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CHEMICAL INDUSTRIES AND TRADE
OF NORWAY AND DENMARK



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FOREWORD

The prominence of the chemical industry in the economic structure of Norway is indicated by the accomplishment of the Norsk Hydro-Elektrisk Kvaestofaktieselskab, the largest single commercial enterprise in the country. This company has practically built the towns of Notodden, with a population of 8,000, and Rjukan, with a population of 10,000.

The completion of the Norsk Hydro, as it is commonly called, made possible an estimated total production of chemicals and allied products valued around \$40,000,000, of which approximately 75 per cent is nitrogen. Norway is, therefore, more of an exporter than an importer of chemicals, total exports aggregating around \$20,000,000 in value, while imports total only half as much.

In addition to electrochemicals, comparatively large quantities of explosives and matches are manufactured, as well as smaller volumes of pigments, paints, and varnishes, and medical and pharmaceutical preparations. These last-named commodities are also imported, a trade in which the United States participates.

Norway has offered an increasing market for American chemicals. The recorded export from the United States, worth around \$700,000 annually, is much less than the actual trade, since there are considerable receipts through North Sea free ports.

Denmark, although not primarily a manufacturing country, is nevertheless a fairly large consumer of chemicals and allied products, with an importation in 1929 valued at \$28,000,000, two-thirds of which were fertilizers; exports were valued around \$3,000,000. Denmark produces as by-products cattle raising, important pharmaceuticals, such as glandular biologicals, which enter into the export trade. Rennet is also produced and exported.

Among imports fertilizers take a prominent place. The United States shares to a large extent in the trade in naval stores, phosphate rock, and carbon black, and to a lesser degree in the trade in many other chemicals.

This bulletin, the bureau's first comprehensive report on the chemical trade of Norway and Denmark, is one of a series publishing the results of studies made by American representatives abroad, of the industries of the major chemical-producing countries in Europe. William T. Daugherty, American trade commissioner at Berlin, made a special trip to Norway and Denmark to study their chemical industries, and was aided in the preparation of this report by representatives of this bureau in Oslo and Copenhagen. Bulletins of the series previously published deal with the chemical industry and trade of Germany, France, Czechoslovakia, Italy, Poland, Great Britain, Portugal, Switzerland, and Sweden.

FREDERICK M. FEIKER, *Director.*
Bureau of Foreign and Domestic Commerce.

NOVEMBER, 1931.

CHEMICAL INDUSTRIES AND TRADE OF NORWAY AND DENMARK

By **WILLIAM T. Daugherty**, American Trade Commissioner, Berlin

NORWAY

Norway, with an area (not including Svalbard) of 125,017 square miles and a population of 2,800,000, is one of the important chemical-producing countries of the world, principally because of its development of the electrochemical branch, in which the production of nitrates is outstanding. The introduction at the Norsk Hydro plant of the Haber-Bosch process of direct ammonia synthesis and the tripling of the company's nitrogen capacity gave the Norwegian chemical industry tremendous impetus, making possible a potential annual chemical production valued around \$40,000,000, an increase of almost 100 per cent. Norway is one of the world's largest producers of cod-liver oil and one of the few countries mining pyrites. These last two commodities, however, are not included in the \$40,000,000.

Norway is both an importer and an exporter of chemicals and allied products, imports approximating \$10,000,000 and exports nearly \$20,000,000 annually. Timber, paper and pulp, fish and oils, ores, metals, and nitrates are among the chief exports, and machinery, textiles, minerals, and cereals are the leading imports.

BASIC RESOURCES

Like Sweden, Norway has a wealth of timber supplying primarily a pulp and paper industry, which in 1930 produced 999,000 tons of mechanical pulp and 426,000 tons of chemical pulp (sulphite and sulphate)—a total of 1,425,000 metric tons, compared with a total of 1,469,000 in 1929. Norwegian enterprise has contributed to the more intensive utilization of sulphite pulp liquors, making alcohol, yeast, printing ink, road binder, and other products.

