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GEORGE OTIS SMITH, DIRECTOR

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OUR MINERAL RESERVES

HOW TO MAKE AMERICA INDUSTRIALLY INDEPENDENT

BY

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OUR MINERAL RESERVES.

By George Otis Smith.

INTRODUCTION.

INVENTORY OF MINERAL RESOURCES.

The United States is not only the world's greatest producer of mineral wealth, but, so far as estimates of the earth's treasures have shown, it possesses greater reserves of most of the essential minerals than any other nation. It is to our national mineral resources that the United States Geological Survey has given special attention since its organization in 1879, for the congressional enactment creating the Survey specified as its duties "the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain."

Geologic investigations have been made with a view of determining the mode of occurrence and the extent of distribution not only of those minerals and rocks that possess present value, but also of those that have only possible future utility, the nature of which may be as yet neither known nor suspected. Thus a geologic map, in so far as its scale permits, is a graphic inventory both of the mineral resources now used and of those that are untouched because they are at present of no value. He is indeed a bold prophet, however, who pretends to forecast either the probability or improbability of future usefulness of any raw material. As has been illustrated by the radium mineral carnotite, the mineralogic curiosity of one decade may become the valuable ore of the next. The principal ore of aluminum, bauxite, was not even mentioned in a list of useful minerals published by the Geological Survey 25 years ago.

The Survey's annual report entitled "Mineral Resources of the United States" contains not only statistical statements of production and consumption, which constitute an annual census of the mineral industry in all its phases, but also a series of comprehensive studies of the sources of mineral wealth, with estimates of the reserves to be drawn upon for future production. The very nature of many mineral resources precludes exact knowledge of the extent of their reserves, and the estimates of other reserves must be made roughly quantitative. At best, future supply and demand can be only approximately measured, but the recognition of this limitation has not discouraged the collection of all available information concerning the country's mineral resources.

PRESENT DEMAND FOR INFORMATION.

The readjustments in the world's commerce necessitated by the European war have already imposed new conditions on many industries. Secretary of the Interior Franklin K. Lane early brought to the public attention the importance of these readjustments with reference to the mineral industry. The following excerpts from his published interview of August 16 will serve to outline some of the new developments to be expected:

A direct benefit to the United States from the European war will be its effect in making the people of this country realize to a greater extent the value of its mineral resources. It is entirely possible so to utilize these resources and expand our industries that the label "Made in America" will become familiar in our own and foreign markets. Of an importance second only to that of the food supply is the supply of mineral products necessary to meet the requirements of Twentieth century civilization. One of the first effects of the war has been to make us realize the interdependence of nations in the matter of food supply. Most of the countries now at war are dependent upon importation of foodstuffs, and we have cause for self-congratulation in the United States that we are able to feed ourselves. What we possibly have not so fully realized is that we are nearly as independent in the possession of essential mineral resources, and that the interference with manufacturing caused by interruption of the flow of importations of many necessary raw materials may be overcome almost wholly by development of neglected resources in our own country.

It has been easier and perhaps cheaper to import mineral products and materials from other countries than to go to the trouble and expense of developing our own resources of the same nature. Forced to the latter course by suspension of commerce from other countries, I believe that American enterprise and energy will almost at once turn to the development of the native resources, rather than permit production to lag and supply to be diminished in any industry. At present these deposits and resources are locked up out of use. To open them to use when the supply from other countries is cut off means to make American industries using these materials independent of the rest of the world, and business men will not neglect the opportunity to make our industries safe from the interruptions of war we are now experiencing. When they have found the domestic supply and begin its use, they will not return to dependence upon the foreign supply, and thereafter good or bad times in the United States, so far as the maintenance of industries is concerned, will be more independent of foreign complications.

Already the copper industry has felt the injurious effect of war, and production has been curtailed. While considerable copper is consumed in the munitions of war, the constructive arts of peace furnish a far better world market for American copper than will the destructive art of war. In the case of zinc, however, the effect of the European war is the opposite. Still, it is within the limits of probability to expect a loss of a half million tons in the foreign production of zinc, or nearly half the world's output, with beneficial effect upon the recent overproduction in the United States, especially as affording the opportunity to export zinc and galvanized-iron products to South American countries, which market has hitherto been only in part utilized by our exporters.

Fuel oil has a large use in naval warfare of to-day, yet the tying up of the big tank steamers on both the Atlantic and Pacific seaports is already embarrassing the oil producers of this country, who depend so largely upon the export trade in all the forms of petroleum, crude and refined. On the other hand, Russia, our strongest rival in oil production, must suffer more complete and longer continued interruption of exports, which should tend to enlarge the market for our oil. The supply of cheap foreign barytes has prevented the development of many good deposits of that mineral, but with the consumers on the Atlantic seaboard already looking for domestic supplies, some of the southern mines should be reopened to supplement the output of those already in operation. The closure of the European market leaves but one buyer for the radium ores of Colorado and Utah, which is decidedly to the disadvantage of the miner. Had the legislation introduced in Congress been promptly enacted the United States Government would probably have been buying these ores at this time.

While the United States leads in coal mines, the six European nations now at war happen to be the six next largest coal-mining countries, producing together over half the world's coal. Interference with both the mining and the commerce of these nations must necessarily increase the demand for our coal, at least in the neutral countries of the world. It is not generally known, however, to what an extent we have been depending upon Europe, principally Germany, for many of the chemical products derivable from coal, and which we have been permitting to go to waste, in the most reckless manner. Coal tar obtained in the manufacture of coal gas and of coke (in retort ovens) is capable of producing hundreds of chemical products, but the chemical industries dependent upon coal tar as a raw material have had little development in the United States. Our imports of coal-tar products in 1913 were valued at $11,000,000 at initiating points and when they reached the ultimate consumer probably cost double that amount. If the present war continues any length of time the American consumer will have to do without aniline colors and dyes, certain drugs, and numerous other coal-tar products, or the American manufacturers will undertake to supply these essential commodities. which have hitherto carried the label "Made in Germany."

Several of the mineral products mentioned by Secretary Lane as those upon which American industries depend, although imported in large part, have been discussed more fully in later statements given to the public press by the Geological Survey. Press bulletins have been published on such subjects as potash, manganese, tin, flint pebbles, arsenic, antimony, and barytes, and in other bulletins the effect of the war on exports of copper, zinc, and radium has been discussed.

Within the last few weeks there has been a lively demand for information regarding possible sources of mineral products, both crude and manufactured. A considerable volume of correspondence on this subject has come to the Geological Survey, and with it the opportunity to act as an agent in bringing consumer and producer into touch with each other. Equally important is the function of pointing out possible sources of minerals which hitherto have been imported from European countries, as well as indicating what supplies are available to meet the new demands for exports.

It seems advisable to bring together the information already given to the press and to supplement it with other data now at hand, with the purpose of furnishing to the public in convenient form a summary of the mineral resources available for utilization under the pressure of present conditions. The preparation of the press bulletins already published has devolved principally upon the geologists of the Survey, who for several years have made a special study of the country's mineral resources. The specialists who have thus contributed to this bulletin are Edson S. Bastin, Ernest F. Burchard, B. S. Butler, David T. Day, J. P. Dunlop, Frank L. Hess, J. M. Hill, Edward W. Parker, W. C. Phalen, and C. E. Siebenthal.

GOVERNMENT PUBLICATIONS.

Several reports issued by the Government will be especially useful to those who are interested in mineral supplies. These publications furnish authoritative answers to many of the inquiries now made by importers and domestic consumers and by exporters and foreign buyers.[1]

The Geological Survey issues an annual report on "Mineral Resources of the United States," which is published finally in two bound volumes, but at first in about 65 separate chapters, which are issued as pamphlets several months in advance of the bound volumes. Each of these chapters treats of an important mineral product.

Other annual publications of the Survey that contain reports on the country's mineral resources are the bulletins entitled "Contributions to Economic Geology," published in two series—(I) metals and nonmetals except fuels, (II) mineral fuels—and "Mineral Resources of Alaska," the report on the progress of investigations in Alaska. The separate papers in these bulletins are also issued in the form of advance chapters and include brief reports on geologic investigations in mining regions or on newly discovered deposits or recently opened mining districts. Examples of such chapters recently issued that are of interest in connection with the present discussion are entitled "Potash in western saline deposits," "Nitrate near Melrose, Mont.," "Late developments of magnesite deposits in California and Nevada," "Analyses of coal samples from various fields in the United States," and "A barite deposit near Wrangell, Alaska."

Another recent Survey publication is a bulletin entitled "Useful Minerals of the United States" (Bulletin 585), which may be described as a directory of all the minerals that are now of recognized utility, with a list of localities at which these minerals occur in sufficient quantity to be of present or possible future value. The directory of minerals is well supplemented by another bulletin of the Geological Survey, entitled "The Mining Districts of the Western United States" (Bulletin 507), which furnishes a complete index to the mineral-producing centers of the western part of the country. A series of maps showing the quarry localities of the country is contained in the 1911, 1912, and 1913 volumes of "Mineral Resources

[1] The publications here mentioned, issued by the United States Geological Survey, the Bureau of Mines, and the Bureau of Foreign and Domestic Commerce, may be obtained free, until the editions are exhausted, on application to the respective bureaus at Washington, D. C.

of the United States," and the 1913 volume also contains a map showing the distribution of limestone.

The Bureau of Mines has issued a comprehensive report on coal analyses (Bulletin 22), representing the important analytical work done in connection with the fuel investigations by that bureau as well as the field surveys by the Geological Survey. Another bulletin on the same subject, including the analyses made since July 1, 1910, is in press and will be issued early in September.

The Bureau of Foreign and Domestic Commerce of the Department of Commerce issues a "Monthly Summary of Commerce and Finance of the United States," which is, of course, the source of authoritative data regarding imports and exports.

Another source of information that is of service to the public is the Geological Survey's list of mineral producers. In response to specific inquiries as to the location of mines of any kind tributary to any particular market, extracts can be furnished from this list. The list, however, is not published, as it includes about 90,000 names and addresses of producers and is constantly being revised, the changes each year amounting to 25 per cent of the list. It can be largely utilized, however, in reply to inquiries from consumers of mineral products.

THE MINERAL PRODUCTS.

VALUE AND SUPPLY.

The value of the mineral production of the United States now reaches $2,500,000,000 a year. Though this value falls far below that of the country's farm products, the magnitude and scope of our mineral industry may be best measured by comparing our own mineral production with that of other countries, no one of which can compete with us in abundance or variety of mineral resources. The United States mines nearly 40 per cent of the world's output of coal and produced 65 per cent of the petroleum in 1913. Of the more essential metals, 40 per cent of the world's output of iron ore is raised from American mines, and the smelters of the United States furnish the world with 55 per cent of its copper and at least 30 per cent of its lead and zinc. These are the raw materials on which has been founded a great metallurgical industry, but on which can be built much more extensive chemical and metal-working industries.

The table of production published each year by the Geological Survey contains no less than 72 items. For present purposes only a relatively small number of these items need to be mentioned, and for convenience these may be grouped under three general headings—mineral fuels, metals, and miscellaneous minerals, the last heading including principally structural materials, fertilizers, and crude chemicals. In each of these groups there are several minerals which already enter largely into the world's commerce, and their consideration is therefore pertinent to the present discussion. The country's reserves of certain of these minerals are great enough to stimulate larger exports and the interference with the importation of others enforces the utilization of reserves as yet relatively untouched. Of a few other mineral products unfortunately the domestic resources are inadequate, or at least undiscovered, and the problem they present is one of exploration and thorough investigation.

