

BAUXITE AND ALUMINUM

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SUMMARY OUTLINE

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The United States led the world in setting new records for the production and consumption of aluminum in 1937. Domestic production of aluminum was 30 percent above that for 1936 and exceeded the previous peak output of 1930 by 28 percent. Despite the sharp business recession during the closing months of 1937, the consumption of primary aluminum was greater than ever before. However, during the latter part of the year, producers' stocks increased. On March 1, 1937, the price of primary aluminum in carload lots advanced 1 cent, while the maximum quotations for small lots declined 1 cent. The tariff on aluminum has been listed as one of the subjects for consideration in the proposed trade agreement with the United Kingdom.

Improvement was noted also in the domestic bauxite industry. Shipments were 13 percent greater than in 1936 and were the largest since 1923. Imports increased 57 percent and were the highest on record. Total bauxite consumption in the United States increased 31 percent in 1937, and the domestic product comprised 55 percent of the total. Quoted prices for bauxite in 1937 differed little from those in 1936.

Salient statistics of the bauxite and aluminum industries in the United States, 1929 and 1936-37

| | 1929 | 1936 | 1937 |
|---|--------------|--------------|--------------|
| Bauxite: | | | |
| Production..... long tons.. | 365,777 | 372,005 | 420,232 |
| Value..... | \$2,265,638 | \$2,198,523 | \$2,444,686 |
| Average per ton..... | \$6.19 | \$5.91 | \$5.82 |
| Imports..... long tons.. | 380,812 | 322,790 | 507,423 |
| Exports (including concentrates)..... do.. | 133,551 | 84,471 | 123,191 |
| World production..... do.. | 2,115,000 | 2,783,000 | 13,592,000 |
| Aluminum: | | | |
| Primary production..... short tons.. | 113,987 | 112,465 | 146,341 |
| Value..... | \$51,864,000 | \$41,612,000 | \$55,609,000 |
| Quoted price per pound ² cents.. | 23.9 | 20.5 | 20.1 |
| Secondary production..... short tons.. | 48,400 | 51,500 | 62,560 |
| Imports..... | \$10,860,009 | \$5,181,264 | \$8,177,600 |
| Exports..... | \$7,971,085 | \$1,609,328 | \$2,943,214 |
| World production..... short tons.. | 312,300 | 1403,800 | 531,300 |

¹ Estimated.

² Revised figure.

³ New York: 1929, virgin metal 98-99 percent pure; 1936-37, 99 percent plus, pure virgin ingot, according to Metal Statistics 1938, published by American Metal Market.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

World production of aluminum increased 32 percent in 1937. The United States ranked first in output, contributing 28 percent of the total. Germany, U. S. S. R., and Canada were next in importance. Germany's apparent consumption of bauxite exceeded that of all other countries, and its aluminum output surpassed that of 1936 by 31 percent and that of 1934 by 243 percent. The unprecedented world consumption of over one-half million short tons of aluminum in 1937 was due to armaments, industrial demand, substitution of aluminum for other metals, and new uses. Surinam, Hungary, and Yugoslavia recorded large increases in bauxite production during the year.

BAUXITE PRODUCTION

The 13-percent increase in the 1937 domestic output of bauxite can be charged entirely to Arkansas, which produced 96 percent of the total, as Alabama and Georgia shipments increased only slightly. In Arkansas underground and open-pit mines near Bauxite, Saline County, and near Sweet Home, Pulaski County, contributed the entire production. The Alabama output came from open-pit operations near Eufaula, Barbour County, and Abbeville, Henry County. Georgia bauxite came chiefly from an open-pit and an underground mine near Andersonville, Sumter County, although a small quantity was shipped from open pits near Kingston, Bartow County, and Hermitage, Floyd County. Bauxite deposits in Tennessee and Mississippi remained idle in 1937.

Bauxite shipped by producers in the United States, 1933-37

| Year | Alabama and Georgia | | Arkansas | | Total | |
|-----------|---------------------|-------------------------|-----------|-------------------------|-----------|-------------------------|
| | Long tons | Value, f. o. b. mine | Long tons | Value, f. o. b. mine | Long tons | Value, f. o. b. mine |
| 1933----- | 11, 997 | \$69, 541 | 142, 179 | \$853, 718 | 154, 176 | \$923, 259 |
| 1934----- | 12, 074 | 71, 991 | 145, 764 | 1, 057, 062 | 157, 838 | 1, 129, 053 |
| 1935----- | 14, 121 | 91, 293 | 219, 791 | 1, 465, 302 | 233, 912 | 1, 556, 595 |
| 1936----- | 17, 062 | 109, 327 | 354, 943 | 2, 089, 196 | 372, 005 | 2, 198, 523 |
| 1937----- | 18, 037 | 121, 825 | 402, 195 | 2, 322, 861 | 420, 232 | 2, 444, 686 |

Domestic bauxites vary considerably in Al_2O_3 content, the essential constituent, but neither alumina content nor moisture is considered by the producers in reporting shipments. The alumina content of the 420,232 long tons of bauxite shipped in 1937 is estimated as about 248,000 tons. Most of the bauxite is dried before shipment. The recent use of bauxite for oil filtration probably will cause an increase in the small quantity of bauxite shipped as crude. In 1937 crude and calcined shipments totaled 148,582 tons, while dried shipments totaled 271,650 tons. Most of the dried bauxite is consumed by the aluminum and chemical industries, while calcined ore goes to the abrasive and refractory trades.

In addition to the nine bauxite-producing concerns in 1936 (Minerals Yearbook 1937, p. 666) there was one new producer in 1937—J. M. Mathison, operating near Abbeville, Henry County, Ala. After a few months' operation early in 1937, Southern Minerals, Inc., discontinued work at its mine near Kingston, Ga. In Arkansas the American Cyanamid & Chemical Corporation continued mining

at its Rauch property, Pulaski County, and opened its Ozark shaft mine in Saline County. Ore from both mines is taken to the drying plant at Berger, to which screening and magnetic-separation equipment were recently added. The Roy Bizzell mine and the Standard mine, both in Saline County, were operated by the Arkansas Bauxite Corporation in 1937. Early in 1938 this concern began development on its McDonald property. Mechanical loading machines are reported to have been installed recently at the company's underground mines, and magnetic-separation and screening equipment have been added to the drying plant. The Crouch Mining Co., Inc., producing bauxite for the General Abrasive Co., sank a new shaft on its England property in Pulaski County, and the Dixie Bauxite Co., Inc., installed magnetic separation in its plant. In 1937 the Republic Mining & Manufacturing Co. continued its previous mining operations with no change in its concentrating, drying, and calcining plants. The Norton Co. continued to purchase bauxite rather than operate its own mine. The Consolidated Chemical Industries, Inc., formerly known as the Louisiana Chemical Co., sank a shaft near Alexander, Ark., and will begin production of bauxite in 1938.

CONSUMPTION BY INDUSTRIES

The aluminum, abrasive, chemical, cement, and refractory industries, in the order named, consume all the bauxite produced in and imported into the United States. A list of the principal bauxite consumers in the United States appears on pages 669 and 670 of Minerals Yearbook 1937.

Bauxite shipped by producers in the United States, 1933-37, by consuming industries, in long tons

| Year | Aluminum | Chemical | Abrasive ¹ | Cement, refractory, ¹ and miscellaneous | Total | Year | Aluminum | Chemical | Abrasive ¹ | Cement, refractory, ¹ and miscellaneous | Total |
|----------|----------|----------|-----------------------|--|---------|----------|----------|----------|-----------------------|--|---------|
| 1933---- | 46,506 | 89,226 | 18,444 | ----- | 154,176 | 1936---- | 211,990 | 73,972 | 84,363 | 1,680 | 372,005 |
| 1934---- | 55,630 | 67,153 | 34,580 | 475 | 157,838 | 1937---- | 211,275 | 75,561 | 126,339 | 7,057 | 420,232 |
| 1935---- | 112,154 | 66,316 | 53,684 | 1,758 | 233,912 | | | | | | |

¹ Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

Aluminum.—The aluminum industry in 1937 consumed 50 percent of the domestic production of bauxite. The only domestic ore used by the industry is that from Arkansas. This source supplied about one-third of the total ore required for the record metal output, and the rest came from South America.