The country produced 1,564,000 metric tons of ore in 1929, valued at 34,111,000 crowns,¹ of which 746,000 tons were iron ore (value, 10,748,000 crowns) and 739,597 tons were pyrites (value 16,556,000 crowns). Copper, molybdenum, nickel, silver, titanium, and magnesite are also among the country's minerals.

Norway's titanium ore deposits at Soknedal, in the Stavanger district, which in 1929 produced 7,923 metric tons, valued at 238,000 crowns, have gained considerable publicity because of the development of titanium white (oxide) to replace white lead and other pigments. Allied with its iron-ore industry, there is a considerable production of ferro-alloys.

¹ Par value of Norwegian crown (krone), \$0.26798.

Norway prizes northern Spitzbergen (Svalbard) and other islands awarded by the League of Nations August 14, 1925, for the coal production amounting to 275,000 to 300,000 metric tons annually. The total shipped to the mother country in 1929 was around 236,000 tons, chiefly for fuel for ships and locomotives. Two Norwegian enterprises, Store Norske Spitzbergen Kulkompani A. S. and Kings Bay Kul Kompani A. S. use Spitzbergen coal.

Norway also imports coal, chiefly from England. Imports in 1930 were 2,274,000 metric tons of coal and 461,000 metric tons of coke, in comparison with 2,435,000 and 540,600 tons, respectively, in 1929.

Norway has an extensive fishing industry, which it exploits in part for cod-liver and whale oils, in which it has a dominant world position. Cod-liver oil originates chiefly in catches around the Lofoten Islands, off the northern coast, and whale oil comes from Norway's two picturesque whaling ports, Sandelfjord and Tonsberg, on the Oslo Fjord, which receive the catches of Norwegian expeditions penetrating as far as Antarctic waters. The production of whale oil in the season ended May, 1931, was 2,272,000 barrels, compared with 1,700,000 barrels the preceding year, 1,210,000 in 1929, and 846,000 in 1928.

The latest production had a value of nearly 200,000,000 kroner. The market was overstocked and prices fell, so that Norwegian expeditions were suspended for the 1931-32 season.

Exports of cod-liver oil were 195,817 hectoliters in 1930, against 223,375 hectoliters (value, 14,976,000 crowns) in 1929, of which 84,569 hectoliters (value, 5,707,000 crowns) were shipped to the United States.

Figures for exports of whale oil are not given, as this industry is concentrated aboard ships plying in extraterritorial waters.

IMPORTANCE OF ELECTROCHEMICAL INDUSTRY

Lacking coal except its Spitzbergen reserves, Norway has harnessed even more electrical power than has its more populous and more extensive neighbor country, Sweden. The amount of electrical power utilized in Norway is estimated at about 2,000,000 horsepower, of which the electrochemical and electrometallurgical industries are supplied with some 700,000 to 800,000 horsepower. Norway's electrochemical industry is distinguished by manufacture, from air fixation, both by electric arc and direct ammonia synthesis processes, of synthetic nitrates, operated by the Norsk Hydro-Elektrisk Kvaestofaktieselskab, with plants at Rjukan, Eidanger, and Notodden. Norwegian annual production capacity of some 90,000 to 100,000 metric tons of contained nitrogen (since the Norsk Hydro trebled its capacity in 1929-30) represents 75 per cent or more, of the total value of output of this country's chemical industry, of close to 150,000,000 crowns annually.

The output of calcium carbide and cyanamide, next in value of electrochemical products, is thought to have dropped in 1930 to around 120,000 tons, valued at 4,000,000 crowns.

VALUE OF OTHER PRODUCTION

Norway also produces explosives and matches valued around 12,000,000 crowns; paints and lacquers worth over 7,000,000 crowns in 1929, although a former important production of titanium white

has been ceded to Germany since then; general chemicals valued at approximately 4,000,000 crowns, and almost as much of the Norwegian classification of "chemotechnical products," including some toiletries and polishes; and pharmaceuticals and cosmetics, valued at 1,750,000 crowns. Soaps, not included in chemical classifications, are valued at 12,000,000 crowns, and there is some production of wood tar.