A glance at the statistics of mineral imports affords a means of comprehending in a broad way how great and complex is the task of attaining national independence in the mining, metallurgic, and chemical industries. Last year the imports of mineral products, both crude and manufactured, exceeded $270,000,000. Of this total probably $200,000,000 represents raw materials and crude metals, the value of these imports being only 8 per cent that of the domestic output. In this list of imports the larger items named in the order of value are unmanufactured copper, precious stones, nitrate of soda, copper ore and matte, nickel, tin, iron ore, pig iron and steel, petroleum products, manganese ores and alloys, platinum, aluminum, pyrite, graphite, stone, potash, and magnesite. In the discussion which follows it will be shown that this country has an abundant supply of most of these mineral products that are now imported in large amounts, and that as to them it can be independent of foreign countries. The only essential minerals of the first rank of which the United States has no known supply at all commensurate with its needs are nitrates, potash salts, tin, nickel, and platinum, the list thus comprising two essential mineral fertilizers and three very useful metals. Probably no other nation in the world so nearly approaches absolute independence in respect to mineral resources.

MINERAL FUELS.

OPPORTUNITY FOR EXPORT.

In its reserves of mineral fuels, the United States holds an impregnable position as a world power in industry and commerce. Our production of coal overtops that of any other nation and, in fact, nearly equals the combined output of Great Britain and Germany, the nations that rank second and third. Inasmuch as the United States leads the world not only in coal production, but also in low cost of coal mining, and apparently possesses the greatest reserves, it follows, as was pointed out by Campbell and Parker in 1908, that foreign countries will obviously look more and more to the United States for their supplies of coal. The lower cost of production in the United States, which is due largely to the favorable location of the coal beds and the extensive use of mining machines, is offset in Great Britain by the proximity of the coal mines to the seaboard. The wages paid in the United States are higher than in any country of Europe. This country's preeminence in the production of petroleum is even more conspicuous, so that the opportunity for exporting mineral fuels presents no immediate problems for the domestic producer.

COAL.

The exports of coal from the United States have never been large enough to affect the production materially. They amounted to 20,000,000 short tons in 1912 and 23,200,000 tons in 1913, or less than 4 per cent of the total output of the mines in each of those years. At present, however, while the six European nations that rank next to the United States as coal-mining countries are at war, the demand for export coal from neutral countries is inevitable.

It must be granted that the sale of manufactured products for export is preferable to the sale of raw materials, but there appears now to be a large opportunity for coal export that will not curtail in the least either the domestic supply of coal or the activities of domestic manufacturers. The exportation of coal to South American countries must be of advantage both in establishing trade relations and in insuring a balance of trade in our favor. Already shipments to European and South American ports have begun, and there is demand for authoritative information regarding the quality of the coal from the different fields accessible to the seaboard. How this information can be obtained has already been mentioned on page 9. As stated by Secretary Lane, "Coal is our one resource about which there need be no present anxiety." In 1908 Campbell estimated that our reserves of easily accessible anthracite and bituminous coal were more than eleven hundred billion (1,166,527,000,000) tons and that nearly half as much more of the same grades was accessible with difficulty, besides comparable tonnages of subbituminous coal and lignite. Five years later a new estimate made by the same geologist, in the light of much better geologic data, especially regarding the extent of the Rocky Mountain coal fields, exceeded these figures by nearly 30 per cent. His estimate of more than fifteen hundred billion (1,500,000,000,000) short tons in the United States, exclusive of Alaska, was published in a volume on the world's coal resources resulting from an international inquiry made by the Twelfth International Geological Congress. This publication, in preparing which the geological surveys of the world cooperated, furnished the first authoritative statement of the coal supply of the world, and showed that North America possesses nearly two-thirds of this supply and that the United States alone has reserves exceeding those of any other continent and nearly double those of Europe.

In view of the steadily increasing consumption of coal in the United States the question how long the exportation of coal should be encouraged or continued must be considered at some future time, for it will plainly not be wise to deplete too greatly this reserve of fuel, on which the Nation's industrial life must depend. At present, however, the question of the duration of our coal supply includes so many indeterminate factors that any prophecy as to the date of its exhaustion must be of questionable value, and it does not now seem at all improvident for us to utilize in some degree this abundant resource as a means of building up our foreign commerce and making new markets for the products of our industries.

Until the present war broke out Great Britain was the only country that exported coal in considerable quantity, but Great Britain is already beginning to feel the pinch of poverty in her coal supplies, and it is highly probable that when peace is once more established she will place restrictions upon her exports of coal. In 1913 the exports of coal from Great Britain amounted to 82,200,000 short tons, and the bunker trade called for 23,555,288 short tons more. In the same year the exports from the United States, as already stated, amounted to a little over 25,000,000 short tons and the total bunker trade at the principal ports—New York, Philadelphia, Baltimore, and Hampton Roads—was only about 7,500,000 tons, indicating that most of the trans-Atlantic liners, the majority of which are English, have been carrying from the other side a sufficient quantity of coal for the round trip.

The high-grade steaming coals of the United States, which would be the coals in chief demand for export trade, are found largely in the eastern half of the Appalachian coal field, which includes the Clearfield, Allegheny, and Somerset districts of Pennsylvania on the north; the Cumberland region of Maryland; the Elk Garden, Fairmont, New River, and Pocahontas districts of West Virginia; the southwestern counties of Virginia; the eastern counties of Kentucky and Tennessee; and the Birmingham and other districts of Alabama on the south. Of these coals, those available in highest quality are the semibituminous coals of the Pocahontas, New River, Elk Garden, and Cumberland districts and the better grades of Clearfield. The fields nearest the seaboard are those of the Cumberland and Elk Garden districts, but these fields are approaching exhaustion, so that the advantage in this respect will fall to the Alabama mines, which are being made more easily and cheaply accessible by the slack-water improvements in Warrior River, which have already resulted in a marked advance of Mobile as a shipping port.

PETROLEUM.

Perhaps the most important change in the conditions of exports and imports affected by the war relates to crude petroleum and petroleum products, including benzine, gasoline, illuminating oils, lubricating oils, residuum, fuel oils, paraffine wax, and medicinal preparations. The exports of these materials amount to over 3 per cent of the total usual exports from the United States, their value for the fiscal year just closed being over $100,000,000.

The exportations of petroleum and its products have practically ceased for a time, with the exception of an occasional cargo of illuminating oil shipped to some country not in a state of war, especially to the West Indies and Mexico. This means the temporary loss to the United States of a foreign market, which consumed about one-fifth of the oil produced, and its effect has been a still more serious disturbance in the conditions of the oil trade.

Up to a few years ago the imports of petroleum and its products into the United States were trifling. In 1912 the imports of crude oil from Mexico assumed considerable proportions, amounting to 145,247,828 gallons. They increased in the following year to 500,000,000 gallons, and in 1914 to 773,052,480 gallons, worth $11,776,737. This Mexican petroleum can be imported to the east coast of the United States at very low cost, to be used for fuel, and has been of a decided benefit in replacing oil produced in the United States, which is capable of higher utilization. The Mexican imports will probably continue. In addition benzine and gasoline have for several years been imported to the extent of 15,000,000 gallons, valued at about $1,000,000, from Borneo to the Pacific coast to make up the necessary supply for that region. These importations from Borneo will now cease and probably would have ceased in any event, on account of the surplus of gasoline now available in that region.

Mention of the opportunity for domestic manufacture of certain medicinal preparations from American petroleum will be found under the heading "Other products" (p. 45).

METALS.

THE GENERAL SITUATION.

Of the metals and metallic ores the United States has been both an importer and an exporter. Our imports of iron ore are double our exports, whereas of metallic copper we export nearly twice as much as we import. The general rule, however, probably is that the imports of manufactured or partly manufactured metals largely exceed in value the ores and crude metals brought into this country for domestic manufacture, and in our exports a somewhat similar ratio exists between crude material and manufactures, so that there is presented a double opportunity for increasing the scope and extent of our metal industries for both domestic consumption and export. Far too much American metal crosses the Atlantic in the crude or semicrude state only to come back to us in various manufactured forms.

The smelter industry in this country is in some degree dependent on foreign ores and matte. The production of metals from such sources last year amounted to $112,000,000, exclusive of gold and silver, which would probably increase this total 50 per cent. The production of copper from foreign sources was by far the larger item, the value of the metal being more than $58,000,000, but Europe was not a considerable exporter, the ore and matte coming principally from Mexico, Canada, and Peru. Nickel having a value of nearly $19,000,000 and nearly an equal value of pig iron was produced from foreign ores, obtained mainly from Cuba. The largest metallic contributions from Europe are the ores of manganese and the ferroalloys, most of which are imported from European countries and represent a production of metals amounting to more than $8,000,000. Foreign lead and zinc, mainly Mexican ores, amounted to about $4,500,000 and $1,000,000, respectively. Although not imported in as large amount as most of the metals already mentioned, platinum really presents a greater problem for the future, inasmuch as the production of about 39,000 fine ounces, having a value of $1,800,000, is derived mainly from Russian ores and concentrates, Colombia being the other foreign source. The sources of the antimony, arsenic, and bismuth consumed in this country are largely foreign, and the world prices of bismuth have been fixed by a European syndicate.

IRON.

The European countries that rank next to the United States in the output of iron ore as of coal—Germany, Great Britain, and France—are at war, and Austria and Russia are also large producers, though they are below Sweden and Spain in rank. The interference with industries caused by military service can not fail to reduce the output of mine and furnace and to enlarge the demand for American iron and steel. The largest exporter of iron ore to the United States is Cuba and the next is Canada, but the imports from these countries can hardly be seriously affected by present conditions. The imports of iron ore into the United States are relatively small except to blast furnaces on the Atlantic seaboard, although it has been expected that unless commerce with the west coast of South America is interrupted a considerable quantity of ore will soon come annually from Chile by way of the Panama Canal.

The iron-ore reserves in the United States are so enormous, however, that iron-mining operations can readily respond to an increased demand for ore should occasion require it. The foreign trade of the United States in pig iron is also relatively small, and the imports and exports of both iron ore and pig iron and steel should remain low, and efforts should be concentrated mainly on the problem of increasing the exports of iron and steel products from the United States, as well as that of supplying manufactures of iron and steel to the domestic market that formerly depended on imported products.

According to present information,[1] there are strong indications that American steel is already needed abroad. Inquiries for steel products are being received by domestic manufacturers from consumers in England, Scotland, Japan, and South America. Consumers in England whose supply from Belgian mills has been cut off are placing orders for their immediate needs with American manufacturers. The demand for steel products on the Pacific coast became very active after the declaration of war; therefore the opening of the Panama Canal becomes at once a factor of great importance to the steel industry and should result in the permanent transference to American mills of a large part of the Pacific trade heretofore placed with mills in England, Germany, and Belgium.

The United States has heretofore had only a fraction of the trade with South America in iron and steel and machinery, but our manufacturers are now actively canvassing the possibilities of extending this trade, and the prospects for increasing our share of it are bright.

MANGANESE.

A serious phase of the interruption to commerce caused by the European war is the shutting off of the foreign supply of ferromanganese from the steel manufacturers of this country. The domestic marketed production of ferromanganese and spiegeleisen in 1912 and 1913 was 227,939 long tons and 226,475 long tons, respectively, and the imports of these alloys for those years were 100,152 long tons and 128,147 long tons, respectively, of which ferromanganese constituted 99,137 tons in 1912 and 128,070 tons in 1913. The imports of these alloys therefore constituted 30.5 and 36 per cent, respectively, of the available supply in 1912 and 1913. England and Germany have furnished most of these imported alloys in recent years. By far the greater part of the ferromanganese produced in the United States is manufactured by steel companies for their own consumption, so that those manufacturers who have heretofore depended on foreign supplies must either make arrangements to purchase the needed alloys from other domestic companies or else enter the field as producers themselves. In either event much more ferromanganese may have to be manufactured in the United States if the foreign supplies are cut off for any considerable period. Added impetus has thus been given to certain projects which are under way for the utilization of the manganiferous iron ores of the Cuyuna Range, Minnesota, in the manufacture of high-manganese pig iron and ferromanganese at Dunbar blast furnaces in Pennsylvania.