All bauxite used by the aluminum industry has been refined to alumina at the East St. Louis (Ill.) plant of the Aluminum Ore Co., a subsidiary of the Aluminum Co. of America. A new \$4,000,000 plant at Mobile, Ala., will begin producing alumina in 1938. It also will use the wet Bayer alkaline process and will have an annual productive capacity of 100,000 tons of alumina. This plant will use imported Surinam bauxite which averages 58 percent Al_2O_3 , 2 percent SiO_2 , 6 percent Fe_2O_3 , and 3 percent TiO_2 ; Arkansas bauxite contains about 57 percent Al_2O_3 , 5 to 6 percent SiO_2 , 3 percent Fe_2O_3 , and 2 percent TiO_2 .

Abrasive.—The manufacture of corundum, emery, and other artificial alumina abrasives consumed 30 percent of the 1937 domestic bauxite output. The abrasive industry uses chiefly calcined bauxite containing 78 to 84 percent Al_2O_3 as well as some refined alumina.

Chemical.—Chemical manufacturers consumed 18 percent of the domestic production of bauxite in 1937. Virtually all the bauxite mined in Alabama and Georgia and much of the Arkansas ore are used by the chemical industry. Total bauxite consumption in this industry was 174,538 long tons in 1937, an increase of 2 percent over 1936. Foreign bauxite accounted for only 27 percent of the total. The average cost of foreign and domestic bauxite at consumers' plants was \$11.48 per ton. In addition to bauxite, aluminum-salts manufacturers used 6,815 short tons of alumina, 974 tons of aluminum metal, and a small quantity of clay.

Aluminum salts and alumina produced in the United States, 1936-37

| | 1936 | | 1937 | |
|-------------------------------|-----------|------------|-----------|------------|
| | Producers | Short tons | Producers | Short tons |
| Aluminum salts: | | | | |
| Alum: | | | | |
| Ammonia..... | 6 | 5,610 | 6 | 5,440 |
| Potash..... | 3 | 3,070 | 4 | 3,098 |
| Aluminum chloride: | | | | |
| Liquid..... | 5 | 1,721 | 6 | 2,245 |
| Crystal..... | 2 | 5,465 | 2 | 7,026 |
| Anhydrous..... | 4 | | 4 | |
| Aluminum sulphate: | | | | |
| Commercial: | | | | |
| General..... | 13 | 373,649 | 14 | 397,733 |
| Municipal..... | 10 | 11,133 | 10 | 14,125 |
| Iron-free..... | 7 | 16,053 | 7 | 15,103 |
| Sodium-aluminum sulphate..... | 2 | 24,769 | 2 | 24,513 |
| Sodium aluminate..... | 5 | | 7 | |
| Total aluminum salts..... | | 441,470 | | 469,283 |
| Alumina ¹ | 26 | 22,055 | 7 | 24,904 |

¹ Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, hydrate, and monohydrate D produced for sale. ² Revised to include crude alumina produced in Utah.

Aluminum salts and alumina shipped by producers in the United States, 1936-37

| | 1936 | | | | 1937 | | | |
|--------------------------------|-----------|------------|------------|---------|-----------|------------|------------|---------|
| | Ship-pers | Short tons | Value | | Ship-pers | Short tons | Value | |
| | | | Total | Average | | | Total | Average |
| Aluminum salts: | | | | | | | | |
| Alum: | | | | | | | | |
| Ammonia..... | 5 | 5,763 | \$302,884 | \$53 | 6 | 5,016 | \$262,245 | \$52 |
| Potash..... | 3 | 2,852 | 159,664 | 56 | 3 | 2,713 | 152,895 | 56 |
| Aluminum chloride: | | | | | | | | |
| Liquid..... | 5 | 1,733 | 80,876 | 47 | 5 | 2,201 | 96,910 | 44 |
| Crystal..... | 3 | 753 | 70,844 | 94 | 2 | 6,823 | 645,437 | 95 |
| Anhydrous..... | 4 | 5,020 | 587,743 | 117 | 4 | | | |
| Aluminum sulphate: | | | | | | | | |
| Commercial: | | | | | | | | |
| General..... | 13 | 376,839 | 7,727,472 | 21 | 14 | 394,507 | 8,793,753 | 22 |
| Municipal..... | 10 | 11,331 | 180,084 | 16 | 10 | 14,034 | 213,841 | 15 |
| Iron-free..... | 7 | 16,182 | 527,850 | 33 | 7 | 16,027 | 541,563 | 34 |
| Sodium-aluminum sul-phate..... | 2 | 24,187 | 1,328,243 | 55 | 2 | 25,573 | 1,386,348 | 54 |
| Sodium aluminate..... | 5 | | | | 7 | | | |
| Total aluminum salts..... | | 444,660 | 10,965,660 | | | 466,894 | 12,092,992 | |
| Alumina ¹ | 26 | 21,840 | 1,605,479 | 74 | 7 | 24,813 | 1,800,412 | 73 |

¹ Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, hydrate, and monohydrate D. ² Revised to include crude alumina produced in Utah.

Aluminum salts shipped in, imported into, and exported from the United States, 1933-37

| Year | Domestic shipments | | Imports | | Exports (aluminum sulphate) ¹ | |
|-----------|-----------------------|----------------------------|---------------------|------------------------|--|------------|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1933..... | ² 365, 506 | ² \$9, 020, 470 | ² 1, 042 | ² \$43, 341 | 28, 270 | \$543, 945 |
| 1934..... | ² 368, 682 | ² 9, 305, 651 | ² 644 | ² 31, 052 | 30, 881 | 594, 440 |
| 1935..... | ² 402, 717 | ² 10, 082, 936 | ² 1, 424 | ² 68, 636 | 33, 091 | 685, 347 |
| 1936..... | ² 444, 660 | ² 10, 965, 660 | ² 2, 106 | ² 50, 608 | 28, 788 | 578, 001 |
| 1937..... | 466, 894 | 12, 092, 992 | 2, 864 | 61, 665 | 31, 807 | 679, 214 |

¹ Also "other aluminum compounds" as follows: 1933, 428 short tons, valued at \$70,011; 1934, 488 tons, \$93,440; 1935, 691 tons, \$126,435; 1936, 1,483 tons, \$250,262; 1937, 2,609 tons, \$426,363.

² Revised to exclude aluminum hydroxide.

Although the primary use of alumina is in its reduction to aluminum metal, alumina also is employed in the chemical industry in the manufacture of such salts as aluminum chloride and iron-free aluminum sulphate. Other uses for alumina include abrasives, refractories, ceramics, and air-conditioning equipment, as a smelter and refinery

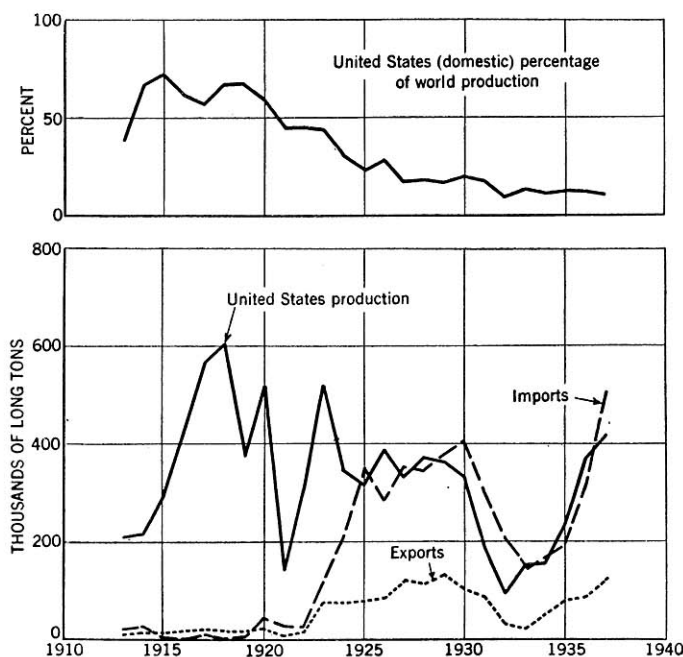


FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913-37.

mold wash, as a mordant in calico printing, and as a filler in paints and varnishes.