PAPER AND PULP

Of a total average annual cut of 10,200,000 cubic meters, the timber industry supplied the pulp mills with around 3,690,000 cubic meters for a production of 1,425,000 metric tons of mechanical and chemical pulp in 1930. Norway operated 62 wood-pulp mills in 1929 and 27 chemical-pulp mills. Production of a value of 46,900,000 crowns by mechanical pulp mills and 100,400,000 crowns by chemical pulp mills places this industry among the foremost of all individual branches of industrial enterprise. The country's wealth of spruce, which amounted to 91 per cent of total pulp-mill consumption in 1929, favors pulp production.

Exports of wood pulp in 1930 were 610,824 metric tons, compared with 600,228 tons in 1929, valued at 28,799,000 crowns, of which 26,732 tons (value, 1,247,600 crowns) were shipped to the United States.

Exports of chemical pulp in 1930 were 241,919 metric tons, against 280,274 tons in 1929, valued at 69,933,936 crowns. A total of 79,763 tons (value, 18,009,000 crowns) went to the United States in 1929.

PYRITES

The largest pyrites deposits are located at Lokken Verk, in Meldal Valley, in Sor-Torndelag Province, and are operated by Orkla Grube-Aktiebolag. These deposits produced 498,825 metric tons of copper pyrites in 1929, resulting in concentrated pyrites amounting to 399,040 metric tons.

Other deposits of pyrites are located at Fauske, in Nordland, and operated by Sulitjelma Aktiebolaget, which in 1929 produced 285,800 tons of copper and zinc pyrites, with 23.53 per cent sulphur, 1.9 per cent zinc, and 0.98 per cent copper. This quantity was concentrated to 56,300 tons of pyrites and 1,483 tons copper. This company has increased its copper production, having erected a smelting plant in 1929 with a production capacity of 5,000 metric tons of copper.

The next largest pyrites deposit is A. S. Stordø Kisgruber, at Lillebo Gruber, in Hordaland Province, where 216,300 tons of crude ore with 24 per cent sulphur were produced in 1929.

A. S. Bjørkaasen Gruber, at Ballangen, in Nordland Province, with an output of 181,000 tons of crude ore analyzing 30.7 per cent sulphur and 0.45 per cent copper, produced 94,800 tons of pyrites with 47.51 per cent sulphur.

The smallest of the four operations, Foldal Copper & Sulphur Co., (Ltd.), at Foldal, in Hedmark Province, produced 22,240 metric tons of sulphur pyrites in 1929.

Against the total Norwegian production of 740,000 metric tons, exports were 204,246 metric tons of pyrites with a low percentage of copper and 452,286 tons with a higher percentage of copper, chiefly to Germany and Sweden.

The Norwegian copper pyrites marketed yield from 40 to 48 per cent sulphur, from 35 to 45 per cent iron, and 1.7 to 3.5 per cent (in some instances up to 6 per cent) copper. Lower grades are also mined for mixing with the higher products. Noncuprous ores have 40 to 50 per cent sulphur, 35 to 45 per cent iron, and traces of copper up to 0.7 per cent. Some grades have traces of zinc, nickel, cobalt, silver, and gold, which are extracted as far as possible.

The Orkla concern, largest of Norwegian pyrites exporters, has perfected a process to produce elementary sulphur from pyrites, and is constructing a plant with an ore-working capacity of 200,000 metric tons, at Thamshavn, near Trondhjem.

ORES

IRON

The largest iron-ore deposit in Norway is operated by the A. S. Sydvaranger, at Kirkenes, founded in 1910, in the Sydvaranger district near the northern limit of the country, at approximately latitude 72° N. The Sydvaranger mines yield the major annual output of crude ore now, of which about one-half is exported, chiefly to England, France, Belgium, Germany, and Poland. This ore is a phosphorus magnetite, analyzing 35 per cent iron, which, when dressed, shows an analysis of 67 per cent iron, 6 per cent silicic acid, 0.01 per cent phosphorus, and 0.01 per cent sulphur. The operation produces iron ore, concentrates, briquets, and cinder.