With regard to manganese ores, the situation presents features of still greater interest. Notwithstanding the abundant supplies of manganese in the United States, its domestic production has been relatively small, but the imports have been so large as to indicate a

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[1] Iron Trade Review, Aug. 20, 1914; Iron Age, Aug. 20, 1914.

strong demand for manganese ore. For instance, during the last 10 years the annual domestic production of manganese ore has ranged between 1,500 and 7,000 long tons, while the imports ranged between 108,000 and 345,000 long tons. In 1913 the domestic production of 4,048 tons, the largest since 1908, was insignificant compared with the imports of 345,090 tons, and constituted only a little over 1 per cent of the available supply. Another illustration of the great disparity between the domestic production of manganese ore and the imports may be noted in the fact that the total production of the United States so far as recorded, going back to 1838, is 414,738 long tons—an amount not greatly in excess of the importations during the single year 1913. The imports of manganese ore recorded since 1868 have reached the grand total of 3,859,616 long tons, and the records are incomplete for the first 20 years of this period.

The foreign situation as viewed by D. F. Hewett early in 1914, in the chapter of Mineral Resources for 1913 on manganese and manganiferous ore, is as follows:

> Imports of manganese ore increased approximately 15 per cent from 1912 to 1913, and this increase came almost wholly from Russia. Unless industrial or political disturbances interfere, there is no doubt that a supply of ores will be available from the deposits of Russia, India, and Brazil for some years to come.

As the disturbances that have arisen will undoubtedly interfere to a greater or less extent with the shipment of foreign manganese ores, it is cheering to know that the United States possesses within easy reach of manufacturing centers abundant reserves of such ores.

The following notes on the domestic sources of manganese may be of interest in the present connection:

For commercial purposes materials containing manganese are separated into four classes—(1) manganese ores, (2) manganiferous iron ores, (3) manganiferous silver ores, and (4) manganiferous zinc residuum. Though manganese forms a part of about a hundred minerals and is a relatively widespread element, practically all the manganese of commerce is derived from material containing one or more of the minerals polianite, pyrolusite, psilomelane, wad, manganite, brannite, and franklinite.

Commercial manganese ores are those which contain at least 35 per cent of manganese and otherwise conform to the specifications of the trade in which they are used. Deposits of manganese ore occur in many parts of the United States, but are most abundant in the Applachian and Piedmont regions, in the southern Mississippi Valley, and on the Pacific coast. Small deposits occur in the New England, Rocky Mountain, and Great Basin regions. The principal producing districts up to the present time have been the James River-Staunton River and Blue Ridge regions of Virginia, the Cave Springs and Cartersville districts in Georgia, the Batesville district in Arkansas, and the Livermore and Tesla districts in California. Districts of minor importance are the New River region in Virginia, the northeastern Tennessee region, the McCormick region in South Carolina, and the Little Grande district in Utah. Mining and shipping in Virginia are now confined to the Blue Ridge and James River-Staunton River regions.

Manganiferous iron ores consist of mixtures of manganese and iron oxides and hydrous oxides, which, though usually containing manganese in excess of 5 per cent, may contain as little as 1 per cent. The proportion of iron in such ores is highly variable, but usually exceeds 40 per cent. Manganiferous iron ores occur in the United States chiefly in the New England, Appalachian, and Lake Superior regions, and minor deposits are found in the southern part of the Mississippi Valley and in the Rocky Mountain region. High-grade manganiferous iron ore used for its manganese content occurs in the Appalachian region. Other manganiferous iron ores, which are so low in manganese that they are classed as iron ores, are produced in the Appalachian and Lake Superior districts. In the blast furnace they yield a "high-manganese" pig iron, which is used for special purposes.

Manganiferous silver ores consist of mixtures of manganese and iron oxides and hydrous oxides, with small quantities of silver and lead minerals. As a rule the iron content exceeds the manganese content, but locally the iron is altogether absent.

Manganiferous silver ores occur in the Rocky Mountain and Great Basin regions, the principal producing locality being Leadville, Colo. Leadville ores have been used in making spiegeleisen from time to time, but none are now used for this purpose.

Manganiferous zinc residuum is an artificial furnace product consisting of manganese and iron oxides in a matrix of slag. It is obtained from zinc volatilizing and oxidizing furnaces using New Jersey zinc ores. Small quantities of zinc residuum are used annually in the manufacture of spiegeleisen.

Bulletin 427 of the United States Geological Survey ("Manganese Deposits of the United States," by E. C. Harder), which is still available for free distribution, contains brief descriptions of most of the known deposits of manganese in this country and the important deposits of other countries, and concise summaries of the chemistry and mineralogy of manganese.

ZINC.

By a queer coincidence the great smelting centers of continental Europe are in regions where active fighting is now going on or may be expected in the near future. The zinc smelters of Upper Silesia are in the extreme southeastern portion of Prussia, mostly in the

Kattowitz, Beuthen, and Tarnowitz districts, which are adjacent to one another and lie within 5 or 10 miles of the Polish-Prussian border and near the corner of Russia, Austria, and Germany. The two smelters in Russian Poland are just across the border from the Silesian smelters. They all seem destined soon to be compelled to suspend or decrease operations on account of military activities, and in any event their output certainly can not reach the outside world. The same thing is true of the smelters in Rhenish Prussia and Westphalia, some of which are very near and most of which are within 100 miles of Liege. In Belgium all but three or four of the zinc-smelting plants lie between Verviers and Liege or are strung along the valley of the Meuse between Liege and Namur; and their industrial prospects can well be imagined. The zinc smelters of France lie outside of the territory where active military operations are likely, and so will probably suffer only from scarcity of labor as the employees are called to the colors and from derangements of transportation. The same is true of the zinc smelters in England; but those of Austria-Hungary will, of course, be put out of commission. Other small smelters in Europe, Australia, and Japan will possibly not be affected except as transportation is interrupted. From these observations it can be seen that the zinc-smelting industry of Europe will be in a sadly demoralized condition while the war continues and for some time thereafter.

If the war continues for one year, the output of these countries for that period would, at a conservative estimate, be only about 250,000 tons—a loss of nearly 500,000 tons for the year. The continental spelter market will also be demoralized, however, so it may be that the reduced production will still be ample. Apparently England's industrial activities after the first readjustments are over may not be seriously restricted.

The war only serves to emphasize a condition which already confronted the zinc industry of the United States—that smelting capacity and spelter production have increased faster than consumption in the United States, as shown by a growth from 93,958 retorts, having an estimated maximum capacity, when working on high-grade ore, of 404,960 tons in 1910, to 127,754 retorts at the close of 1914, with the completion of those now building, having an estimated maximum capacity of 542,955 tons. The production in 1910 was reported to be 210,424 tons; the production for the first half of 1914 is at the rate of over 350,000 tons a year, and no doubt the second half of the year will witness a considerable gain over that figure. The increase of spelter stocks from 4,522 tons at the close of 1912 to 40,659 tons at the end of 1913, and to 64,039 tons at the middle of 1914, also shows that production is increasing faster than consumption.

The actual gain in capacity is even more than is indicated by these figures, for in the earlier years a number of small, antiquated smelters that had been idle for several years were included in estimating the total capacity, whereas in the later years almost all such smelters have been dismantled or abandoned completely, and there have been more new, modern additions than ever before in the same time. It is to be borne in mind that a certain portion of the capacity is taken up in the redistillation of zinc drosses, and that some plants do not yield full capacity because they treat lower-grade ores, so that the spelter produced from ore always falls much short of the maximum capacity. On the other hand, the new zinc oxide plant at Leadville, Colo., will take a great deal of the low-grade carbonate ore away from the zinc smelters, so that the capacity per retort will be increased because of the higher grade of the remaining supply; and the introduction of ore flotation in the Western States will probably raise the grade of zinc concentrates from that section, likewise increasing the capacity per retort.

The following table shows that the production of zinc at the mines is steadily increasing:

	1911	1912	1913
Joplin district	137,633	152,465	146,474
New Jersey	77,445	69,755	84,122
Colorado	47,304	66,111	59,673
Montana	21,905	13,459	44,337
Upper Mississippi Valley	33,939	37,115	32,346
Other States	27,034	39,911	51,430
	345,260	378,816	418,382

The largest increase in sight is the result of the application of ore flotation concentration in Montana, but an increase due to the same cause is to be looked for in Idaho and possibly in Utah. In Montana the Butte & Superior mill is now producing at the rate of 50,000 tons of zinc a year, and the new Pilot Butte mill, which has just gone into operation, should raise the State output to 70,000 tons a year, or if, as planned, another unit is added to this mill the State output may rise to 90,000 tons and more by 1915. In Colorado the new zinc-oxide plant at Leadville is reported to be purchasing 14 per cent zinc carbonate ore, as against a minimum of about 20 per cent ore purchased by zinc smelters. As the Leadville carbonate ore is not amenable to concentration this means a large increase in the available zinc-ore resources of that region. Another source of zinc which will be made available in the future is zinc-bearing copper ore, the zinc content of which now either makes the ore unsalable or, when the ore is smelted for the copper, collects as flue and baghouse dusts, for the recovery of the zinc from which there is at present no satisfactory process. Much ore of this sort is mined in

Shasta County, Cal., and such zinciferous dusts are accumulating in large quantities at the smelters in that region.

With the establishment of peace in Mexico it is to be expected that imports of zinc ore from that country will again reach large proportions, and likewise the imports from Canada may perhaps become larger even than they were in 1909, before the imposition of the tariff. With the closure of the Belgian and other continental markets to the zinc concentrates from Broken Hill, Australia, those concentrates may be partly diverted to the United States. If a sufficient foreign market becomes available the surplus smelter capacity in the United States might perhaps be employed in smelting foreign zinc ores under bond, and a business might grow up similar to that which exists in lead smelting.

If an extensive business of smelting foreign zinc in bond should grow up it would probably be found desirable to build special smelters for that work at tidewater in the vicinity of New York City, convenient to fuel supplies and acid markets and to water transportation to Mexico and through the Panama Canal to British Columbia and Australia. This business could be done only at the expense of domestic production of zinc ore, for the present domestic production more than equals the apparent domestic consumption as spelter and as zinc oxide and bids fair to exceed it greatly in a year or two unless consumption is increased by the development of export trade in manufactured zinc and galvanized-iron products.

The opening of the Panama Canal, the necessary establishment of American lines of transportation to South America, Australia, and the Orient, and in the present crisis the large dependence of those continents on the United States for their supply of zinc all make for a quick commercial introduction of the products of the United States zinc industry to those continents—an introduction which under other conditions might have taken years.

It is known that large stocks of spelter exist in Europe. The Ironmonger, of London, gives the stocks at the end of March as 73,000 long tons and quotes an estimate of 80,000 long tons for the end of April. At that rate the stocks on hand June 30 must have beeen considerably over 100,000 short tons, compared to 64,039 short tons in the United States. The greater part of the European stocks, however, must have been held in the interior and must now be isolated, so that for the term of the war they may be disregarded. After the war what remains of these stocks will become available again and will possibly operate to depress prices, but in the meantime the United States zinc operators will have had the opportunity to dispose of domestic stocks and to become established in the foreign markets.

The following statistics of zinc exports from the principal zinc-smelting countries of Europe have been taken from the official publications of the countries concerned and are given for 1912 because official figures for 1913 are not available for all the countries:

Zinc exports in 1912 from Germany, Belgium, France, and Great Britain, in short tons.