Cement, refractory, and miscellaneous.—The cement industry imported all its 1937 bauxite requirements from Greece. The Atlas Lumnite Cement Co. (U. S. Steel Corporation subsidiary) produces all the domestic calcium aluminate cement at its Buffington (Ind.) plant. This cement is made by melting bauxite and limestone in a

rotary kiln under careful temperature control. The molten material is tapped into pigs and cooled, and the clinker is crushed and ground. The cement is used in making heat-resisting and insulating concrete, for early-strength structural and corrosive-resistant concrete, and for the manufacture of dark-colored cast stone.

Only 1 percent of the bauxite produced in the United States was used for refractories. Diasporic clay from Missouri as well as bauxite is used in making synthetic mullite and other aluminum silicate refractories.

Producers reported the shipment of 3,600 long tons of bauxite for use in oil filtration in 1937. In addition, some bauxite shipped to the oil-refining industry probably was included under "Chemical" and not separately recorded.

PRICES

In 1937 the producers of bauxite in the United States reported prices ranging from \$4.02 to \$13.98 per long ton for crude, dried, and calcined ore. The weighted average selling price for crushed and dried bauxite, f. o. b. all mines, was \$5.23 per ton; for calcined bauxite, f. o. b. Arkansas mines, \$11.45 per ton. The average value for all grades of domestic ores sold was \$5.82 per ton.

FOREIGN TRADE

Bauxite imports in 1937 were the largest on record, increasing 57 percent over 1936 and 24 percent over 1930, the previous peak year. Exports gained 46 percent compared with 1936. The 1937 imports (chiefly dried bauxite) originated as follows: Surinam, 399,648 long tons; British Guiana, 81,725; Greece, 15,350; and France 10,700. Receipts from Surinam increased 84 percent over 1936, while those from British Guiana decreased 10 percent. Formerly British Guiana ore was refined to alumina at East St. Louis and reexported to Canada, but now the new Arvida alumina plant processes most of the Canadian requirements. Greece was a new source for bauxite in 1937, and imports from Yugoslavia and British India were discontinued. In addition to bauxite, 182 tons of alumina were imported during the year (117 in 1936), comprising 175 tons from Canada, 5 from France, and 2 from Switzerland.

Bauxite imported into and exported from the United States, 1933-37

| Year | Imports for consumption | | Exports (including bauxite concentrates) | | Year | Imports for consumption | | Exports (including bauxite concentrates) | |
|-----------|-------------------------|-----------|--|-----------|-----------|-------------------------|-------------|--|-------------|
| | Long tons | Value | Long tons | Value | | Long tons | Value | Long tons | Value |
| 1933----- | 149,548 | \$899,696 | 21,760 | \$645,688 | 1936----- | 322,790 | \$2,370,778 | 84,471 | \$2,322,915 |
| 1934----- | 166,653 | 1,201,710 | 51,415 | 1,039,955 | 1937----- | 507,423 | 3,609,063 | 123,191 | 3,456,916 |
| 1935----- | 199,959 | 1,448,592 | 82,491 | 2,191,167 | | | | | |

All 1937 exports classified as bauxite and other aluminum ores, 83,745 long tons (largely calcined ore), went to Canada. Exports of bauxite concentrates and alumina totaled 39,446 tons and were con-

signed as follows: Canada, 28,284 tons; Norway, 9,110; Sweden, 2,019; and Japan, 33. Virtually all the alumina and some of the bauxite exported were used in the manufacture of aluminum, while the abrasive trade consumed much of the calcined bauxite.

The total supply of bauxite, domestic production plus excess of imports over exports, totaled 765,400 tons compared with 582,300 tons in 1936. In the compilation of these figures the tonnage of bauxite concentrates and alumina is multiplied by two since approximately 2 tons of bauxite are required to make 1 ton of alumina.

ALUMINUM

PRODUCTION

The record domestic production of primary aluminum in 1937 increased 30 percent in quantity and 34 percent in value over 1936. According to J. P. Dunlop, of the Bureau of Mines, the quantity of secondary aluminum produced in 1937 increased 21 percent over 1936. Secondary aluminum recovered unalloyed totaled 29,360 short tons and that in alloys (mainly No. 12), 33,200 tons. Refining of secondary aluminum is an important industry, and aluminum ingots and alloys meeting rigid specifications are produced. Production of secondary aluminum was equivalent to 43 percent of the primary output in 1937. Of the new aluminum produced in 1937, 37 percent was made at Massena, N. Y.; 31 percent at Alcoa, Tenn.; 19 percent at Badin, N. C.; and 13 percent at Niagara Falls, N. Y.

Aluminum produced in the United States, 1933-37

| Year | Primary metal | | Secondary metal | | Year | Primary metal | | Secondary metal | |
|--------|---------------|----------------|-----------------|----------------|--------|---------------|----------------|-----------------|----------------|
| | Pounds | Value | Pounds | Value † | | Pounds | Value | Pounds | Value † |
| 1933.. | 85, 125, 000 | \$16, 174, 000 | 67, 000, 000 | \$15, 343, 000 | 1936.. | 224, 929, 000 | \$41, 612, 000 | 103, 000, 000 | \$19, 055, 000 |
| 1934.. | 74, 177, 000 | 14, 094, 000 | 92, 800, 000 | 17, 632, 000 | 1937.. | 292, 681, 000 | 55, 609, 000 | 125, 120, 000 | 23, 773, 000 |
| 1935.. | 119, 295, 000 | 22, 070, 000 | 102, 800, 000 | 19, 018, 000 | | | | | |

† 1933: Based on average price of 22.9 cents a pound; 1934-37: Based on average price of primary aluminum as reported to Bureau of Mines.

The Aluminum Co. of America started a \$26,000,000 expansion program in 1937, a large part of which will be completed in 1938. The program includes the new alumina plant at Mobile, Ala., a new extrusion mill at Lafayette, Ind., a new sand foundry and forging plant at Los Angeles, Calif., and expansion of the large aluminum rolling mill at Edgewater, N. J. The company also has signed a contract with the Tennessee Valley Authority for delivery of 100,000 kw of electricity to take care of increased power requirements for a larger aluminum-reduction works at Alcoa, Tenn. The expansion at Alcoa eventually will double the present productive capacity.

On April 23, 1937, the United States of America, through the Department of Justice, filed suit against the Aluminum Co. of America, et al., in the District Court of the United States for the Southern District of New York. The petition asks for dissolution of the company, charging that it is a monopoly in violation of the antitrust laws. The trial date has been set for May 1938. On December 17, 1937, the

Federal Power Commission denied the application of the Carolina Aluminum Co., a subsidiary of the Aluminum Co. of America, to construct a hydroelectric plant on the Yadkin River near Tuckertown, N. C. A strike at Alcoa, Tenn., curtailed production in the company fabrication unit early in the summer of 1937.

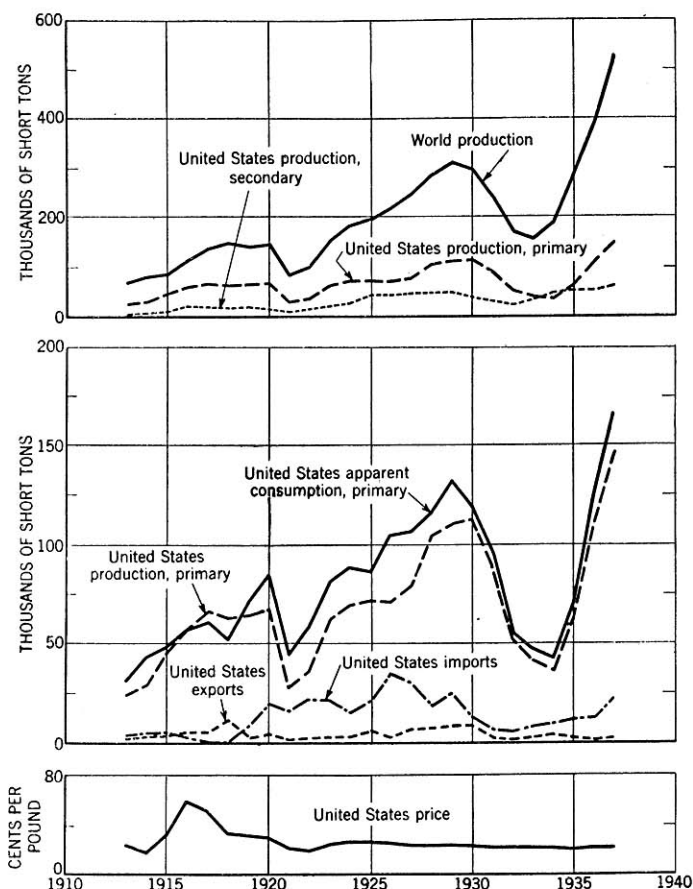


FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913-37. Price is No. 1 virgin 98-99 percent at New York through 1929, thereafter 99 percent plus virgin ingot, as reported by American Metal Market.

