and there is a sketch of the Prussian astronomer Argelander, with a portrait. The editor writes on "Science and Wealth," urging that some of the wealth which science has produced should be bequeathed to aid scientific research. New York: D. Appleton & Company. Fifty cents a number, $5 a year.

THE PRODUCTION OF ALUMINUM.

THE following is from a bulletin recently issued from the United States Census Office concerning the output of aluminum in that country:

In the last decade electro-metallurgical processes for obtaining aluminum have become favorite subjects for patents with inventors. It is sufficient to describe briefly the two which have been commercially successful in this country, and they will serve as types of all. The earlier of these, the Cowles process, was established in 1885, and is carried on by the Cowles Electric Smelting and Aluminum Company, at Lockport, New York. It is at present (1890) confined to the production of aluminum alloys, viz., aluminum bronze (and brass) and ferro-aluminum. This was the pioneer of such processes in the United States, and created an industry which has since been developed and extended. This process, which is now well known to persons interested in metallurgy, consists in passing the current from a powerful dynamo through a mixture of alumina (in the form of corundum, bauxite, etc.), carbon, and pieces of copper contained in a suitable vessel lined with carbon, through the ends of which vessel the large terminals of the dynamo are inserted. The mixture is arranged so as to prevent short circuiting. On passing the current the alumina is reduced in the presence of carbon and unites with the molten copper to form an alloy rich in aluminum. This alloy is afterward remelted, and enough copper added to it to reduce the aluminum contents to the proportions desired for aluminum alloys of the required grades.

The Cowles Company has produced aluminum bronze as follows:

PRODUCT OF ALUMINUM BRONZE.

Years.	Pounds.	Value.
1885.....	4,000 to 5,000	$1,600 to $ 2,000
1886.....	50,000	20,000
1887.....	144,764	57,000

Besides aluminum bronze the Cowles Company makes ferro-aluminum by the same process by which the bronze is made, substituting iron for copper. The alloy, containing from five to ten per cent. of aluminum, is used as a vehicle for introducing aluminum into molten iron to increase its tensile strength and solidity. An idea of the growing demand for ferro-aluminum for this metallurgical use is obtained from the statement of the Cowles Company that they made in 1886 from 2,000 to 3,000 pounds, valued at from $780 to $1,170, and in 1887, 42,617 pounds, valued at $16,621. The total aluminum alloys produced in 1889 was 171,759 pounds.

Many proposals have been made and many patents obtained for making alloys of aluminum with iron and sometimes with copper by reducing alumina with carbon in the presence of fluxes and the metals. Clay, kaolin and other compounds of alumina, it is asserted, may be used for this purpose. Sometimes the iron or copper is added to the melted mixture used as a "bath," sometimes the mixture is added as a flux to iron in a cupola or similar furnace, and sometimes it is used as a paste on iron, which is then heated. The object in most cases is to make an iron aluminum alloy for "beneficiating" iron. The announcement of the good effect produced on iron by adding minute quantities of aluminum to it while melted and Mr. Keep's experiments on this subject have probably led inventors to patent processes of the above kind. It is to be regretted that these processes do not yet offer clear and certain evidence that they are distinct and decided improvements like the electrical processes, or, indeed, that they are operative in the manner described.

The Herault process, which, like the Cowles, makes aluminum alloys, has not been put into commercial operation in this country up to the close of the census year.

In the United States the extraction of aluminum itself is also effected by dynamo electricity, and is a new industry carried on by the Pittsburgh Reduction Company, at Pittsburgh, Pa., operating under the patents of Mr. C. M. Hall. The process consists in forming a fused bath of the fluorides of aluminum, calcium and sodium, to which calcium chloride is subsequently added, by melting a mixture of cryolite, aluminum fluoride, and fluorspar in a suitable vessel lined with carbon, adding aluminum thereto, and then separating the aluminum by the current from a dynamo, the carbon electrodes of which dip into the bath. The process is continuous, because the alumina is renewed as it becomes exhausted. One merit of the process is that the fused bath is of less specific gravity than the aluminum set free, which therefore sinks to the bottom of the vessel. If alloys are desired, the negative electrode is formed of the metal which it is desired to alloy with aluminum. Variations in the composition of the bath are described in the different patent specifications, but that above given is believed to be the one used in practice. This company produced 19,200 pounds of aluminum in 1889, which was sold at $2 per pound in quantity. The total production of aluminum in the United States during 1889, including that contained in alloys, was 47,468 pounds, with a total value of $97,335.