To—	From Germany.		From Belgium.		From France.		From Great Britain.		Total.	
	Slabs and sheets.	Galvanized iron.	Slabs and sheets.	Galvanized iron.	Slabs and sheets.	Galvanized iron.	Slabs and sheets.	Galvanized iron.	Slabs and sheets.	Galvanized iron.
Canada	822	....	2,903	....	....	....	465	29,398	4,190	29,398
Mexico	....	....	2,115	....	....	837	....	1,319	2,115	2,156
Central America and West Indies	....	....	202	97	....	5,261	....	4,812	202	10,170
South America	280	4,370	4,897	8,835	5,280	2,113	....	123,263	10,457	138,581
Africa	4,018	....	9,288	....	15,328	58,514	....	71,592	28,634	130,106
Australia and New Zealand	....	....	2,547	60	....	1,282	....	143,525	2,547	144,867
Asia, Japan, and East Indies	5,720	1,758	5,956	5,446	8,502	13,708	4,152	287,360	24,330	308,272
	10,840	6,128	27,908	14,438	29,110	81,715	4,617	661,269	72,475	763,550

The foregoing table shows a foreign market for over 72,000 tons of zinc, of which about 30,000 tons consists of spelter in slabs and the remainder of zinc sheets. The American zinc industry should stand an excellent chance to take over the trade in zinc slabs and such part of the trade in zinc sheets as American zinc-rolling mills can furnish. The trade in galvanized-iron sheets is dominated by Great Britain, which controls 87 per cent of the total export trade in that commodity with the four countries concerned. In addition to smelting over 65,000 tons of spelter in her own plants Great Britain in 1913 imported 150,000 tons, presumably used chiefly in making her enormous output of galvanized iron. It would seem that any expansion in Great Britain's foreign trade either in spelter and zinc sheets or in galvanized iron would entail the importation of more spelter from the United States. This country therefore has the opportunity to furnish the major part of 222,000 tons of spelter a year as long as the war lasts, together with whatever part of the spelter for the galvanized-iron trade of the southern continents and Asia it can acquire. The first demands will naturally come from Great Britain, and according to reports they have already begun. With the end of the war, however, the continental smelters will begin to compete strongly for that trade. The southern continents and Asia are therefore more likely to become steady outlets for our zinc products, and by the time the war closes American zinc should have obtained a permanent foothold in those markets, sufficient to take care of the surplus smelter capacity of the United States.

These calculations do not take into account the increased exports of zinc pigments that must absorb some of the domestic surplus zinc resources. Moreover, the United States imports each year from Continental Europe about 2,500 tons of zinc dust. This supply of zinc dust is now cut off, and the dust has already greatly advanced in price. Zinc dust is produced at two American smelters and could easily be produced at others, so that no doubt the better prices will result in the whole demand being supplied from domestic sources and thus absorbing another portion of the surplus zinc ore.

LEAD.

The effect of the war on the lead situation is as yet uncertain. One month of war has not disturbed the already low price of lead in the United States, but it would seem that the conflict must ultimately enhance the price. All exports of lead as well as of copper and zinc have been forbidden by the English Government, which has requisitioned all visible supplies, so that no lead is now available for the English consumer. Great Britain will apparently be the best market at present for American lead, although the lead now imported into England comes mostly from Spain and Australia, and so long as ocean transportation is available it will naturally continue to come from those countries. In 1913 the imports of lead into Great Britain exceeded her exports of lead by over 180,000 short tons.

The following table shows the lead output of the principal producing countries in 1912–13, in short tons:

World's production of lead in 1912 and 1913.

	1912	1913
United States (domestic refined)	392,517	411,878
Spain	205,799	223,767
Germany	194,666	199,627
Australia	118,387	127,867
Mexico	132,276	68,343
Belgium	56,438	55,997
Great Britain	32,187	33,620
France	34,282	30,864
Other countries	115,961	118,495
	1,282,513	1,270,458

It seems likely that the war will curtail this output about 250,000 tons, nearly one-fifth of the total production. Inasmuch as the product of those countries affected by the war would probably have been mostly consumed in the countries themselves, and as they are not now in a position to use much of the metal in arts and manufactures, it seems probable that the market value of lead will not be much affected by the curtailment of production.

Lead smelted from foreign ore in bond and articles manufactured from foreign lead and exported with benefit of drawback have been exported from the United States in large quantities for many years, as shown by the following table, which gives also the production of lead in the United States from domestic and from foreign ores:

Production of lead in the United States and exports of foreign lead, 1909–1914.

[In short tons.]

Year.	Production.		Exports.	
	From domestic ore.	From foreign ore and bullion.	From warehouse.	Under drawback.
1909	352,839	97,040	86,077	4,796
1910	375,402	94,870	69,786	8,800
1911	391,995	94,984	101,227	12,080
1912	392,517	88,377	64,906	11,320
1913	411,878	50,582	44,544	9,757
1914	....	....	[a] 8,833	....

[a] Six months only.

There has been a rapid and progressive decline in the quantity of foreign lead smelted in the United States since 1911, owing to the unsettled conditions in Mexico. A similar decline appears in foreign exports. For the current year the exports of bonded lead will apparently not be more than one-third as much as in 1913 and about one-seventh as much as four years ago. The stock of foreign lead of all kinds remaining in warehouse June 30, 1914, was 7,237 short tons, principally at New York and El Paso.

For many years prior to 1914 there have been no exports of domestic lead ore, bullion, or pig lead. Manufactures only of domestic lead have been exported. During the first seven months of 1914 the London price of lead has averaged 4.136 cents a pound, against 3.962 cents, the price at New York. The difference in March, June, and July was about 0.3 cent a pound. By August 19 the London price had increased to 4.875 cents a pound, a full cent above the New York price. Commencing with March, there have been important exports of domestic lead to Europe, as follows:

Exports of domestic lead from United States to Europe, March–July, 1914.

	Short tons.
March	5,838
April	5,931
May	2,045
June	6,348
July	10,219+
	30,381+

The exports up to and including June went principally to continental Europe, a little going to Russia, as indicated in the table below, but with the differential between London and New York prices which obtained in the middle of August, lead will no doubt be exported to London.

Destination of domestic lead exports.

	Short tons.
Great Britain	7,153
Germany	5,141
Netherlands	4,720
Belgium	2,101
Russia	448

The production of domestic lead in 1913 was the largest in the history of the industry, and considering trade conditions during that year it is likely that there was a considerable increase in domestic stocks. The exports of domestic lead, however, must have gone far toward relieving this condition. A continuation of these exportations must result in advanced prices in the United States.

TIN.

Probably one of the best illustrations of America's opportunity to develop new industries is afforded by tin. The outbreak of the European war caused the New York price of tin to rise to 65 cents a pound early in August, although late in July tin was sold as low as 34 and 35 cents a pound. This increase of price was due mostly to the insecurity of ocean freights, and already prices are lower, and they may go lower still, owing to the stoppage of manufacturing and other industrial plants in Europe and the consequent restriction of the market for bar and pig tin.

The known American deposits of tin are small, and production from them will probably not be much affected by the present higher prices. The benefit which the United States may obtain from the present situation is the establishment of a tin smelter in this country in which to smelt Bolivian tin ores and such small output of American ore as is produced. The tin concentrates produced last year in Alaska and shipped from Nome, as well as those produced near Gaffney, S. C., and Tinton, S. Dak., amounting to 84 tons of 60 per cent ore, were all shipped to British smelters.

At the present time between 30,000 and 40,000 tons of tin concentrates, carrying more than 20,000 tons of metallic tin, are shipped each year from Bolivia to Europe for smelting. The United States imported several times that amount of metallic tin last year and would easily absorb all the tin smelted from the Bolivian ore. Furthermore, it has been demonstrated that the smelting of Bolivian ores presents no difficulties that American metallurgists can not readily overcome. Owing to the European war Bolivian ores will now be easier to buy, and if ships can be found to carry the ore an opportunity seems to be presented for Americans to begin purchasing ores that have hitherto gone to Europe.

A few years ago a smelter was established at Bayonne, N. J., in which to smelt Malayan tin ores, but when the fact became known the English Government placed a high export duty on Malayan tin ores not going to some part of the British Empire. Such a thing could not happen in Bolivia, and the smelting of Bolivian and other ores in this country would to some extent, at any rate, relieve American consumers from the speculative profits of the London market.

COPPER.

With the possible exception of the silver industry, the copper industry will probably feel the injurious effects of the European war more seriously than any other of the leading American metal industries. During the last five years approximately 50 per cent of the copper turned out by American refineries has been exported almost entirely to the countries now involved in the European war. Some of this copper has been imported for metallurgical treatment, and the imports will probably be somewhat restricted on account of shipping conditions.

During these five years, however, domestic consumers have taken only about 63 to 67 per cent of the copper produced from mines within the United States, so it is evident that there must be a material curtailment of production while present conditions prevail. Considerable copper is of course consumed in munitions of war and for other military purposes, but the constructive arts of peace are far more favorable for the copper industry than the destructive art of war.

American producers have already greatly curtailed their production, and it seems almost certain that the output must be materially restricted for an indefinite period, the length of which will depend largely on the European conditions.

Out of the total copper exports in 1913, valued at $143,000,000, over $126,000,000 represented metal in pigs, ingots, and bars, and nearly all the remainder was exported in plates, sheets, rods, and wire. All these exports went to European countries with the exception of about $7,000,000 worth, which was sent mainly to Canada. Both the imports and the exports of articles manufactured of copper and brass were comparatively small. The exports of articles made from brass amounted to only about $5,600,000, an almost negligible quantity compared with the domestic consumption. The value of the European exports of articles manufactured from copper and brass was undoubtedly many times that of the exports from the United States. A very small percentage of the European exports came to the United States, so that the war will have little effect on domestic trade.

The opportunity for the American manufacturer lies in entering the foreign markets that were largely supplied by European exports of manufactured goods. The capacity of the domestic manufacturing plants has not been strained to meet consumption and the plants have not been operated to full capacity, so that as far as manufacturing facilities are concerned they are able to supply a large part of any demand from South America, Africa, China, Australia, and other countries. With lack of competition from Europe and low prices for crude material the export trade should be profitable to the manufacturers and result in the consumption of nearly all the domestic production of copper.

ALUMINUM.

During the last 10 years there has been a rapid and healthy growth in the consumption of metallic aluminum in the United States. From less than 9,000,000 pounds in 1904 the consumption has grown to more than 72,000,000 pounds in 1914. This increase was partly met, in some years at least, by the increase in imports. Although most of the aluminum consumed in the United States is of domestic origin, a very considerable part of it is imported from France and other European countries. With the possible cutting off of the European supply of the metal—scrap, crude, and manufactured—it will be increasingly difficult to fill the domestic need.

The use of metallic aluminum is widespread. Its employment in the manufacture of articles of everyday use has become so common that such articles no longer attract attention. Its use, however, is now being extended to the construction of welded tanks, cooking vats, and vessels which are employed by brewers, preserve manufacturers, and fat recoverers, and in similar industries where a metal that will conduct heat, will not corrode, and is nonpoisonous is essential. Aluminum vessels of large size are used also in the manufacture of essences, sirups, varnishes, fatty acids, table oils, and nitric acid. A recently developed branch of the aluminum industry is the manufacture of the powdered metal known to the trade as aluminum-bronze powder, which is used extensively as a paint pigment, in explosives, in lithographing, and in printing. The use of aluminum wire as a conductor in long-distance power-transmitting schemes is of interest. Aluminum foil, though not exactly a new product, is now being used on a larger scale than ever before, owing to improved methods in its manufacture—the result of long and expensive experiments which have reduced its cost appreciably. Finally, the use of the metal in aeroplanes and automobiles may be mentioned.

Plants manufacturing aluminum in the United States have been rapidly expending and enlarging their output in recent years to meet the growing demands for the metal. One of the largest projects is that of the Southern Aluminum Co., which is vigorously pushing operations on the Yadkin River, N. C. This company, with a capital of several million dollars, has, it is understood, been organized by an amalgamation of certain French and Swiss interests and of certain metal interests in the United States. The company contemplates erecting a plant where more than 100,000 horsepower will be developed. Whether the European war will interfere with the progress of this work can not be stated, but it is hoped that it will not.