CONSUMPTION

The apparent domestic consumption of primary aluminum increased 34 percent in 1937 over 1936. The following table shows comparative data from 1929 to 1937, inclusive. Actual annual consumption is not given, as the table does not consider fluctuations in producers' and consumers' stocks, data on which are not available for all years. From 1930 to 1933 there was a considerable accumulation of stocks (about 150,000 tons) at producers' plants.² Withdrawals from these stocks during the past 4 years were as follows: 1934, 26,079 short

² American Metal Market, Vol. 65, No. 7, January 11, 1938, p. 1.

tons; 1935, 27,515 tons; 1936, 13,279 tons; and 1937, 1,742 tons. The addition of these tonnages to the apparent consumption shown in the table would portray more accurately actual primary aluminum consumption during the period 1934-37. Accumulation of stocks began again late in 1937 and continued in 1938.

From 1929 to 1937 production of secondary aluminum was equivalent to 46 percent of apparent consumption of primary metal.

Aluminum available for consumption in the United States, 1929-37, in short tons

| | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 |
|--|---------|---------|--------|--------|--------|--------|--------|---------|---------|
| Primary aluminum: | | | | | | | | | |
| Production | 113,987 | 114,519 | 88,773 | 52,444 | 42,563 | 37,089 | 59,648 | 112,465 | 146,341 |
| Imports for consumption ¹ | 25,440 | 12,731 | 7,416 | 4,092 | 7,623 | 9,296 | 10,646 | 12,781 | 22,589 |
| Exports ¹ | 139,427 | 127,250 | 96,189 | 56,536 | 50,186 | 46,385 | 70,294 | 125,246 | 168,930 |
| Apparent consumption | 130,911 | 118,585 | 93,839 | 54,318 | 47,332 | 42,202 | 68,309 | 124,443 | 166,238 |
| Secondary aluminum production | 48,400 | 38,600 | 30,300 | 24,000 | 33,500 | 46,400 | 51,400 | 51,500 | 62,560 |

¹ Crude and semicrude, some of which may be secondary aluminum.

Despite the sharp recession in business during the closing months of the year more aluminum was purchased by consumers in the United States in 1937 than ever before. This increased consumption is attributed to the great industrial activity earlier in the year and the broadening of present uses for aluminum, as well as to the discovery of new uses. The service and performance rendered by aluminum emergency bulkheads constructed at the Gallipolis Dam on the Ohio River 2 years ago resulted in the construction of similar bulkheads for the Emsworth Dam northwest of Pittsburgh. Each aluminum bulkhead weighs only 15 tons, whereas a steel bulkhead, just two-thirds as high, would have weighed 28 tons. More buildings in Pittsburgh installed movable aluminum bulkheads, 12 feet high, to serve as a protection against heavy floods.

The consumption of aluminum cable was the greatest in the history of the industry. Additions to the 430,000 miles or more of aluminum cable, steel reinforced (commonly called A. C. S. R.), already in use in the United States and Canada, included a 237-mile transmission line from Boulder Dam to the Colorado River Aqueduct and more than 100,000 miles of rural distribution lines. Aluminum cable is being used in the construction of a new 230,000-volt line from Boulder Dam to Los Angeles. A few years ago it was reported that A. C. S. R. comprised approximately 60 percent of all high-transmission-line mileage carrying 110 kv and above, 70 percent of all lines of 132 kv and above, and 73.5 percent of all lines of 220 kv and above. A much smaller but substantial percentage of the transmission lines carrying 4,000 volts and above is said to be of aluminum.

The transportation industry found new uses for aluminum. The order of the Interstate Commerce Commission permitting the construction of aluminum tank cars for transportation of aviation gasoline opens a new field of use hitherto inaccessible. It will probably be possible to transport other highly volatile chemicals in similar con-

tainers. Aluminum railroad passenger coaches, dining cars, kitchen-dormitory cars, and engine cabs are in operation. Fifty all-aluminum street cars are now under construction. In the aviation field uses for aluminum, long an important metal for aircraft, are still expanding. Much aluminum was used in the construction of the huge Boeing DC-4 and clipper ships, the 46-passenger Martin clipper built for the U. S. S. R., and the Aircuda type army plane. In the marine field, a new aluminum mast was made for America's cup contender *Ranger*, and streamlined masts were used on ice boats. Twenty-two aluminum lifeboats, each seating 99 persons, were constructed in England for the *Nieuw Amsterdam*, flagship of the Holland-American Line. The new Cunard liner *Mauretania* will employ aluminum-alloy funnels. Each of three ferry boats to ply between New York and Staten Island used 55,000 pounds of aluminum for construction of shade decks and pilot houses.

During 1936 the approximate consumption of primary aluminum by industries was as follows: Transportation (land, air, and water) 20 percent, machinery 18 percent, cooking utensil 13 percent, miscellaneous foundry and metal working 13 percent, electrical conductor 12 percent, iron and steel metallurgy 5 percent, chemical and building 3 percent each, and food products and miscellaneous 13 percent.

PRICES

For more than 2 years prior to March 1, 1937, prices for 99-percent-plus pure virgin ingot aluminum, delivered, based on open-market quotations in New York, ranged from 19 to 22 cents per pound. On and after March 1, 1937, the quotation remained at 20 cents for carload lots, with a ½-cent premium for smaller lots down to 1 ton and a 1-cent premium for less than ton lots. Increased production costs effected the 1-cent increase on minimum quotations. In London the 1937 home and export market price for ingots, 98 to 99 percent, remained at £100 per long ton. According to Metal Statistics, 1938, dealers' 1937 buying prices per pound in New York for principal grades of aluminum scrap averaged 11.95 cents for cast aluminum and 14.28 cents for new aluminum clips. Although aluminum-scrap prices declined during the last few months of 1937 they were not affected as much as prices for other metal scrap, as virgin aluminum had not been marked as high relatively as some other metals.

FOREIGN TRADE

Crude and semicrude aluminum imports were 77 percent higher in 1937 than in 1936 and exports 235 percent greater. Imports of crude and semicrude metal accounted for 14 percent of the apparent consumption of primary aluminum in 1937. Of these imports (22,589 short tons), 12,814 tons came from Canada, 4,812 from Norway, 3,010 from Switzerland, 583 from the United Kingdom, and 1,370 from other countries. The value of imports of aluminum manufactures increased 27 percent and that of exports 37 percent.