Two other larger iron-ore works are (1) Dunderland Iron Ore Co. (Ltd.), operating deposits in Nord-Raana district, in the northern Nordland Province, which in 1929 produced 204,200 tons of ore analyzing 32 per cent iron and no sulphur (dressed, it analyzes 67.7 per cent iron, and 0.03 per cent phosphorus); (2) Ofotens Malmfelter A./S., operating at Bogen, likewise in Nordland, which resumed operations in 1930 after a long period of idleness.

Fosdalen Gruber, working magnetite, is located at Malm, near Steinkjer, in Nord-Trondelag Province. This operation produced 111,400 metric tons of magnetite in 1929, and 1,400 tons of pyrites.

Rødsand Gruber, at Nasset, in More Province, produced 31,100 metric tons of magnetite in 1929.

With a production of iron ore having a metal content of 746,112 metric tons in 1929, Norway exported 522,560 metric tons of concentrate, chiefly to Germany.

ZINC

Some 40,000 metric tons of zinc are produced electrolytically from imported concentrates by Det Norske Zink Kompagni, of Eitrheim, in Hardanger Province, which attained this capacity in 1930, after a former output of around 6,000 metric tons.

Exports of zinc were 27,097 metric tons in 1930, in comparison with only 3,062 metric tons in 1929, emphasize the increased production by this company.

ALUMINUM

Five Norwegian aluminum establishments produce annually about 30,000 metric tons of aluminum, valued at 44,000,000 crowns. They are (1) Det Norske Nitrid A. S., with plants at Eydehavn and Tysedal, with a combined capacity of 16,000 metric tons; (2) A. S.

Norsk Aluminium Co., with plants at Høyanger, with a capacity of 7,000 metric tons annually; (3) A. S. Stangfjordens Elektrokemiske Fabriker, at Søndfjord; (4) A. S. Haugvik Smelteverk, at Glomfjord, with a capacity of 8,000 metric tons; and (5) A. S. Vikelands Brug, at Vikeland, near Kristiansand, with a capacity of 3,400 metric tons.

Norway's aluminum exports in 1930 were 23,676 metric tons, against 29,584 tons in 1929, valued at 44,918,876 crowns.

COPPER AND OTHER ORES

Copper.—The center of the small copper-ore industry is at Roros, established in 1644, in Sor-Trondelag Province, which recently sought Government aid to resume mining operations. These mines produced around 9,000 metric tons of copper ore in 1929, although they did not operate for the full year. This crude ore yielded only 514 metric tons of refined copper.

Exports of copper ore were 15,233 metric tons in 1929, chiefly to the United States.

Knaben Molybdengruber A. S., of Fjotland, in Vest-Agder Province, produced 30,000 cubic meters of raw ore that yielded 227.5 metric tons of molybdenite in 1929. Export of practically all this production went to Germany and France.

Nickel.—Nickel ore is mined by Raffineringsverket A. S., at Evje, in Aust-Agder Province. Its smelting ore analyzes 1.53 per cent nickel and 0.96 per cent copper.

Silver.—Kongsberg Solvverk, at Kongsberg, in Telemark, the oldest mining enterprise here and owned by the State, operates the sole silver deposits in Norway. In 1929 it produced 21,029.3 metric tons of crude ore, recovering 8,831.4 kilos. This plant is said to have been run at a loss for several years. It was established in 1623.

Titanium.—Norway's titanium ore is located at Soknedal, near Stavanger, in Rogaland Province, and is worked by Titania A. S., which in 1929 produced 10,400 cubic meters of ore, permitting a shipment of 6,126 metric tons of ilmenite and 2,990 metric tons of magnetite.

Magnesite.—Norsk Magnesit Industri produced 2,310.5 metric tons of magnesite ore in 1929 which yielded 1,809.4 metric tons of crude magnesite.