The mineral bauxite, the raw material from which metallic aluminum is made, comes from Arkansas, Tennessee, Georgia, and Alabama. Arkansas furnishes the bulk of the ore used in the manufacture of the metal. The three southern Appalachian States named produce the greater part of the bauxite used in the manufacture of aluminum salts.

In 1913 we produced 210,241 long tons of bauxite, a marked increase, amounting to more than 30 per cent, over the production of the preceding year, and in fact a marked increase over the production of any previous year in the history of bauxite production. This increase is attributable in large measure to the advance in the metallic aluminum industry. The imports of bauxite in 1913 were 21,456 long tons, valued at $85,746, or less than one-tenth of the domestic output. Most of this foreign ore came from France, which is to-day the leading bauxite-producing country of the world. With the interference with mining and shipping caused by the war it is a question whether this supply will not be greatly curtailed or completely cut off. This should greatly stimulate the search for new deposits and the working on a larger scale of the known deposits in the southern Appalachian States.

Bauxite is not only used in the manufacture of metallic aluminum but is employed extensively in making alum and the aluminum salts in general, bauxite brick for furnace linings, and artificial abrasives.

ANTIMONY.

Antimony is ordinarily one of the cheaper metals, selling at one and a half times to twice the price of zinc; but after the outbreak of the European war it reached more than 20 cents a pound, a price higher than that of aluminum, though it is now lower. During the six years from 1908 to 1913, inclusive, the price of Cookson's antimony ranged from 7.45 to 10.31 cents a pound, and the yearly averages ranged from 8.24 to 8.58 cents a pound. Much of the time during the present year the price has been still lower, and toward the end of July it was quoted as 7 to 7.10 cents. Other brands have ranged from 0.25 to 1.25 cents lower. As has been pointed out in the United States Geological Survey's reports, at these prices antimony ores can not be worked profitably under the high labor costs prevailing in the mining regions of the United States unless the deposits are very large and advantageously situated. No deposits of antimony ores have been found in the United States which entirely fulfill these conditions, and as a result practically all the antimony metal used here is imported from European smelters, mostly from England. The ores for these smelters come largely from China, Mexico, and France. So long as the war lasts, and especially so long as sea traffic is disturbed, the production will be curtailed and prices raised, for the use of antimony in type metal, and especially in bearing metals, is fixed and will continue. Other uses, such as the making of coffin trimmings, which consume a surprisingly large quantity of antimony and from which there is no secondary recovery, might conceivably turn to aluminum or other metals as substitutes.

For several years the production of antimony in the United States from domestic ores has been confined to that contained in antimonial lead and small quantities recovered in the electrolytic refining of copper and lead. A production of antimony from foreign ores—which can only be estimated—is also made. The antimonial lead is mostly a by-product in the smelting of the precious metals, and efforts are made to save all possible, so that this production can not be largely increased. The quantity saved in electrolytic copper refining can probably be increased, though not enough to make it a serious factor in the market.

The production, recovery, imports, and approximate consumption of antimony in the United States for 1913 are shown in the following table:

Production, recovery, imports, and consumption of antimony in the United States, 1913.

	Quantity (short tons).	Value.
Antimony contained in antimonial lead from all sources, including by-product antimony	2,540	$430,491
Recovered from wastes, scrap, etc. (including a little ore), nearly all as alloy	2,775	462,115
Imports:		
Metal and regulus	6,240	798,581
Crude antimony and ore (probable antimony content)	1,200	137,780
Approximate consumption of metallic antimony	12,755	1,828,967

Besides these items, more than 1,000 tons of oxide and salts of antimony, valued at over $117,000, were imported.

It is probable that under the pressure of high prices attempts will be made, as in 1906–7, to work American deposits. If this can be done without great initial outlay, some antimony miners will probably make good profits; but it may be only a few months before prices will be back to or near those prevailing during the last six or seven years.

In the United States deposits of stibnite (antimony sulphide) near Gilham, Ark.; Battle Mountain, Lovelocks, and Austin, Nev.; Burke and Kingston, Idaho; Tonasket, Okanogan County, Wash.; Graniteville and San Emigdio Canyon, Cal.; Antimony, Utah; Red Bridge, Oreg.; and other places are potentially productive in times of prices as high as those now prevailing.

A greater benefit than the temporary operation of the mines would probably accrue to this country from the establishment of smelters which would import and smelt Chinese, South American, Canadian, and Mexican antimony ores. At present the only regular antimony smelting in this country is done by a smelter which is said to be a branch of an English smelter.

ARSENIC.

The consumption of white arsenic in the United States in 1913 amounted to about 7,200 tons, valued at $570,000, of which 2,513 tons, valued at $159,236, was produced in this country as a by-product from copper and precious-metal smelters, and the remainder was imported largely from European countries. For the present imports of arsenic will probably be seriously diminished by the European war. The American smelters can save much more arsenic than they do now, for the cheapness of the product has prevented the saving of all that was practicable, and the war would seem to open the way for an increase in the American output.

Works for the exclusive production of arsenic have been erected at only two places in the United States—Brinton, Va., and Mineral, Wash. It is difficult for such plants to produce arsenic to be sold in competition with the by-product of the smelters except in periods of high prices, such as may again prevail if the war and its industrial disturbances are long continued.

PLATINUM.

The production of platinum from domestic sources in the United States in 1913 only amounted to 1,034 fine ounces. Of this, only 483 ounces was taken from placer mines in California and Oregon. As the estimated world's production in 1913 amounted to 268,339 ounces, the United States output amounted to less than one-half of 1 per cent. Of the world's output Russia contributed over 90 per cent and Colombia about 6 per cent. In addition to refined metal and manufactures of platinum valued at $3,065,489, the refiners in the United States recovered 39,154 fine ounces of platinum from imported sands and ore. Much of this was probably used in the manufacture of jewelry. It is rather difficult to determine exactly what effect the war will have on the Russian mines. The output will undoubtedly decrease, but the European consumption of platinum for jewelry and other purposes will be negligible. Prices for the metal were high during the last two years, and any large increase in values will probably result in a lessened consumption. The supply of crude metal available from sources other than Russia will not probably exceed 20,000 troy ounces. The high prices in 1913 did not result in any increase of the output from domestic mines, and it is not likely that the yield of platinum from such mines in 1914 will exceed 2,000 ounces. The sources of the domestic output have been limited to placer mines in California and Oregon and the Rambler mine in Wyoming and to the recovery from the refining of foreign and domestic bullion, scrap, sweepings, etc. It is reported that ore which carries considerable platinum is now being mined in Nevada.

Although it appears that the supply of platinum will be only about 25 per cent of that formerly available, it will be sufficient for necessary mechanical purposes if it is not diverted to mere purposes of personal adornment.

RADIUM.

The European war has, for the present at least, totally closed the European market to American radium ores. As is well known, the uranium ores of Colorado and Utah are sold exclusively for their radium content, so little use being known for the uranium that the ores can not be sold for their content of that element. The closure of the European market leaves the miners without a buyer; so that while the war lasts, and probably for some time afterward, the market will be restricted and without the benefit of competition.

As already pointed out by Secretary Lane, had the bills introduced in Congress been passed, the United States Government would probably have been in the market as a buyer, and the miner might now have a chance to sell his ore.

MISCELLANEOUS MINERALS AND MINERAL PRODUCTS.

CEMENT.

The United States imports relatively little hydraulic cement, only 84,630 barrels having been imported in 1913, whereas the domestic production in that year was nearly 93,000,000 barrels. There is little or no need to import any cement, for all parts of the country are now fairly well supplied with mills for the manufacture of Portland cement, and the supply of raw materials is practically inexhaustible. A significant feature of the cement industry, however, is the fact that, though only about 80 per cent of the normal cement-producing capacity of the country is employed at the maximum, there is often an overproduction; yet the exports of hydraulic cement have scarcely exceeded 4,200,000 barrels in any year, this amount being only about

5 per cent of the total output—not sufficient to take care of the surplus production in a year of great activity.

There seem to be excellent reasons for stimulating the export trade in cement as rapidly as possible, for, although the export of a relatively bulky and low-priced material such as cement does not promise large direct profits to an individual producer, indirectly the creation and maintenance of an export trade should benefit the industry at large through the opportunity afforded of disposing of surplus stocks and thereby tending to maintain steadier prices.

American manufacturers have not yet made the most of their opportunities to establish greater export trade. Statistics show that the export of cement from England, Germany, Belgium, and France not only have been considerably greater than those from the United States, but have borne a much higher ratio to the production in these countries. The quantity of cement exported by France in recent years is estimated to have reached at least 23 per cent of her production, and that of Germany about 17 per cent. There are few cement plants in South American countries, and in the past these countries have been supplied mainly from Europe. There is evidently an opportunity now for the cement industry of the United States to secure this trade. The extent to which we have made ourselves independent of foreign cement in times of peace is shown by the fact that 20 years ago our domestic product was less than one-fifth (18.2 per cent) of the consumption. In 1913 our imports were less than 0.1 per cent of the domestic production, and our exports were from 30 to 40 times the imports.

BARYTES.

Since the outbreak of the war in Europe many American users of foreign barytes have been forced to look at home for their future supplies, and it may be well to inform the general public that there is undoubtedly a good supply of barite in this country. Barytes has a wide variety of uses in the manufacture of paint, lithopone, wall paper, glass, artificial ivory, insecticides, fertilizer, etc. The largest consumers of barytes are the manufacturers of "ready mixed" paint and of lithopone. The largest plants at which these products are made are near the Atlantic coast.

In 1912 the United States produced 37,478 short tons of barytes, valued at $153,313, or $4.09 a ton, and imported 26,186 short tons of crude barytes, valued at $52,467, or $2 a ton. In 1913 the domestic production was 45,298 short tons, valued at $156,275, or $3.45 a ton, and the imports of crude barytes were 35,840 short tons, valued at $61,409, or $1.71 a ton. From these figures it can be readily seen that the users of barytes located on the eastern seaboard have been able to procure foreign barytes cheaper than they could buy domestic barytes.

The following facts regarding the location both of mines in operation and of undeveloped deposits are given by the United States Geological Survey and will be of present interest.

In the United States the principal sources of supply are the Missouri and Appalachian districts. In 1913 the Missouri district furnished between 68 and 69 per cent of the total production of the United States, and among the Appalachian States Georgia, North Carolina, Tennessee, South Carolina, and Virginia, named in the order of production, reported an output of crude barytes.

So far as known, no barytes has been produced from Alabama mines since 1906. There are some deposits which probably could be worked in Calhoun, Etowah, and St. Clair counties, in the northeastern part of the State, and in Bibb County, near the center.

Within a radius of about 15 miles centered about Cartersville, Bartow county, Ga., considerable iron ore, ocher, and barite are mined from residual clays derived from Cambrian and Ordovician rocks. The deposits are on the east side of the Appalachian fold and form a northward continuation of the Alabama field.

In Kentucky barite deposits are known in the central (Blue Grass) and western parts of the State. Barite has been mined in Boyle, Fayette, and Garrard counties south of Lexington, though deposits are known in 13 counties centered about the capital.

The greater part of the barytes produced in the United States is obtained from deposits in Washington, St. Francois, Franklin, and Jefferson counties, of east-central Missouri, and from Cole, Morgan, and Miller counties, in the center of the State. Practically all the barytes, locally known as "tiff," is mined from shallow shafts and open cuts in the residual clay.

Two districts in eastern Tennessee contain important deposits of barite. The French Broad district, on the North Carolina line, south and a little east of Knoxville, includes parts of Cocke and Sevier counties. Owing to lack of transportation the veins in this region have not been extensively worked. In the Sweetwater district, including parts of Loudon, McMinn, and Monroe counties, centering about Sweetwater, there has been extensive development and a considerable production of barytes in the past.