Aluminum imported for consumption in the United States, 1935-37, by classes

| Class | 1935 | | 1936 | | 1937 | |
|---|------------------|-------------|------------------|-------------|------------------|-------------|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Crude and semicrude: | | | | | | |
| Crude form, scrap, alloy, etc..... | 21,075,683 | \$3,645,704 | 25,158,541 | \$4,072,634 | 44,701,669 | \$6,770,400 |
| Plates, sheets, bars, rods, circles, squares, etc..... | 215,552 | 48,634 | 404,030 | 92,327 | 476,400 | 112,139 |
| | 21,291,235 | 3,694,338 | 25,562,571 | 4,164,961 | 45,178,069 | 6,882,539 |
| Manufactures: | | | | | | |
| Leaf (5½ by 5½ inches)..... | (¹) | 105,269 | (¹) | 95,798 | (¹) | 67,979 |
| Powder in leaf (5½ by 5½ inches)..... | (²) | 2,824 | (²) | 976 | (²) | 212 |
| Bronze powder and powdered foil..... | 277,979 | 99,300 | 478,043 | 173,780 | 295,299 | 124,276 |
| Foil less than 0.006 inch thick..... | 944,330 | 293,094 | 1,879,389 | 655,477 | 2,724,550 | 996,513 |
| Table, kitchen, and hospital utensils, and other similar hollow ware..... | 81,549 | 51,226 | 77,509 | 46,805 | 86,114 | 48,815 |
| Other manufactures..... | (³) | 32,963 | (³) | 43,467 | (³) | 57,266 |
| | (³) | 584,676 | (³) | 1,016,303 | (³) | 1,295,061 |
| Grand total..... | (³) | 4,279,014 | (³) | 5,181,264 | (³) | 8,177,600 |

¹ 1935: 41,298,561 leaves; 1936: 43,260,596 leaves; 1937: 29,279,568 leaves; equivalent in pounds not recorded.

² 1935: 644,025 leaves; 1936: 177,916 leaves; 1937: 54,150 leaves; equivalent in pounds not recorded.

³ Quantity not recorded.

Aluminum exported from the United States, 1935-37, by classes

| Class | 1935 | | 1936 | | 1937 | |
|--|------------------|------------------|------------------|------------------|------------------|-----------|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Crude and semicrude: | | | | | | |
| Ingots, scrap, and alloys..... | 3,361,097 | \$485,940 | 953,546 | \$129,808 | 4,719,034 | \$967,342 |
| Plates, sheets, bars, strips, and rods..... | 609,250 | 208,432 | 652,207 | 252,016 | 664,482 | 293,453 |
| | 3,970,347 | 694,372 | 1,605,753 | 381,824 | 5,383,516 | 1,260,795 |
| Manufactures: | | | | | | |
| Tubes, moldings, castings, and other shapes..... | 949,329 | 349,884 | 901,584 | 318,287 | 588,960 | 279,361 |
| Table, kitchen, and hospital utensils..... | (¹) | 302,152 | 554,961 | 301,051 | 765,810 | 411,864 |
| Foil..... | (²) | (²) | (²) | (²) | 422,850 | 121,269 |
| Aluminum and aluminum bronze powder..... | (²) | (²) | (²) | (²) | 316,482 | 114,760 |
| Other manufactures of aluminum..... | (¹) | 720,822 | (¹) | 608,166 | (¹) | 755,165 |
| | (¹) | 1,372,858 | (¹) | 1,227,504 | (¹) | 1,682,419 |
| Grand total..... | (¹) | 2,067,230 | (¹) | 1,609,328 | (¹) | 2,943,214 |

¹ Quantity not recorded.

² Not separately recorded.

TECHNOLOGIC DEVELOPMENTS

In 1937 there was a substantial increase in the use of bauxite for filtering and decolorizing petroleum fractions, particularly those of paraffin-base oils. Experiments indicate that American bauxites high in alumina are best for the purpose. The form of impurities does not appear to be particularly important. Monohydrated alumina, as typified by some European bauxite, is not suitable. This recent use of bauxite as an adsorbent medium for the percolation filtration

of lubricating-oil stock is described by Hubbell and Ferguson.³ Another paper compares the cost of bauxite with an improved fuller's earth in oil filtration.⁴

In Europe a study has been made of the possible utilization of waste-red-mud residue obtained from the Bayer and Deville-Péchiney processes.⁵ The British Aluminium Co., Ltd., successfully markets the red sludge from its alumina plants.⁶

Utley recently described a method for the determination of organic matter in bauxite.⁷ In Arkansas the organic matter comes from the overlying lignitic clays and consists mostly of humic acids, humates, and their oxidation products.

In aluminum metallurgy the trend is toward refinements in alloys to ease the handling and fabrication of the metal. The free-cutting alloy, 11S, has speeded up automatic-screw-machine operations, and the intermediate-strength wrought alloy, 53S, has found new applications because of its high resistance to corrosion and easy formability.

The Reynolds Metals Co., Knoxville, Tenn., is producing aluminum-coated steel, "Alplate," by the Fink continuous process.⁸ The ferrous metal is heated and subjected to the action of a reducing gas, such as hydrogen, before passing into an aluminum bath. Wire and strip metal up to 18 inches in width are manufactured which have unusual resistance to corrosion and high-temperature.

Recent experiments indicate that small quantities of metallic aluminum powder can be administered to prevent silicosis and other forms of pneumoconiosis.⁹

WORLD BAUXITE AND ALUMINUM INDUSTRIES

BAUXITE PRODUCTION

In 1937 the world output of bauxite reached a new peak. The estimated production of 3,650,000 metric tons is an increase of 29 percent over 1936 and 70 percent over 1929, the two previous record years. The principal producing countries, in order of importance, were: France, Hungary, United States, Surinam, Yugoslavia, Italy, British Guiana, Netherland India, and the U. S. S. R. The 1937 estimate indicates that Netherland India increased its bauxite production nearly 100 percent over 1936, Surinam 67 percent, Greece 50 percent, Hungary 37 percent, U. S. S. R. 23 percent, Italy 22 percent, and Yugoslavia 21 percent. Brazil and the Unfederated Malay States, comparatively new producers, accounted for almost 20,000 tons each.

³ Hubbell, Jr., R. H., and Ferguson, R. P., Bauxite as an Adsorbent for Percolation Filtration: Refiner and Natural Gasoline Manufacturer, Vol. 17, No. 3, March 1933, pp. 104-108.

⁴ Fitzsimmons, Ogden, Fuller's Earth and Bauxite Type Adsorbents Compared: Nat. Petrol. News, Vol. 29, No. 24, June 16, 1937, pp. 60-63, 67.

⁵ Hermann, E., Nutzbarmachung der Abfälle aus der Tonerde-Herstellung; Chem. Ztg., No. 61, 1937, pp. 493-496. (Ab. in Bull. Imperial Inst., London, Vol. 35, No. 4, October-December 1937, pp. 477-478.)

⁶ Metallurgia, Use of Waste from Alumina Production: Vol. 17, No. 101, March 1938, p. 178.

⁷ Utley, Don, Organic Matter in Arkansas Bauxites: Ind. and Eng. Chem., Ind. Ed., Vol. 30, No. 1, January 1938, pp. 35-39.

⁸ Engineering and Mining Journal, Aluminum Coating Successfully Applied to Steel: Vol. 138, No. 9, September 1937, p. 38.

⁹ Denny, J. J., Robson, W. D., and Irwin, Dudley A., The Prevention of Silicosis by Metallic Aluminum: Canadian Min. Jour., Vol. 58, No. 8, August 1937, pp. 407-415.

World production of bauxite, 1933-37, by countries, in metric tons

[Compiled by M. T. Latus]

| Country | 1933 | 1934 | 1935 | 1936 | 1937 |
|---------------------------------------|-----------|-----------|-----------|-----------|------------------------|
| Australia: | | | | | |
| New South Wales..... | 333 | 161 | 111 | ----- | (1) |
| Victoria..... | 681 | 970 | 1,064 | 752 | (1) |
| Brazil ² | | | | 7,000 | (1) |
| British Guiana ² | 36,663 | 51,417 | 113,290 | 172,884 | 305,533 |
| France..... | 490,500 | 528,400 | 512,850 | 649,500 | 688,200 |
| Germany..... | 1,727 | 6,560 | 8,547 | 12,425 | (1) |
| Greece..... | | | 9,489 | 129,898 | (1) |
| Hungary..... | 72,425 | 184,991 | 211,079 | 329,091 | 451,576 |
| India, British..... | 1,092 | 18 | 7,758 | 3,702 | (1) |
| Indochina..... | | | | 30 | (1) |
| Italy..... | 94,818 | 131,266 | 170,064 | 262,246 | (1) |
| Netherland India..... | | | 9,923 | 150,381 | ³ 300,000 |
| Portuguese East Africa..... | | | 30 | 29 | (1) |
| Rumania..... | 1,156 | 1,458 | 6,218 | 2,039 | (1) |
| Spain..... | 2,500 | | (1) | (1) | (1) |
| Surinam (Dutch Guiana)..... | 103,977 | 103,338 | 112,682 | 234,845 | 392,329 |
| Unfederated Malay States: Johore..... | | | | 37 | 19,305 |
| U. S. S. R..... | 50,600 | 61,000 | 132,000 | 203,200 | ³ 250,000 |
| United Kingdom: Northern Ireland..... | 709 | 58 | | | (1) |
| United States..... | 156,651 | 160,371 | 237,666 | 377,976 | 426,977 |
| Yugoslavia..... | 80,855 | 84,828 | 216,197 | 292,174 | 354,233 |
| | 1,095,000 | 1,315,000 | 1,749,000 | 2,828,000 | ³ 3,650,000 |

¹ Data not yet available.² Exports.³ Estimate.

