenite and the allied species, leonite, are shown. With the boracite of the eighth group a number of comparatively rare boron minerals are exhibited. Although about twenty-five species in all, with several varieties, are shown it must not be supposed that all have commercial importance. In fact, at the present time only five of the above-named minerals find application on the large scale, and these are kainite, sylvin, boracite, carnallite and rock-salt.

Kainite is mainly used as a fertilizer and for this purpose is prepared for market by simple grinding. The mineral as mined contains on an average about sixty per cent. of pure kainite. Its value in agriculture depends on the amount of potassium sulphate present, although the combined percentage of magnesium sulphate and chloride is higher. It is therefore sold with a guaranteed amount of potash corresponding to twenty-three per cent. of the sulphate. Small amounts of several purified salts are made from kainite as a starting point. The amount of kainite sold increased from 1313 tons (of 1000 kgms.) in 1865 to 545, 084 tons in 1892. Sylvinite, which contains on an average twenty-five per cent. of potassium chloride, sixty-five per cent. of sodium chloride, and seven or eight per cent. of the sulphates of potassium and magnesium, is also used mainly in the manufacture of fertilizers. The production of sylvinite increased from 2220 tons in 1888 to 32,669 tons in 1892. Boracite occurs in lumps usually mixed with carnallite. These lumps are sorted out by hand and sold for the production of borax and boric acid. The crude salt with seventy-five per cent. of boracite guaranteed, was mined to the extent of four tons in 1864 which increased to 205 tons in 1883, and 166 tons in 1892. Carnallite is naturally the most important of the Stassfurt minerals and occurs generally mixed with rock-salt and kieserite. The average composition of the crude carnallite, roughly separated from the bulk of salt found with it is:

Carnallite	61 per cent.
Rock-salt	25 " "
Kieserite	12 " "
Anhydrite and clay	2 " "

Pure carnallite should have the following percentage composition:

$MgCl_2$	34.5 per cent.
KCl	26.8 " "
H_2O	38.7 " "

from which it appears that the amount of KCl, the most valuable of the constituents, in the average mineral is 16.5 per cent. It is sold on a guarantee of 14.3 per cent., usually, and is employed in the crude form to some extent as a fertilizer, but most of it is used in certain industries whose reputation is world wide and which will be referred to later. In 1882, 5590 tons of carnallite were used as a fertilizer directly, while 1,053,709 tons were converted into purified salts. In 1892, 40,114 tons of crude carnallite were used in Germany as a fertilizer, and 723 tons were exported for the same purpose, while 695,912 tons were converted into concentrated salts. Immense quantities of potassium chloride are made, the amount being about 125,000 tons annually during the last fifteen years; a part of this is employed in agriculture, and the rest in chemical industry, mainly in making saltpeter by double decomposition with sodium nitrate. Several crude mixtures containing potassium salts are made from carnallite and are sold as fertilizers. They contain from fifteen to forty per cent. of potash (K_2O). The mining of rock-salt at Stassfurt is still a very important industry notwithstanding the constantly increasing amounts of salt produced elsewhere. The amount mined in 1857 was 12,797 tons, with a pretty regular increase down to the present time. In 1890 the product was 302,205 tons, in 1891, 365,910 tons, and in 1892, 293,247 tons. Some of this is very pure, 99 to 100 per cent., and serves for the production of fine white table salt, butter and pickle salt. The coarser and less pure grades are sold for salting cattle and for various chemical purposes.

The Mining building contains a small exhibit of Stassfurt minerals, but other nations make only very small exhibits of fertilizers, with the exception of Chile, which shows sodium nitrate in large quantities in crude and manufactured form.

As illustrating the results obtained by the application of chemistry to agriculture we have first in importance among the exhibits those made by the United States experiment stations. They consist of charts, diagrams, and jars filled with animal and vegetable products obtained under certain definite conditions of fertilization or feeding. Reference must be made also to the full literature of the subject found in the form of bulletins not only in the *Experiment Station Record* but sent out as independent publications by the states themselves. The work of the Rothamstead laboratory and farm is illustrated by several charts displayed with the United States station exhibits. These were sent by Messrs. Lawes and Gilbert. It appears that the most valuable part of the exhibit sent by them has been lost on the way. In the French section there are numerous charts illustrative of results gathered from the experimental farms of France. Brief mention must be made of several industrial exhibits which have a certain interest from the chemical standpoint. Starch and starch sugar are displayed by five American firms; one French firm sends rice starch, but Germany, England, Austria, and other European countries are not represented here. The chemical features of the cane-sugar industry are poorly illustrated in the United States displays. Nebraska makes an interesting exhibit of beet sugar. Two factories are in operation in that state, and the amount of refined sugar they put on the market in 1892 was nearly 4,000,000 pounds. Indications are that a much greater yield will be marketed this season. Photographs of the sugar machinery at the works are shown. It has been demonstrated that the soil and climate of Nebraska and other states are well adapted to the culture of the beet; the chemical division of the Department of Agriculture is able and ready to render all needed scientific aid, but the question of labor is the perplexing one which must be solved before the United States can think of supplying its own demand for sugar. No sugar is found in the exhibits of Austria or Germany, but some of the British colonies, Belgium, France, Italy, Russia, and the countries of Central and South America, make good displays. Interesting photographs of the machinery and other parts of one of the large Russian factories are shown and are quite worth examination. Edible oils and certain other refined products are found in abundance in the agricultural display, but their description is beyond the scope of this article. The samples of olive oil sent by California indicate that the industry is a growing one in that state.