In Virginia barytes occurs in three unlike areas—in the red sandstone and shale series of the Triassic; in the old crystalline metamorphic rocks, particularly in the Piedmont crystalline limestone area; and in the valley region of faulted and folded Cambrian and Ordovician limestones. The deposits in the Triassic red sandstones of Prince William County, in the northeastern part of the State, are of little importance at present, though they have been intermittently worked since 1845. The barite deposits of Bedford, Campbell, and Pittsylvania counties, in the south-central part of the State, centered about Evington and Toshes, are in highly altered crystalline rocks formed from old sedimentary and igneous rocks. Barite has been found associated with similar rocks in six other counties in the Piedmont region, but has not been mined to any considerable extent. In southwestern Virginia, in Tazewell, Wythe, Russell, and Smyth counties, barite occurs in the Cambrian and Ordovisian limestones or their residual clay.

Deposits of barytes are known in Mariposa County, in California; in Clark, Elko, Mineral, and Nye counties, in Nevada; in Blaine County, in Idaho; and in Alaska. Most of the deposits in the Western States are undeveloped, as there has apparently been a scanty market for this material in that region, and railroad freight rates have not permitted western barite to compete with either foreign or domestic barite in the principal centers of use in the East. In 1913 E. F. Burchard, of the United States Geological Survey, discovered a considerable deposit of barite associated with quartzite schists on Castle Island, in the Duncan Canal, 40 miles northwest of Wrangell, in Southeastern Alaska.

Witherite, or barium carbonate ($BaCO_3$), is used in the manufacture of glass and porcelain, and in the preparation of oxygen, barium salts, boiler compounds, vermin poisons, and green fire. It is a dense, soft white powder, which is poisonous. So far as is known to the United States Geological Survey, there are no deposits of witherite of commercial size in the United States. Commercial deposits have been mined in England, Silesia, Hungary, Styria, and Russia. Barium carbonate can be prepared by igniting a mixture of 10 parts of powdered barite, 2 parts of charcoal, and 5 parts of potassium carbonate. Potassium sulphide and barium carbonate result from the reaction, and may be separated by water, as barium carbonate is very sparingly soluble in water. Another method of preparing barium carbonate is by heating 100 parts of powdered barium sulphate with 250 parts of sodium carbonate and 200 parts of water in autoclaves at 5 atmospheres pressure.

PHOSPHATE ROCK.

Of the mineral fertilizers phosphate is the one of which the United States has large reserves. The fields and gardens of Europe largely depend on this supply, nearly one-half of our production going to trans-Atlantic ports. The great bulk of the phosphate rock exported is obtained in Florida and, of course, includes chiefly the better grades.

Though phosphate rock is an important item of export, interruption of the foreign sales can not be regarded as a national calamity.

The phosphate reserves in the East are not large, and domestic use can be found for all this material.

The States of Florida, Tennessee, and South Carolina have for many years been the main source of phosphate rock in the United States. The output of Florida, the leading State in phosphate-rock production, has about reached its maximum, particularly so far as the hard-rock industry is concerned. The land-pebble industry continues to show a vigorous growth.

In Tennessee the brown-rock deposits, which several years ago were given but a brief future existence, promise to yield as much or more phosphate than has already been extracted from them, as they are now worked on a large scale with modern machinery and under modern mining methods. Pioneer methods are, however, still employed in some parts of the brown-rock phosphate regions and are attended by a great waste of good material. With the passing of the brown and blue phosphate fields into the control of the larger fertilizer corporations, which practice modern mining methods and have installed expensive plants to treat the mined rock, a gradual change has taken place, and the life of the fields is being thereby prolonged.

The South Carolina field was the first to be exploited on a commercial basis. Though mining has fallen off in this field it is quite likely that much rock remains for future use. As the most readily accessible material has been removed, the remaining rock will be correspondingly expensive to mine. The product, moreover, being of medium grade, can not compete with higher-grade rock in the manufacture of superphosphate. Hardly any rock is being exported from this field at the present time.

The new western phosphate field was discovered in 1906, and although for economic reasons it has not yet produced on a large scale, the main production of phosphates in the future will probably come from the West, where the principal deposits are located on the public domain. Some of the economic reasons that retard the development of the western phosphate fields are comparative newness, lack of transportation facilities, high freight rates, and remoteness from centers of consumption.

Since the discovery of the western fields systematic investigation has been prosecuted by the Survey, and this work has resulted in the discovery of new and important deposits and has greatly added to the known extent of the deposits. Lands remaining in Government ownership that are known to contain valuable phosphate deposits and those that are believed to contain such deposits have been temporarily withdrawn from entry. These reserves are located in Florida, Idaho, Utah, Wyoming, and Montana. The work of surveying the western phosphate lands is still going on, and it only remains for effective legislation to be enacted to make these large reserves available for use.

POTASH SALTS.

Outside of Germany there is no known commercial source of potash salts. If the German supplies are cut off during the European war the agricultural world must either go without potash salts after the meager stock now on hand is exhausted or bestir itself to find another adequate source. Many inquiries regarding a domestic supply of potash salts have been addressed to the United States Geological Survey since the beginning of the war, and the fertilizer journals report that small quantities of spot material are changing hands at sharp premiums. The situation is undoubtedly still less satisfactory than it was a few years ago, when national interest was first awakened to the fact that the United States is entirely dependent on Germany for this important class of fertilizer materials.

The imports of potash salts listed as such in the reports of the Bureau of Foreign and Domestic Commerce include the carbonate, cyanide, chloride, nitrate, and sulphate of potassium, caustic potash, and other potash compounds. The annual imports of these salts during the last three years have averaged about 635,000,000 pounds in quantity, and $11,000,000 in value. These figures, however, represent only a part of the potash salts entering the United States, as they do not include the imports of kainite and manure salts which are used in fertilizers. The quantity of materials of this class imported for consumption in the United States during the last three years has averaged about 700,000 tons, valued at $4,300,000, annually. Thus it is apparent that the value of the annual imports of potash salts exceeds $15,000,000.

Potash salts are employed in many industries other than the fertilizer industry. Already letters have come to the Geological Survey from glass works and chemical industries inquiring where a domestic supply of potash salts can be secured. The chemical manufactures of potash include potassium hydrate, or caustic potash, and the carbonate and bicarbonate of potash, used principally in glass and soap making; the potash alums; cyanides, including potassium cyanide, potassium ferrocyanide, and potassium ferricyanide; various potash bleaching chemicals, dyestuffs, explosives containing potash nitrate, and a long list of general chemicals.

The needs of the manufacturers and the farmers of the country are well known and keenly appreciated by the Geological Survey. Since the question of a domestic supply of potash salts has become of public interest the Government has endeavored to locate deposits in this country and has followed up every clue that seemed to promise results of importance. The Survey's work has extended from

New York to California and from Michigan to Louisiana and has covered all branches of investigation where results might be expected exclusive of the study of kelp. Its investigations have been carried out along several lines: (1) Deep drilling for saline residues has been done at Fallon and in Columbus Marsh and Black Rock Desert, Nev., and will be continued in Black Rock Desert this year; (2) natural and artificial brines and bitterns have been collected at all the salt-making establishments in the United States and a great many other localities and examined; (3) deposits of alunite and other minerals containing potassium have been investigated in Utah and other States; (4) certain occurrences of igneous rock known to contain considerable quantities of potash salts have been examined. Much work has also been done by private initiative along practically all the lines mentioned above. The Bureau of Soils of the Department of Agriculture has investigated the kelps. The work is not yet finished and will be pushed with increased vigor, provided the necessary funds are supplied.

NITRATE.

The third mineral fertilizer is sodium nitrate, which is imported from Chile in large quantities, 612,861 tons, valued at $21,630,811, coming in 1913. Deposits of sodium and potassium nitrate are known in Utah, Nevada, California, Oregon, Montana, and New Mexico and have been described in publications of the Geological Survey and Bureau of Soils, but thus far no material of this kind has been found in sufficient quantity to promise commercial value. The latest report that has come to the Geological Survey relates to a deposit in Arizona.

One important domestic source of combined nitrogen is the gas works and by-product coke ovens, which in 1912 reported a recovery of ammoniacal liquor, ammonia, and ammonium sulphate valued at $9,519,268. This output of by-product ammonium sulphate increased in 10 years from 17,643,507 pounds to 99,070,777 pounds, and as it is linked with the great coking industry further increases can be expected.

Another domestic supply of nitrogen compounds lies in the fixation of atmospheric nitrogen by electricity. Cheap hydroelectric development is necessary to establish this industry, which would make our large agricultural and industrial interests free from the uncertainties of the foreign supply. It is hoped that the waterpower legislation now before the United States Senate may promote hydroelectric development in large units and thus utilize some of the great water powers in the West in obtaining nitrogen from the air.

GRAPHITE.

Although the value of the graphite imported into the United States in 1913 was almost twice the domestic production, the cutting off of the foreign supply should seriously affect only the crucible industry. There is an ample supply of graphite in this country suited for stove polish, foundry facings, and paint pigments, and large deposits of amorphous graphite in northern Mexico, now comparatively peaceful, are controlled by American firms and can be depended upon for supplies of graphite for pencils, lubricating material, and many other uses. Moreover, graphite is now being manufactured in the electric furnaces at Niagara Falls in amounts far in excess of the domestic production from natural sources, and this graphite is well adapted for most of the uses to which graphite is applied except crucible making.

The graphite for which we depend mainly on foreign sources is that used in the manufacture of crucibles and other refractory products, but as these uses probably consume over half of the graphite used in this country, such dependence is a matter of no small importance. Moreover, the manufacture of crucible steel requires graphite crucibles. The graphite used in crucible making has been brought largely from the British island of Ceylon, although within the last few years some has been brought from the French island of Madagascar. This graphite is flaky or fibrous and for this reason is eminently adapted to crucible making. For this use it has never met with serious competition from domestic graphite. The earthy amorphous graphite mined in this country and the graphite manufactured at Niagara Falls are not adapted to this use, and as a rule the expense of concentrating domestic flake graphite has been prohibitive. Nevertheless it is to the domestic supplies of flake graphite that this country must look in the event of foreign supplies being cut off. Practically inexhaustible supplies of this material are known to occur in New York, New Jersey, Pennsylvania, North Carolina, Alabama, Texas, and some other States. Similar deposits are abundant in Canada. The graphite in these deposits occurs as small flakes in rocks composed mainly of quartz, feldspar, and mica, the graphite constituting 5 to 10 per cent by weight.

Several plants are now engaged in working such deposits, and many others now idle could be put on a producing basis in a short time and at little expense. Although the product might not be equal to the Ceylon graphite in all respects for crucible making there is no question that it would be adequate, for similar graphite has for years been successfully used in Germany.

Another American resource is the graphite deposit near Dillon, Mont. The graphite there is very similar to that from Ceylon and should be adaptable for crucible making. Although the deposit does not compare in size with the Ceylon deposits, it might render material aid in case of a shortage.

The graphite deposits of the United States are fully described in a report by Edson S. Bastin on the production of graphite in 1913, recently issued by this Survey.

FLINT.

In 1913 nearly $320,000 worth of flint pebbles was imported into the United States, mainly from Denmark and France. In these countries the flint occurs as irregular nodules in the chalk cliffs that border certain parts of the coast, and under the impact of the waves the hard flint nodules become freed from their relatively soft chalk matrix and are gathered in great quantities from the beaches for shipment to various parts of the world. After reaching their destination the more irregular nodules are calcined and ground to a fine powder for use in pottery manufacture, but those that have been well rounded by the waves are reserved for use in tube mills, their hardness and chemical inertness making them a desirable grinding agent.