ALUMINUM PRODUCTION

In 1937 the world production of aluminum totaled approximately 482,000 metric tons compared with 366,300 tons in 1936, an increase of 32 percent. The United States, the leading world producer in 1937, increased its output 30 percent over 1936, Germany 31 percent, the U. S. S. R. 19 percent, Canada 62 percent, France 30 percent, Norway 49 percent, and Italy 44 percent. In many countries output was at full capacity as producers realized on their recently expanded plant facilities. Yugoslavia was the only new producing country.

World production of aluminum, 1933-37, by countries, in metric tons

[Compiled by R. B. Miller]

| Country | 1933 | 1934 | 1935 | 1936 | 1937 |
|---------------------|---------|---------|---------|---------------------|---------------------|
| Austria..... | 2,100 | 2,100 | 2,200 | 3,000 | 4,000 |
| Canada..... | 16,200 | 15,800 | 21,400 | 26,200 | 42,550 |
| France..... | 14,300 | 15,100 | 22,000 | 26,500 | 34,500 |
| Germany..... | 18,900 | 37,200 | 70,800 | 97,200 | 127,500 |
| Hungary..... | | | 300 | 900 | 1,200 |
| Italy..... | 12,100 | 12,900 | 13,800 | 15,900 | 22,900 |
| Japan..... | | 700 | 4,000 | ¹ 6,700 | ¹ 10,500 |
| Norway..... | 15,400 | 15,300 | 15,000 | 15,400 | 22,900 |
| Spain..... | 1,200 | 1,200 | 1,200 | 600 | ----- |
| Sweden..... | | 300 | 1,800 | 1,800 | 1,800 |
| Switzerland..... | 7,500 | 8,100 | 11,800 | 15,900 | 16,500 |
| U. S. S. R..... | 4,400 | 14,400 | 25,500 | ¹ 37,900 | ¹ 45,000 |
| United Kingdom..... | 11,000 | 12,900 | 15,200 | 16,300 | 19,400 |
| United States..... | 38,600 | 33,600 | 54,100 | 102,000 | 133,000 |
| Yugoslavia..... | | | | | 200 |
| | 141,700 | 169,600 | 259,100 | 366,300 | 482,000 |

¹ Approximate production.

ALUMINUM CONSUMPTION

Data published by the Metallgesellschaft estimate 1936 world consumption of aluminum at 407,400 metric tons, a 33-percent increase over 1935. Europe consumed 60 percent of the total. The estimated apparent consumption of the seven largest users of aluminum in 1937 was as follows: United States 150,800 metric tons, Germany 129,800, U. S. S. R. 47,500, United Kingdom 47,400, France 27,000, Italy 26,300, and Japan 21,500.

REVIEW BY COUNTRIES

Brazil.—There are great reserves of bauxite in Brazil, but unfortunately their inland location makes transportation to market expensive at present. The principal bauxite deposits, near Poços de Caldas in Minas Geraes and São Paulo, are aluminous laterites formed by the alteration of phonolites and foyaites, nephelite rocks.¹⁰ The ore contains 50 to 64 percent Al_2O_3 , 2 to 7 percent Fe_2O_3 , 0.5 to 6 percent SiO_2 , 1 to 2 percent TiO_2 , and 30 percent combined water. Approximately 10,000,000 tons of aluminous phosphorite containing 22 to 33 percent Al_2O_3 , 27 to 34 percent Fe_2O_3 , and 2 to 16 percent P_2O_5 occur in the Gurupy coastal region between the States of Maranhão and Pará. In 1937 the Companhia Geral de Minas exported about 20,000 metric tons of bauxite to Argentina from its open-pit mines near Poços de Caldas. The company recently completed construction of a 200-ton-capacity plant for drying, calcining, grinding, and sacking the ore. The bauxite is used to make aluminum sulphate for water purification. High freight rates limit the use of bauxite mined by the Companhia Electro-Chimica Brasileira at Ouro Preto, Minas Geraes, to local chemical consumption.

British Guiana.—Bauxite exports from British Guiana increased from 172,884 metric tons in 1936 to 305,533 tons in 1937. The Demerara Bauxite Co., Ltd., shipped about 53 percent of the 1937 tonnage to Canada and 27 percent to the United States. The company pays a royalty of 10 cents per ton for bauxite mined and exported from Crown lands and a 1½-percent export tax on the declared value of all ore exported. Harder¹¹ states that British Guiana bauxite contains 59 to 61 percent Al_2O_3 , 1 to 2.5 percent Fe_2O_3 , 2.5 to 4 percent SiO_2 , and 30 to 32 percent combined water.

Canada.—Of the total 1937 exports of Canadian aluminum (44,000 tons), 20,786 tons were shipped to the United Kingdom, 11,633 to the United States, 8,010 to Japan, and 1,066 to China. Bauxite imports increased from 155,506 tons in 1936 to 275,713 in 1937. Of the latter, British Guiana supplied 160,083 tons, the United States 115,602, and the United Kingdom 28. In addition, Canadian statistics report the importation of 114 tons of alumina—110 from the United States and 4 from the United Kingdom. Apparently imports classified as bauxite also include concentrates and alumina.

A \$10,000,000 expansion program was started by the Aluminum Co. of Canada in 1937, under which ingot capacity will increase from approximately 50,000 tons to 80,000 tons per annum and the Arvida

¹⁰ Pinto, Mario da Silva, Bauxite, Serviço de Fomento da Produção Mineral; Rio de Janeiro, Brazil, No. 24, 1937, 21 pp. Teixeira, E. A., Bauxite in the Plateau of Poços de Caldas; Mineração e Metallurgia, Rio de Janeiro, Vol. 1, No. 5, January-February 1937, pp. 205-214.

¹¹ Harder, E. C., Bauxite: Am. Inst. Min. and Met. Eng., Industrial Minerals and Rocks, New York, 1937, pp. 111-128.

alumina plant capacity will be doubled. The Lake St. John area of Quebec has large reserves of hydroelectric power available for this expansion.

France.—Of the total French bauxite production in 1937 (688,200 metric tons), 552,900 tons came from the Department of Var and 107,000 from the Department of Hérault. The bauxite mines employed 1,198 workmen. Bauxite exports totaled 301,700 tons, of which the United Kingdom received 180,118 tons and Germany 87,525. Approximately one-third of the output went to the alumina plants at Gardanne, St. Auban, Salindres, La Barasse, and Les Aygolades, which produced 113,800 tons of alumina in 1937, about 25 percent of which was exported to Switzerland, Norway, and Austria. In 1937, 568,000 tons of bauxite was consumed by the alumina and aluminum industries, 53,800 in cement, 18,200 in refractories, 13,000 in abrasives, and 25,000 in other industries.

Of the total 1937 output of aluminum (34,477 metric tons), 12,452 came from the Department of Savoie, 6,419 from Isère, 5,753 from Ariège, 5,124 from Hautes-Alpes, 2,853 from Haute-Savoie, and 1,876 from Hautes-Pyrenees. Consumption totaled 27,000 and exports 9,800 tons. The capacity of aluminum-reduction plants at Argentière-la-bessee and St. Jean de Maurienne was increased recently. The Sté. d'Electrochimie, d'Électrométallurgie, et des Aciéries Électriques d'Ugine plans to construct another reduction plant in the Pyrenees. Aluminum of 99.998 percent purity is produced by Péchiney at its St. Jean de Maurienne plant at Froges near Grenoble.