TWO IMPORTANT SHIP-RAILWAY PROJECTS.

FROM the manner in which engineering societies in this country and Canada are becoming interested in the proposed ship-railways across the lower Michigan peninsula and across the peninsula between Owen Sound and Lake Ontario, it would seem that something definite in the way of legislation regarding these projects may soon be expected. The people of Toronto, and in fact all Canada, are especially interested in the Owen Sound—Lake Ontario—connection. The paper recently prepared by E. L. Corthell, C.E., of Chicago, entitled "An Enlarged Waterway Between the Great Lakes and the Atlantic Seaboard," is being discussed in all of the lake cities. At a meeting of engineers and capitalists recently held in Toronto great enthusiasm was caused by a consideration of the data presented by Mr. Corthell. Toronto would derive a large increase in shipping from such an improvement.

Gen. F. L. Hagadorn, an army engineer of some prominence who has given a great deal of attention to ship-railways, takes up the subject in a recent issue in one of the Detroit papers. He also refers particularly to that part of Mr. Corthell's paper relating to ship-railways from Owen Sound to Lake Ontario and across the lower Michigan peninsula from Michigan City, Ind., to Toledo, Ohio, this latter making a direct line for lake propellors from Chicago to Buffalo. He says: "As early as 1837 the project of building a ship-canal around the falls of St. Mary's river was discussed in the legislature of the state of Michigan, and the matter was brought before congress in 1840, but was earnestly opposed, one of its opponents—the distinguished Henry Clay—speaking of it as "a work beyond the remotest settlement in the United States, if not in the moon." This, of course, produced a laugh, and it was not until twelve years after the general government donated 750,000 acres of public lands, and a right of way 400 feet wide, to enable the State of Michigan to undertake the work. (Henry Clay had laughed the proposition out of twelve years growth.) And everyone will remember the opinion of the naval experts who were called upon to report upon the model of Ericsson's Monitor. "Take it home with you," said one of them, "and worship it. You may do so without breaking any of the commandments: for it is not in the likeness of anything that is in the heavens above, or in the earth beneath, or in the waters beneath the earth." It has been said that no ship-railway is at present in operation; but it should be added that a very important one is now under construction, and will probably before long be carrying ships weighing 2,000 tons 17 miles overland across the isthmus of Chignecto between Nova Scotia and New Brunswick. For the last sixty years the necessity of a ship canal across the lower Michigan peninsula has been repeatedly urged, and a survey and estimate has been made for the route from Benton Harbor, Lake Michigan, to a point near Monroe, on Lake Erie, a distance of about 160 miles. This would require sixty-five locks and the crossing of nineteen railroads, at a cost of $138,405,432. A ship-railway over the same peninsula fully equipped for service, will not cost over $39,000,000.

"In 1867 Congress directed a survey to be made for a ship canal around the Falls of Niagara. The work was performed by Col. E. C. Blunt, U.S. engineer, his project being for a canal of fourteen feet deep; and twenty-one years after (1888) Congress ordered another survey for a channel sufficient for ships drawing twenty feet. The route was twenty-five miles long, and the estimate $23,617,900. This was again revised with a large canal prism and an increase of rock excavation, the total estimate being $35,000,000. The estimate for a ship-railway over the same route, less six and a half miles, to accommodate vessels of twenty feet draught and 5,000 tons displacement, is $10,731,613, fully equipped. These figures are given to show the comparative cost of railways and canals over familiar routes, but the comparison will hold good in all cases, and under all circumstances, the variations, if any, always in favor of the railway. The comparative rate of speed is also a matter to be taken into account. On a ship-railway the speed can never be less than ten or fifteen miles per hour. On the Suez Canal it is limited to five miles, and on the Welland to four, but it scarcely ever attains to these on either."—Cleveland, Ohio, *Marine Review*.