The cutting off of the imports of flint pebbles should work no material hardship to the pottery industry, as that industry uses only subordinate amounts of flint compared with the crystalline quartz obtained in Connecticut, New York, and Maryland, and as the supply of the quartz is far in excess of the present demands. A cutting off of the supply of rounded flint pebbles suitable for tube-mill use would probably entail some inconvenience, for so far as is known we have no flint deposits that are comparable in both quality and quantity of material with the foreign supplies or that could compete with them (except perhaps locally) under ordinary conditions of uninterrupted foreign commerce.

On account of the high quality of the foreign flints and the cheapness with which they can be brought into this country, little attempt has been made either by the Survey geologists or by dealers in flint to investigate the domestic sources. Deposits of flint pebbles have been observed at several localities in this country in the course of the geologic surveys, but they have seldom been examined with especial view to the possible utilization of the flints in tube mills. The information available is therefore fragmentary and may, at the most, serve only as a guide to further prospecting and testing.

The principal localities at which flint pebbles have been noted in particular abundance are all in the Gulf States. The pebbles occur mainly in gravel beds, and only part of them are well rounded. In some places the gravels are stained and partly cemented by oxides of iron, but elsewhere they appear to be fairly free from iron.

In Arkansas flint pebbles have been noted at many places in Greene, Craighead, Poinsett, Cross, and St. Francis counties, along Crowleys Ridge, which is paralleled by the St. Louis, Iron Mountain & Southern Railway. From 4 to 7 miles west of Paragould, in Greene County, where a public road crosses the highest part of the ridge, beds of gravel not exceeding 5 feet in thickness occur, usually overlain by 1 to 5 feet of loam. The gravels consist chiefly of gray, brown, and pink angular or fairly well-rounded pebbles of flint and chert, the largest 6 inches in length, and a considerable percentage of white, partly rounded to smoothly rounded pebbles of quartz, the largest 1 inch in length. An exposure on the property of Mrs. Mahala Shelton, 6 miles southwest of Jonesboro, in Craighead County, on the south side of one of the small headwater streams of L'Anguille River, shows from 4 to 11 feet of gravel, consisting mainly of angular to party water-worn brown chert pebbles and cobbles, reaching a maximum dimension of 1 foot. Red, pink, gray, and black chert pebbles and a few smoothly rounded pebbles of pink and white quartz were also observed. Excavation for road material 1 mile east of Wynne, in Cross County, just south of the St. Louis, Iron Mountain & Southern Railway, showed 16 feet of gravel, consisting chiefly of angular to fairly well rounded pebbles and cobbles of brown and gray flint and chert as much as 6 inches in length, with some well-rounded quartz pebbles, lying in a matrix of coarse reddish sand. This material is covered by about 10 feet of loam.

In northeastern Mississippi gravels carrying abundant flint pebbles have been noted in Tishomingo County, a locality about 2½ to 3 miles east of Iuka being especially mentioned. Some of these deposits are 50 to 75 feet thick and cover large areas. The flints are only in part well rounded and portions of the deposit are iron stained. The gravel is extensively excavated for use in road making.

In Texas light opalescent to black flint pebbles are abundant at several localities. They are well exposed along the river bluffs near Austin, Travis County, where they have weathered out of the limestone. They also occur along Nueces River near Oakville, in Live Oak County, and over large areas near Tilden, in McMullen County. Only here and there are these flints well rounded, and many of them are coated with a thin film of iron oxide.

For certain kinds of tube mill grinding—as, for example, the grinding of feldspar or of crystalline quartz for making pottery—pebbles practically free from any iron-bearing mineral must be used, for even small specks of iron-bearing minerals produce stains in pottery on firing. For other purposes, however, as, for example, the grinding of gold ores preparatory to cyanidation, the same freedom from iron is not necessary, and rounded pebbles of various kinds of hard rocks collected from benches, stream beds, or gravel deposits may be used. On the Rand, in South Africa, pebbles of quartzite that weather out of the "Banket" or conglomerate are extensively used, and it is possible that rounded pebbles of dense cherty-looking rhyolite, a rock rich in silica, such as occur in considerable abundance along portions of the Maine coast in the Penobscot Bay and Eastport regions, could be used for these purposes.

SULPHUR.

Sulphur furnishes an instructive example of the capture of the domestic market by the American producer. In 1903 the United States imported 191,000 tons of sulphur for consumption and produced only a few thousand tons in Louisiana, Nevada, and Utah. Last year the imports of sulphur for consumption amounted to only 22,605 long tons, valued at $448,564, whereas the value of the imported sulphur in 1903 was more than $3,700,000. In 1903, moreover, we exported 89,221 tons of sulphur, valued at $1,599,761. making the balance of trade in our favor last year $1,151,197.

The sales of domestic sulphur last year amounted to 311,590 long tons, valued at $5,479,849, and a large quantity of unsold sulphur is still at the mines. This immense increase in the sulphur industry is due to the successful operation of the Frasch process in Louisiana and Texas, where the industry has already reached the point of having its output limited only by the demands of the market.

The imports of sulphur come mainly from Japan and Italy and are almost wholly entered at the Pacific ports.

The production of pyrite in the United States does not, however, show the same gratifying ratio of growth. In the last decade it has increased from about 200,000 tons to 341,000 tons, but the imports of pyrite have more than doubled in the same period, and last year amounted to 850,592 long tons, valued at $3,611,137, or more than twice the domestic production. It is evident that foreign pyrite is the controlling factor in the market, the production in America being insufficient to supply the demand. The principal States mining pyrite are Virginia, California, Wisconsin, Ohio, Illinois, Georgia, Indiana, Missouri, and New York. The imported pyrite comes chiefly from Spain, in which the principal deposits of pyrite occur. The imported Spanish ore is admirably suited for making sulphuric acid.

Closely connected with the production of sulphur and pyrite is the sulphuric-acid industry, which now utilizes to some extent the sulphur that formerly went to waste in the air as smelter gases. The by-product acid made last year had a value of $4,346,272. This source of sulphuric acid is capable of much larger utilization, the production of sulphuric acid from smelter acid being limited only by the demands of the market available. These resources are important, because sulphuric acid is so extensively used in the chemical industries that its consumption has come to be regarded as a gauge of chemical activities in general.

MAGNESITE.

Up to the present the United States has been dependent largely upon foreign sources for its supply of magnesite or carbonate of magnesia, the imports in 1913 amounting to 172,591 short tons, as compared with only 9,632 tons produced in this country. It is interesting to note that the major portion of the imports (163,715 short tons) came from Austria-Hungary, one of the belligerent nations, and that most of the remainder came from Greece, and was landed for calcining at Hamburg and Rotterdam before being reshipped to this country. The question of the adequacy of the domestic supply to meet our needs therefore assumes much importance. Magnesite is valuable for a variety of purposes, which may be summarized as follows: (1) Various refractory uses, as brick, furnace hearths, crucibles, etc.; (2) as magnesium sulphite for the digestion and whitening of wood-pulp paper; (3) in crude form for the manufacture of carbon dioxide; (4) calcined and ground for oxychloride or Sorel cement; (5) miscellaneous applications in crude or calcined form; (6) miscellaneous uses of refined magnesia salts. The magnesite from Austria-Hungary is received chiefly at Philadelphia and is used in the manufacture of refractory brick. The Grecian magnesite enters chiefly at New York and is used for all the purposes enumerated above.

The dependence of American users of magnesite on the foreign supplies is due to several causes. One is the location of the American deposits in California, at so great a distance from the eastern markets that the freight rates have been prohibitive. The establishment of water transportation through the Panama Canal may be expected to alleviate this difficulty. A second cause is the difference in composition between the magnesites of Austria-Hungary and those of California. The former generally contain 6 to 8 per cent of iron, which appears to be beneficial in the manufacture of refractory brick.

With the cutting off of the Austro-Hungarian and possibly of the Grecian supplies there would seem to be every reason why the California industry should be materially advanced. The deposits in that State are numerous, and many of them are fairly large and of high grade. In the opening and development of these mines their nearness to railroad transportation seems to have been of more importance than the character or extent of the deposits. Certain deposits, notably in Santa Clara and San Benito counties, are known to be large in extent and of good character of material, but they lie idle owing to the distance the mineral must be hauled to a railroad, while smaller mines close to railroad stations are being worked.

For certain purposes magnesite is used raw, and for other purposes it is calcined, and the imports include both kinds. As in the manufacture of cement, for example, freshly calcined magnesite seems to be superior to old calcined material, there would seem to be a field for more extensive calcining and grinding in our own country, entirely irrespective of the source of the material.

FLUORSPAR.

The fluorspar industry of the United States has shown a steady growth from a production of 4,000 short tons in 1884 to 115,580 tons, valued at $736,286, in 1913. This notable gain has been conditioned largely by the growth of the open-hearth process of steel manufacture, which absorbs about 80 per cent of the fluorspar produced. Fluorspar is used also as a flux in blast furnaces, iron foundries, and silver, copper, and lead smelters; in the manufacture of fluorides of iron and manganese for steel fluxing; in the manufacture of glass, enameled, and sanitary ware and of hydrofluoric acid; in the production of aluminum; in the electrolytic refining of antimony and lead; and for many other purposes.

The increase in the home production and the imposition of a tariff on fluorspar in 1909 have resulted in a marked decrease in the amount brought in from foreign countries, and in 1913 only 22,682 short tons was imported, compared with the 115,580 tons produced at home. The imports come almost entirely from Great Britain and amount to over 55 per cent of the total English production of this mineral. The English product entering at New York is able to compete with domestic "spar" as far west as Pittsburgh.

There can be no question of the adequacy of the American supply to meet all demands in case the English supply is cut off. In 1913 the output came from Illinois, Kentucky, New Mexico, Colorado, New Hampshire, and Arizona, named in the order of yield. Furthermore, the foreign spar is of lower grade than the mechanically treated spar from Illinois and Kentucky, and as fluorspar is of value chiefly according to its purity, purchasers find that the purer American spar is more efficient and consequently cheaper in the end.

STRONTIUM.

The Geological Survey has received in the last few weeks inquiries regarding American occurrences of strontium minerals. Many of the domestic occurrences are of minor extent and most of them are of little commercial value under ordinary conditions. The two strontium minerals of commercial importance are celestite ($SrSO_4$)

and strontianite ($SrCO_3$). Strontianite is the more valuable, as by simple treatment with acids it is readily converted into the salts desired for commercial purposes. It is, however, rarer than celestite and therefore has been mined on a comparatively small scale. Celestite and strontianite are readily determined before the blowpipe, as both of them have a crimson flame due to the element strontium.

Celestite can hardly be assigned a value in the United States, because heretofore it has not been found in sufficient quantities and in positions accessible enough to make its exploitation profitable, in view of the scant demand for it. During 1913 no strontium was reported as mined in the United States. There is a small market for strontium compounds, as is shown by the import figures. No strontium carbonate, oxide, or protoxide was imported in either 1911 or 1912, but in 1913 the total value of imports of these salts was $2,284. Probably some strontium nitrate was imported for use in "red fire," but it is not possible to obtain figures of the imports of any salts of strontia except those named above. Nearly all the strontium salts used in the United States are imported from Germany. Strontium occurs also abundantly in Sicily.

The metal strontium is not commercially used, but its salts are variously employed. Of these the hydrate and nitrate are of greatest importance. A simple process for obtaining the hydrate is the calcination of the carbonate, strontianite, where that is available. The temperature required is much higher than that of ordinary lime burning. Strontium hydrate is used principally in the recovery of sugar from beet molasses. Strontium nitrate is made by dissolving the carbonate in nitric acid, if the native mineral can be procured sufficiently free from other bases that would consume the acid. The carbonate used is sometimes made from the sulphate by fusing it with soda ash and leaching out the sodium sulphate. The chief use of strontium nitrate is in pyrotechny, where it imparts a red color to the flame. The chlorate and carbonate are also used for this purpose, but to a less extent. The chief users are the manufacturers of fireworks and makers of fusees used by railroads and steamships for night signals.