Germany.—Germany continued to be the second largest producer of aluminum in 1937, supplying 27 percent of the total world output. Extensions to the aluminum industry, begun in 1935, continued during 1937. The aluminum-reduction plant capacity was increased at Rheinfelden (Badenwerke) from 400 to 500 tons monthly and at Töging (Innwerke) from 700 to 800 tons monthly, and the plant near Hoyerswerda (Lautawerk) is being enlarged. The new alumina plant at Lautawerda belonging to the State-owned Vereinigte Aluminiumwerke A. G. ("VAAG") began operations early in 1937. Recent reports mention the proposed construction of a new alumina and aluminum-reduction works on the east side of the Lausitz district. The Martinswerk alumina works near Cologne has been able to dispose of its recently increased output. Successful experiments for the extraction of alumina from German clay by the Th. Goldschmidt A. G. of Essen and the "VAAG" have culminated in the construction of a plant that will be completed by the middle of 1938. The process uses sulphurous acid. On July 1, 1937, German aluminum producers voluntarily reduced the fixed price of primary aluminum 7.6 percent, from 144 marks to 133 marks per 100 kg. The new quotation is still higher than the official prices in some other countries—122 marks in the United Kingdom and 113 marks in the United States (reckoned on a gold basis).

Germany's apparent consumption of bauxite in 1937 exceeded that of all other countries. The foreign-exchange situation in regard to bauxite is not serious owing to the relatively small value of bauxite, about 6 to 7 percent of the total cost of finished aluminum, compared with a ratio of 50 to 60 percent or more for copper and other nonferrous ores. Bauxite imports increased from 981,162 metric tons in 1936 to 1,313,152 in 1937. Of the 1937 total imports, 472,313

tons were derived from Hungary, 405,825 from Yugoslavia, 138,813 from Netherland India, 111,271 from Italy, 95,037 from France, 80,669 from Greece, 5,782 from Denmark (probably cryolite), and 3,442 from other sources. Domestic output probably did not exceed 20,000 tons of low-grade ore. The aluminum industry consumed only about 40 percent of the 1937 supply, and apparently large quantities of ore went to stock piles as it is not likely that the chemical, abrasive, and cement industries used the balance of the imports.

Greece.—It is estimated that more than 110,000 metric tons of bauxite were produced in Greece in 1937. Exports increased from 86,016 tons in 1936 to 122,280 in 1937. Of the latter quantity, 71,430 tons went to Germany, 18,150 to United Kingdom, 7,300 to Japan, 2,800 to Norway, and 1,000 to Sweden. Readily accessible bauxite reserves total 10,000,000 and possible reserves, 50,000,000 tons. The most important mines are near Mount Parnassus, and extend from the Gulf of Corinth near Itea northward to Gravia and Bralo; the area is worked chiefly by Société des Mines Bauxite de Parnassus (Greek). The ore from its Topolia mines is largely soluble and is adaptable to the Bayer process, but ore from the Castelli and Varianni mines must be used either by alumina plants not employing the wet alkaline process or by the cement industry. Greek bauxites are characterized by their richness in diasporic (monohydrated) alumina (50 to 60 percent) and iron oxide (18 to 20 percent).¹² Silica and titanium dioxide contents are low.

Hungary.—In 1937 Hungary continued to supply Germany with most of its bauxite requirements. Some of the ore mined was consumed by the alumina plant at Magyaróvár which ships alumina for export and to the aluminum-reduction works at Csepel Island. The bauxite reserves of Hungary are estimated at 250,000,000 tons, the largest in Europe.¹³ The principal deposits are southwest of Budapest at Gánt and Halimba and are leased by the Aluminiumércbánya es Ipar R. T., controlled by Hungarian, Swiss, and German capital. Less-important deposits in southern Hungary at Villany and Peregusza are leased from the State by the Magyar Bányamüvelő R. T. Most of the present production comes from Gánt. The most extensive deposits and largest ore reserves, as yet undeveloped, are at Halimba. The Gánt bauxite is worked by open-pit methods, although the ore, 30 to 65 feet thick, is overlain by 15 to 65 feet of overburden. Steam shovels remove the overburden, and the easily mined ore is hand-shoveled into horse-drawn cars. The ore contains 50- to 63-percent Al_2O_3 , 15- to 30-percent Fe_2O_3 , and 2 to 4 percent SiO_2 . An Anglo-Hungarian concern and an American interest are considering the establishment of another aluminum-reduction plant in Hungary.

Italy.—Italy plans to increase its aluminum output of 22,900 metric tons in 1937 to 30,000 in 1938. In Italy, as in Germany, the self-sufficiency policy calls for the substitution of aluminum for many of the deficient metals, particularly copper and iron. Two new alumina plants employing the Bayer process were established recently at Porto Marghera and are expected to replace the old plants at Bussi and Porto Marghera (Haglund process). The plant belonging to Prodotti Chimici Nationali (Canadian) at Aurelia near Civitavecchia, originally built to produce alumina from leucite, will be converted to

¹² Zenghelis, C., Greek Bauxites and Their Exploitation: 17th Cong. Ind. Chem., September-October 1937; published in Light Metals Research, London, Vol. 6, No. 6, pp.1133-136.

¹³ Bureau of Mines, Mineral Trade Notes: Vol. 5, No. 1, July 20, 1937, pp. 2-5.

the Bayer alumina process by 1939. Istrian bauxite will be consumed. The annual capacity of the aluminum-reduction plant at Borgofranco d'Ivrea which belongs to the Società Alluminio Italiano (Canadian) will be expanded from 1,800 to 3,000 tons by the end of 1938.

Japan.—Japanese aluminum imports probably reached an all-time high in 1937, despite the growth in the domestic industry since its inception early in 1934. Five producing concerns are extending their plants, and numerous other companies are entering the business.¹⁴ Production of all five companies probably did not exceed 12,000 metric tons in 1937. The Japan Aluminum Co. with an alumina and aluminum-reduction plant at Takao, Formosa, has an aluminum productive capacity of 6,000 tons annually. This capacity will be increased to 8,000 tons in 1938 and more later on. The Bayer process is used with bauxite from Netherland India. The aluminum productive capacity of 3,000 tons for the Japan Electric Industry Co. will be advanced to 8,000 tons in 1938. Korean alunite had been converted to alumina by the company at Koyasu, Nagano Prefecture, but bauxite from the Malay States is now said to be used. The reduction plant is at Omachi. Japan Soda Co., Ltd., treats bauxite from Netherland India by the Bayer process. Its reduction plant is at Toyama, northwestern Japan. Sumitomo Kagaku Kogyo at Niihama, Ehimo Prefecture, southern Japan, was at last report using a fertilizer byproduct as raw material. The Nichiman Aluminum Co. (Japan-Manchukuo Aluminum Co.) was using Korean and Manchurian alunite and shale at its plant at Iwasemachi, Toyama Prefecture, but this is now supplemented by Greek bauxite. Besides the producing concerns mentioned, the Manshu Keikinzo, or Manchuria Light Metal Co., is constructing a plant at Fushun, Manchuria, 20 miles east of Mukden, which will treat high-alumina clay from Yentai by the Pedersen process. Eight other firms are reported to be constructing or planning aluminum works in Japan and Korea.

Bauxite is imported from Netherland India, British India, the Malay States, Greece, and perhaps to a small extent from Brazil. Some alumina is also imported. The Mitsui Mining Co., in conjunction with Nanyo Takushoku Kaisha, plans to produce and import bauxite in 1938 from the Japanese-mandated island of Pelew. Japan imports aluminum chiefly from Canada, Norway, Switzerland, and France. In 1936 Japan's aluminum production totaled 6,700 and its imports 10,240 metric tons. During the first 7 months of 1937 Japan imported only 4,090 tons of aluminum but imports were heavy later in 1937. Apparent primary aluminum consumption during the year probably totaled more than 21,000 tons. Secondary metal accounts for 25 per cent of the Japanese consumption of aluminum, which is expected to reach 40,000 tons in 1938.