MINES, MINING, AND METALLURGY.

The exhibits in this department are divided into twenty-seven groups, 42 to 68 inclusive, and there is scarcely one, which in some degree at least, is not interesting to chemists. In this general survey of the field I shall attempt to touch upon only those which are important as in some measure involving chemical processes.

First among these in the catalogue order is the elaborate display of the Standard Oil Company, of Cleveland. Everything connected with the industry of collecting and refining oil is represented here by profile maps, models of plants, samples of various crude oils, samples of light and heavy refined oils and other products. The list of refined products is large and instructive. Various mineral oils, crude and refined, are found in the displays of several states, notably from New York, Pennsylvania, Ohio, and Indiana. Crude mineral oils and asphalts are found in the displays of California, Utah, and Wyoming. Chemists interested in the asphalt industry will find good exhibits from the French, Swiss, Trinidad, and western American districts. Portland and other cements and the materials from which they are made are shown by American, German, French, and English exhibitors. In the German section of the Mines building there is a well-equipped cement testing laboratory, with all necessary appliances for chemical and physical examinations.

It would be useless to attempt a description of metals and ores, which are the chief attraction in this department, but special attention must be called to a few which are of unusual interest. Johnson, Matthey and Company, London, exhibit metals of the platinum group in crude and manufactured form. There are several large pieces of platinum and gold-lined platinum apparatus for the concentration of sulphuric acid, various smaller vessels for laboratory use, a standard meter of platinum-iridium and a number of rods and bars employed in tests of coefficients of expansion, etc. There are shown, also, an ingot of palladium weighing 1,000 ounces and valued at £7,000, an ingot of iridium weighing 240 ounces, large samples of rhodium, osmium, ruthenium and a number of rare salts of some of these metals. The Deutsche Gold und Silber-Scheide-anstalt of Frankfurt am Main, makes a very good display of gold, silver, and lead products, also colors for pottery, assaying chemicals and apparatus. Attention must be called in this place to the exhibit of W. C. Heraeus of Hanau, found in the manufactures building; more will be said about it in the proper place. The Canadian Copper Company, of Ontario, shows in large quantities nickel ores, alloys and pure metal. Like many other important exhibits this one appears to have been overlooked by the catalogue maker. The exhibit of the Pittsburgh Reduction Company, of aluminum and alloys and process of reduction is a creditable one and worthy of study. A model of the electric furnace used in the plant at Kensington, near Pittsburg, is shown. Assayers will find a well-equipped laboratory in this building furnished with modern appliances as used in the United States. Several men are at work here and ready to make all explanations asked for. In the exhibits of Utah, Wyoming, New Mexico, and Montana are several minerals which when compared with the great ore displays may appear of little importance, but which, however, are worthy of consideration. It is not popularly known, although described in bulletins of the United States Geological Survey, and recently at length in bulletin 60, that in the localities named there are vast beds of salts, sometimes nearly pure, but frequently mixed, which in time must play an important part in the industries of this country. Sodium sulphate exists, especially in Wyoming, in beds of great extent, sometimes crystalline and sometimes effloresced and nearly dry. The bulletin referred to gives analyses of this substance. I give here two analyses of native samples, which represent, I am told, large deposits. The analyses were made in my laboratory:

	1.	2.
Na_2SO_4	97.20	97.36
$NaCl$	0.59	0.14
Na_2CO_3	0.04	....
$CaSO_4$	0.58	0.75
$MgSO_4$	0.85	1.26
H_2O and loss	0.74	0.49
	100.00	100.00

I have seen samples of even greater purity. Much of the sulphate is mixed with carbonate, over fifty per cent. of the latter being frequently present in effloresced condition. Attempts have been made to manufacture pure alkali from this, but up to the present time without marked success (see in this connection an article by Professor Lunge, *Ztschr. angew. Chem.*, January, 1893). During the present year a new company has begun operations in Wyoming and has already achieved results which point to success in the future. Magnesium sulphate is also found in quantity in parts of Wyoming, but the absence of good railroad facilities renders all these deposits of little value at the present time. As coal seems to be found in abundance in the vicinity of some of these beds their development is one of the certainties of the future.

SOME EXPERIMENTS ON SAMPLING BY QUARTATION.

By P. W. Shimer and S. K. Reifsnyder.

FOR reducing the bulk of a coarsely crushed sample of ore on the laboratory sampling table preparatory to still finer crushing, it is customary to mix, spread out, and quartate the sample once or oftener. In order to determine the degree of accuracy obtainable by this procedure, as well as to discover, if possible, the best way to manage the details of mixing and quartation, the following experiments were made upon a mixture of 500 grams lead shot just large enough to be retained by a ten mesh sieve; 500 grams magnetic iron ore of a size between ten mesh and twenty mesh and 500 grams of crushed glass passed through a twenty mesh sieve, but from which the finest powder had been removed by washing with water. By reason of the different sizes, shapes, and specific gravities of the elements of this mixture it is a very difficult one to sample.

It was conceived, therefore, that any inaccuracy in the results of sampling would be prominently brought out and that any method that would give good results on this mixture, could be confidently used on the less difficult mixtures occurring naturally in ores. The mixture of 500 grams each of shot, magnetite, and glass was first separated by sifting, with the result that it was found to be possible to recover the exact amount ($33\frac{1}{3}$ per cent.) of each from the mixture. 500 grams of each were again