Strontium in the form of the iodide, bromide, acetate, lactate, arsenate, phosphate, and other salts is used as medicine and in the chemical laboratory.

Celestite occurs 15 miles south of Gila Bend, Maricopa County, Ariz., associated with gypsum, sandstone, and conglomerates containing pebbles of coarse-grained granite. It is found in the form of a bed or beds overlain and underlain in some places by beds of sandstone and in others by igneous flows. The bed with which the celestite is directly associated is 40 to 50 feet thick. Of this thickness the upper 8 to 10 feet looked most promising as a source of the mineral, the remainder of the celestite zone appearing rather sandy. The mineral presents a variety of appearances. The high density, of course, characterizes the purest material. In general it is rather light colored.

In California celestite, together with salt, gypsum, and other important economic minerals, occurs along the northeast margin of the Avawatz Mountains, in San Bernardino County. The minerals are located on land of the Avawatz Salt & Gypsum Co., near the south end of Death Valley. The nearest railroad is the Tonopah & Tidewater, about 10 miles east of the southeast end of the claims. The celestite occurs in lake beds associated with salt and gypsum. Above the lower lake beds and below the gypsum occur the celestite beds. The celestite is exposed in the form of resistant "hogbacks," in some places flanking the ridges and in others cutting them and continuing across the valleys between them. The thickness of the celestite zone may be locally as much as 75 or 80 feet, but the exact thickness is difficult to ascertain in all places, owing to the presence of wash and talus. It must not be understood that the entire thickness of the outcropping reef is pure celestite. It is more than probable that the pure mineral will be found in some places in thin bands and streaks and in others more or less intimately mixed with gypsum, sand, chalcedony, clay, and the oxides of manganese, iron, etc. The typically exposed reefs of celestite are dark brown in color and are conspicuous beside the light-colored gypsum. This dark-brown color may be due to the presence of manganese or iron oxides, or both.

In the vicinity of Schoharie, Schoharie County, N. Y., celestite and strontianite have been found in a rather impure limestone. They occur in pockets and thin seams and have been found in greatest quantity on the east side of Schoharie River, near quarries in limestone of the Helderberg group. Strontianite also occurs in rocks of the Clinton formation near Clinton, Oneida County, N. Y., associated with celestite in geodes. The best examples of the occurrences were found at the old quarries near Lairdsville, 2 miles west of Hamilton College. Celestite and strontianite have also been found near Theresa and on the shore of Chaumont Bay, in Jefferson County, N. Y. About 2 miles from the village of Adams Center, in Jefferson County, a vein of celestite is known to occur in the Trenton limestone. An occurrence has also been reported near Lockport, Niagara County. E. H. Kraus has reported celestite as disseminated through dolomitic limestone near Syracuse. Other places in New York where celestite is said to occur are at the Rossie lead mine and Stark, in St. Lawrence County, and at Depauville, in Jefferson County.

One of the most noted localities in the United States where strontium minerals have been found is Put-in-Bay, South Bass Island, Ottawa County, Ohio. Here celestite was found in 1897 during the sinking of a well, the walls of which caved in, revealing a cavern in limestone. The floor, ceiling, and walls of the cave were found to be composed of celestite, and the owner reported that the mineral was found to a depth of 22 feet below the floor.

In 1904 a deposit of celestite was developed 5 miles north and a little west of Austin, Tex., in the Mount Bonnell and Mount Barker district. The celestite is associated with strontianite, Epsom salts, and other minerals, and occurs in a flat-lying arenaceous and argillaceous magnesian limestone bed in the Glen Rose limestone (Lower Cretaceous).

An occurrence of celestite has been noted near Cedar Cliff, Mineral County, W. Va. The rock in which the celestite crystals occur is a thickly bedded, nearly horizontal argillaceous limestone. The celestite occurs in crystalline form in flattened lenticular cavities or pockets from a foot to a yard in diameter and from 3 to 7 inches in height. In the adjacent limestone strontium sulphate was found so abundantly as to indicate that the rock was strongly impregnated.

Celestite is known to occur at Drummond, Chippewa County, Mich. In Monroe County of the same State it is found disseminated through dolomite, and at the point especially studied the upper layer of the rock contained over 14 per cent of celestite. Below this layer there is a porous stratum with cavities containing celestite and free sulphur. The sulphur is found in considerable quantities and was probably formed by reduction of the sulphate.

Celestite has also been found near Frankstown, Blair County, Pa.; in Brown County, northeastern Kansas; in Larimer County, Colo.; in cavities in limestone near Nashville, Tenn.; and associated in fine, clear crystals with the colemanite of Death Valley, San Bernardino County, Cal. Strontianite occurs with celestite in New York, as already noted, and is also found in Mifflin County, Pa.

OTHER PRODUCTS.

The demand for several of the minor mineral products will be stimulated by the changes in trade with Europe, with the result of increasing materially the production for 1914 and following years. In the case of pottery this movement toward a stronger hold of the domestic market is already well under way. The production in 1913 was the largest in the history of the industry. The underlying cause of this prosperity is no doubt the improvement in the character of the American product in texture, finish, color, decoration, and the prevention of crazing, some of the higher grades of American pottery equaling if not surpassing some of the best imported ware. The imports of pottery have always been more or less interesting. For many years the value of the imported pottery exceeded the value of that made at home, but about the close of the nineteenth century domestic production caught up with imports, and since that time it has greatly exceeded them, the production in 1913 being nearly four times as great in value as the imports. There was, however, last year a considerable decrease in exports of pottery, a change which should now be reversed by reason of the changes in the world's commerce that have become inevitable.

For the manufacture of pottery of the better grades considerable clay, mainly kaolin, is imported into this country from Europe and China, the value of these imports last year exceeding $2,250,000. It seems probable that under the necessity of finding a domestic supply these finer clays can be in large part replaced. Already a process of decoloring kaolin is reported as successful, and this may make large deposits of kaolin and ball clay available for the manufacture of white ware and pottery.

Another minor product is mineral water, of which the annual imports are over 3,000,000 gallons, having a value of nearly a million dollars. Two-thirds of these imports came from Germany, France. and Austria-Hungary, and as soon as the stocks on hand are consumed domestic waters should take the place of those derived from foreign springs. In this connection it is interesting to note that last year the reported sales from 838 commercial springs in the United States were more than 57,000,000 gallons, having a total value of $5,500,000. The recent activity of the New York State Reservation Commission in conserving the natural mineral waters at Saratoga Springs, as well as in improving local conditions, is of interest in calling attention to the many opportunities in this country for utilizing such waters and adopting modes of treatment similar to those which have made the bath resorts of Germany and Austria famous. There is a somewhat popular but fallacious impression that certain European waters have medicinal properties not possessed by any American waters, and many persons addicted to the Apollinaris, Clysmic, or Celestine-Vichy habit might be equally well satisfied by waters from American springs in bottles of American glass, bearing labels printed in the United States.

Of the abrasives imported into this country last year to the amount of $917,000, all could be replaced with domestic products except the diamond dust and bort, the value of which was $100,000 in 1913. Already the domestic output of both natural and artificial abrasives is increasing faster than the imports, and the manufacturers need only to realize the abundance of tripoli, diatomaceous earth, pumice, garnet, corundum, and emery to reduce further their dependence on foreign supplies.

Precious stones constitute one of the largest items in our imports, usually amounting to more than $40,000,000 a year. Inasmuch, however, as fully three-fourths of this value is represented by diamonds, there is little opportunity to substitute the American product. The Arkansas output of diamonds is valued at only a few thousand dollars a year, and this sum is exceeded by the value of the annual production of emerald, ruby, opal, tourmaline, and turquoise. The sapphires from Montana constitute the only domestic factor of importance in the precious-stone market, stones valued at about $200,000 being mined each year.

Common salt continues to be imported in considerable quantity, more than a million barrels coming to Atlantic ports last year. The country is amply able, however, to supply the entire home demand, as the capacity of its salt mines and works is in excess of the present output. The imports last year were only 3.2 per cent of the total consumption, whereas in 1890 the percentage was 17.2.

Secretary Lane has called particular attention to the "long-felt want" in the United States of a chemical industry based on coal tar, a raw material of which our gas and coke retorts yield an abundant supply. The commercial production of coal tar in 1912 was about 125,000,000 gallons (approximately 1,000,000,000 pounds), to which should be added the tar that is at many works burned for fuel or allowed to go to waste.

The extent to which this tar is manufactured in the United States is practically limited to simple distillation for recovery of the light oils (such as benzol), creosoting oils, and pitch. No carbolic acid is made in this country, the acid in the tar going into the creosoting oils used in the preservation of railroad ties, bridge timbers, and other wood exposed to the decaying action of air and water. Crude coal tar contains from 0.5 to 1 per cent of carbolic acid and from 10 to 12 per cent of carbolic oil.

We exported last year 36,500,000 pounds of coal tar, 30 per cent of it to France and 20 per cent to Belgium, for which we received $150,000. Of carbolic acid alone we imported over 8,000,000 pounds, one-third of it from Germany, for which we paid, exclusive of freights, commissions, and profits, $675,000. We imported altogether chemical products of coal tar, including dyes, colors, and medicinal preparations, to the value, duty paid, of about $12,000,000 at the points of shipment. The need of aniline color and dye works in the United States is now self-evident, as is also the opportunity for other branches of the chemical industry.

Several medicinal articles of which petroleum forms a large percentage have been imported, especially a very carefully refined oil having about the consistency of a very light lubricating oil. This has been made, for convenience, in Baku, Russia, and some of it has been manufactured in the United States from petroleum distillates imported from Russia, and has been sold as "alboline," "petrolatum oil," etc. The working up of the trade for these oils on the basis of Russian raw material was largely a matter of pure chance, not of necessity, inasmuch as oils of the same character can be readily produced from American petroleum, and in fact have been produced in small quantities for many years. Thus vaseline oil is a by-product in the manufacture of vaseline, and has been used for the same medicinal purposes for many years. There is no other product of petroleum manufactured abroad which is not also manufactured in the United States. Arrangements have been completed whereby American alboline will be on the United States market in quantity before the end of the present calendar year, whether hostilities cease or not.

One of the products of petroleum that has been exported to a value between $9,000,000 and $10,000,000 during the last three years is paraffin wax. In spite of these large exports, natural mineral wax (ozokerite) is imported, for the reason that its melting point is very high, and although the paraffin wax from petroleum can be produced with this high melting point, the process is difficult and costly. Ozokerite occurs in considerable quantity in Utah in the region of Soldiers Summit, and has been produced there, but the cost of extracting it from low-grade material, together with the cost of transportation to the market, which is chiefly in the Eastern States, has made it possible for the foreign material, which comes from Galicia, to compete with it successfully. The domestic ozokerite should now replace the foreign material.

Another material related to petroleum which has long furnished a large import trade is asphalt from the island of Trinidad. This trade has persisted in spite of the very large developments of asphalt from the residue of asphaltic oils, and even under the war conditions the imports will undoubtedly continue.

The importation of one product of asphalt, however, has now been cut off, and that is ichthyol, a peculiar asphaltic material found in Austria, which finds application after appropriate chemical treatment as a very important medicament. The raw material comes from a fossiliferous deposit near Seefeld, in the Austrian Tyrol. It is carefully selected and subjected to dry distillation. The distillate thus obtained is then sulphonated and subsequently neutralized with ammonia. The use of this material has greatly increased in the last few years, and it has proved very beneficial. Since the beginning of the war its price has doubled, going to over 60 cents an ounce. Already a firm in St. Louis has a material on the market which has been favorably recommended as an efficient substitute closely resembling ichthyol itself.

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