Netherlands.—The Billiton Mining Co., which operates the bauxite deposits on the island of Bintan in Netherland India through a subsidiary, is planning construction of an aluminum-reduction works somewhere in the Netherland Empire.¹⁵ The Aluminium Wals-en Persbedrijven N. V. was recently formed in Amsterdam for the

¹⁴ Canadian Chemistry and Process Industries, Rapid Growth of Japanese Aluminum Industry: Vol. 22, No. 2, February 1938, p. 52. Schillig, W., Beschleunigter Ausbau der japanischen Aluminiumindustrie: Metallwirtschaft, Berlin, Vol. 17, No. 8, Feb. 25, 1938, pp. 215-216.

¹⁵ American Metal Market, New York, Vol. 45, No. 70, April 9, 1938, pp. 5-6.

fabrication of aluminum. A Swiss and perhaps a German firm will furnish some of the capital in this venture.

Netherland India.—In 1937 the Nederlandsch-Indische Bauxiet Exploitatie Maatschappij ("NIBEM," a Billiton Mining Co. subsidiary) produced an estimated 300,000 metric tons of bauxite from its deposits at Soengei Kolak on the island of Bintan. Present ore reserves are estimated at 10,000,000 tons.¹⁶ Approximately 67 percent of this output was ordered by Germany, 27 percent by Japan, and the balance by other countries. An alumina plant may be constructed and Palembang may be selected as the site due to its proximity to coal deposits. Upon completion of the proposed alumina and aluminum-reduction works, the Netherland Empire would become self-sufficient with respect to aluminum. These plans for an aluminum industry assure a market for Netherland India bauxite, irrespective of action that Japan may take in obtaining ore from its own mandated islands in the Pacific Ocean, and further development of deposits in British India. Prospecting for bauxite on the nearby islands of Angkoet, Kojang, and Pulau Bulang is reported.

Norway.—Of the 21,503 metric tons of aluminum exported from Norway in 1937, 4,939 went to the United Kingdom, 3,559 to the United States, 2,717 to Germany, 2,438 to Czechoslovakia, 2,340 to Belgium, and 2,117 to Japan. In 1937 imports of bauxite totaled 40,474 tons (24,046 in 1936) and of alumina, 38,016 tons (23,021 in 1936).

A strike affecting the electrochemical industry resulted in the cessation of aluminum production in some plants during September 1937. Norsk Aluminium Co., Høyanger, recently increased the capacity of its Eriksdal hydroelectric plant to meet increased consumption in the aluminum-reduction works. Norway continues to foster the use of aluminum for sardine cans.

Spain.—The Spanish civil war damaged the aluminum-reduction plant of Aluminio Español, S. A., at Sabinanigo and caused operations to cease early in 1937.

Surinam (Dutch Guiana).—More bauxite was produced in Surinam in 1937 than in any previous year. All but a few hundred tons of the bauxite shipped from Moengo in 1937 by the Surinaamsche Bauxite Maatschappij went to the alumina plant at East St. Louis, Ill.

Switzerland.—In 1937 the Neuhausen Co. ("AIAG") expanded the capacity of its aluminum-reduction plant at Chippis, Canton Valais. Alumina for the three Swiss reduction plants must be imported.

Aluminum stocks of the Alliance Aluminium Cie. (Basel) were reduced to normal levels in 1937, and cartel members were able to resume full-time operations. The international aluminum cartel has been discussed by Wallace and Anderson.¹⁷

Unfederated Malay States.—Bauxite reserves are reported in the Malay States, and in 1937 production totaled 19,305 metric tons. Japanese interests are said to operate two bauxite mines in the State of Johore, one near Batu Pahat and the other near Sungei Kim Kim on Johore Straits.

Yugoslavia.—The large bauxite output of Yugoslavia comes from

¹⁶ Bureau of Mines, Mineral Trade Notes: Vol. 6, No. 5, May 20, 1938, pp. 3-5.

¹⁷ Wallace, Donald H., Market Control in the Aluminum Industry: Harvard University Press, Cambridge, 1937, 599 pp.; ch. in International Control in the Nonferrous Metals, Macmillan Co., New York, 1937, 801 pp.

Anderson, Robert J., Cartellisation in the World Aluminium Industry: Metallurgia, Vol. 17, No. 98, December 1937, pp. 45-47; No. 99, January 1938, pp. 88-90; No. 102, April 1938, pp. 231-233.

Dalmatia and Herzegovina.¹⁸ The new aluminum-reduction plant at Lozovac, near Sibenik, started production early in the fall of 1937. Alumina is supplied by the Kemicna Tovarna Moste at Ljubljana. A British firm contracted for most of the first aluminum production. The latest Soderberg system is used, and metal of 99.08-percent purity is produced. It is reported that the Aluminium A. G. (Belgrade) soon plans to increase the 1,000-ton annual capacity of the plant.

U. S. S. R.—Probably 250,000 metric tons of bauxite were produced in the U. S. S. R. in 1937. The Soviet reserves of low- and good-grade bauxite have been estimated at more than 45,000,000 tons.¹⁹ The bauxite output from Tikhvin, southeast of Leningrad, is now supplemented by better ore from the eastern slope of the Ural Mountains. The Kolchedan-Sokolovo mine near Kamensk began production in 1936, but the best ore comes from the Krasnaya Shakochka deposit near Vagran. The ferruginous laterite from the Kamensk area contains 36 percent Al_2O_3 , 35 percent Fe_2O_3 , and 5.3 percent SiO_2 , while the Vagran bauxite averages 56 percent Al_2O_3 , 26 percent Fe_2O_3 , and 3.7 percent SiO_2 . Bauxite is also found in the eastern and southern Urals, Kazakhstan, southwestern Asiatic Russia, West and East Siberia, and the Far Eastern Territory, little of which has been fully explored. Alumina in nepheline tailings from apatite mined in the Kola Peninsula is to be extracted at a new plant in Kandalaksha. Large deposits of alunite, leucite, and clay also occur in the U. S. S. R.

The Bayer alumina process will be used at the new Kamensk plant; the other works (Volkhov, Tikhvin, and Dnepr) employ modifications of the Pedersen and Deville-Péchiney processes. Aluminum-reduction plants using hydroelectric power include the Volkhov, Dnepr, and a new plant at Sosnovetz, Karelia, which was to be completed in 1937 for the reduction of alumina from nepheline. The new Kamensk aluminum-reduction plant will employ steam-generated power. The foregoing developments, achieved at tremendous costs, record a rapid growth in the Soviet aluminum industry since 1932 when industrial output began. Future plans call for aluminum-reduction works at Permski, at Chirchik, and near Savano-Zangin (Armenia) and for the production of 200,000 tons of aluminum by 1942.

United Kingdom.—The recent program of the British Aluminium Co., Ltd., specifies a new alumina plant at Newport, Monmouthshire, Wales; extension of the alumina plant at Burntisland, Scotland; and further expansion of the aluminum-reduction plant of its affiliate, North British Aluminium Co., Ltd., at Lochaber, Scotland. The company reduction plant at Kinlochleven was forced to close for a short period late in 1937 owing to the lack of hydroelectric power caused by the drought. The company also operates a reduction works at Foyers and an alumina plant at Larne Harbour, Ireland. Production of alumina was increased by International Aluminium Co., Ltd., at Hebburn-on-Tyne. The product is reduced to metal by Aluminium Corporation, Ltd., at Dolgarrog, North Wales.

In 1937 the United Kingdom imported 222,955 metric tons of bauxite compared with 235,158 in 1936. Imports of crude aluminum and its alloys totaled 32,079 tons in 1937 and 22,067 in 1936. Of the 1937 metal imports, 20,564 tons came from Canada, 6,366 from Switzerland, and 4,381 from Norway.

¹⁸ Bureau of Mines, Mineral Trade Notes: Vol. 5, No. 6, Dec. 20, 1937, pp.4-5, and Vol. 5, No. 4, Oct. 20, 1937, p. 2.

¹⁹ Anderson, Robert J., Russian Aluminium: Mining Mag., London, Vol. 58, No. 2, February 1938, pp.73-86.