NORWEGIAN ORE PRODUCTION, 1927-1929

Ore	1927		1928		1929	
	Metric tons	Crowns	Metric tons	Crowns	Metric tons	Crowns
Silver.....	14,422	460,000	14,267	517,000	13,922	345,000
Copper.....	2,524	133,000	15,285	1,466,000	28,569	4,814,000
Sulphur pyrites with copper content.....	617,044	12,975,000	738,535	15,840,000	739,597	16,556,000
Nickel.....	7,612	137,000	21,246	606,000	23,473	463,000
Iron.....	479,334	6,574,000	662,708	9,373,000	746,112	10,748,000
Zinc-lead.....	333	15,000	100	3,000	3,669	47,000
Titanium.....	5,733	172,000	7,948	232,000	7,923	238,000
Rutile.....	45	54,000	59	69,000	43	51,000
Magnesite.....	1,090	17,000	932	15,000	1,028	144,000
Molybdenite.....	155	510,000	216	713,000	228	705,000
Total.....	1,126,292	21,047,000	1,461,296	28,833,000	1,564,564	34,111,000

FERRO-ALLOYS

Norwegian production of ferro-alloys amounted to 124,536 metric tons in 1929 (value, 31,211,000 crowns) against 119,218 metric tons in 1928 (value, 29,288,000 crowns). Total exports (all in metric tons) of ferromanganese in 1929 were 68,981 (value, 17,247,740 crowns); ferrosilicon, 40,896 (value, 10,721,175 crowns), and ferrochromium, 3,870 (value, 1,938,952 crowns). The chief customers generally were Germany and England.

About 12,050 metric tons of ferrosilicon and 250 metric tons of ferromanganese were made in 1929 by A. S. Porsgrunds Elektrometallurgiske Fabrik (10,276 horsepower), established in 1914. A. S. Bjolvefossen (5,000 horsepower), in Hardanger, and Ila & Lilleby Smelters (5,500 horsepower), in Trondhjem, make ferrosilicon and ferrochromium.

A. S. Fiskaa Verk, of Oslo, with a plant of about 4,500 horsepower at Kristiansand, produce ferrosilicon.

The Electric Furnace Products Co., in Sauda, founded in 1923 and financed by an American corporation, has a plant of about 27,000 horsepower and makes ferromanganese and ferrosilicon.

Almindelige Elektro-Metallurgisk A. S., of Oslo, operates a ferro-alloy plant at Salterod, near Arendal.

A. S. Arendal Smelteverk, at Eydehavn, made ferro-alloys until 1929, but confines production now to silicon carbide (carborundum).

A. S. Hafslund makes carbide and ferrosilicon (25,000 metric tons annually).

A. S. Meraker Smelteverk, at Koppero, makes carbide and ferro-alloys.

PRODUCTION OF CHEMICALS

Official statistics of Norwegian chemical production, published by the Royal Central Statistical Bureau (Oslo), estimate the value of production in 1929 to be around 81,000,000 crowns, or nearly \$22,000,000, against an approximate 90,000,000 crowns, or \$27,000,000, in 1928. The decline in the 1929 production may be accounted for by a drop of 7,400,000 crowns in output of nitrates and 2,600,000 crowns in titanium white.

GROWTH OF NITROGEN PRODUCTION

About 40 per cent of these respective values was accounted for by the average at that time of 30,000 metric tons of contained nitrogen produced by the Norsk Hydro-Elektrisk Kvaestofaktieseskab, with a capital of 104,300,100 crowns, operating nitrate plants at Rjukan and Eidanger, near Porsgrund, and at Notodden. Incidentally, these comprise the largest single commercial entity in the Norwegian Kingdom.

With the introduction at the Norsk Hydro plant at Rjukan of the Haber-Bosch process of direct ammonia synthesis and the tripling of the company's nitrogen capacity (from 30,000 to 90,000 metric tons) in 1930, Norwegian chemical production received tremendous impetus. With its former 30,000-ton production of nitrogen, valued at an average of 40,000,000 crowns, a treble production (announced as almost accomplished in the Norsk Hydro annual report, issued in November,

1930) leads to the conclusion that this country's nitrogen production alone has attained a value of close to 120,000,000 crowns, to which may be added another 40,000,000 crowns for other chemical output (under normal conditions), giving an estimate of a potential annual chemical production of 150,000,000 to 160,000,000 crowns, or a value of \$40,000,000 to \$43,000,000. Thus, Norway's nitrogen production has become 75 to 80 per cent of the country's total chemical production, against 40 per cent previously.

This statement envisages no reduction in output as the German I. G., which has controlled the Norsk Hydro production quota under the international nitrogen pact, imposes no production limitation in Norway, where most advantageous conditions of operation recommend full-time output for the export reservoir maintained by the German I. G. Farbenindustrie A. G.

This later estimate of Norwegian chemical production capacity, then, makes obsolete a figure of 90,000,000 crowns, which was referred by German authorities to the League of Nations economic conference in 1927 as representing Norway's importance in world chemical production, and which placed Norway twelfth and last, after Sweden, on the list headed by the United States and Germany.

TITANIUM OXIDE

In contrast to the increase in nitrogen production, a decrease is indicated in other Norwegian chemical production in 1930 and 1931. This country's former sizable production of titanium white by Titan A. S., of Fredrikstad, which reported an output valued at 4,500,000 crowns in 1928, fell to an output valued around 1,900,000 crowns in 1929, with indications of further decrease thereafter. Titan A. S. assigned its production of solid titanium oxide to the German I. G., which organized its Titan G. m. b. H. at Leverkusen to manufacture and sell in reserved European territory. The Norwegian titanium ore, found at Soknedal, near Stavanger, is now exported to Germany primarily for processing. In 1929 exports were 6,366 metric tons (value, 201,515 crowns) in comparison with 2,663 metric tons in 1928 and 215 in 1927, when Titan A. S. was manufacturing its own oxide.

ELECTROCHEMICAL PRODUCTS

Official (1929) figures credit seven establishments with production of electrochemical products. These products are nitrates (now valued at well over 100,000,000 crowns), carbide and cyanamide (value close to 6,000,000 crowns), silicon carbide (value close to 2,500,000 crowns), and smaller values of chlorine and caustic soda, as well as electrolytic hydrogen and oxygen, the former entering into the manufacture of synthetic ammonia of Norsk Hydro. One company, A. S. Vadheim Elektrokemiske Fabriker, of Bergen, manufactures electrolytic sodium.

Consumption of electrical energy, in kilowatt years, by industries making chemicals, ferro-alloys, and metals was as follows, according to a report of Axel Aubert, of Norsk Hydro, on Norway's electrochemical industry in 1930.

**CONSUMPTION OF ELECTRICAL ENERGY BY THE ELECTROCHEMICAL INDUSTRIES
OF NORWAY**

Product	Norway		World		Norway, 1930		
	1913	1930	1913	1930	Per cent of world	Kilowatt-hours per kilo	Kilowatt-years per ton
Electrolytic:	<i>Kw.-yrs.</i>	<i>Kw.-yrs.</i>	<i>Kw.-yrs.</i>	<i>Kw.-yrs.</i>			
Hydrogen ¹		130,000		220,000	59	² 15-16	³ 1.7-1.8
Alkali.....	1,000	3,000		150,000	2		
Zinc (cadmium).....		22,000		200,000	11	3.6-4.8	.41-0.55
Nickel.....	1,000	1,000					
Aluminum.....	6,000	70,000	200,000	600,000	11	23-30	2.6-3.4
Sodium.....		1,000		40,000	2	15	1.7
Electrothermal:							
Arc nitrogen.....	140,000	130,000	140,000	140,000	93	² 70	³ 8.0
Carbide.....	30,000	15,000	125,000	400,000	4	3.0-3.4	.34-0.39
Cyanamida.....	10,000	25,000	60,000	400,000	6	² 15.6-16	³ 1.7-1.8
Carborundum.....		6,000		40,000	15	7.5-11	.85-1.25
Pig iron.....		10,000		50,000	20	2.4-3	.27-0.34
Ferrosilicon.....	5,000	45,000	30,000	150,000	30	6-15	.7-1.7
Ferrochrome.....		3,000		50,000	6	5-12	.6-1.4
Ferromanganese.....		40,000		80,000	50	3.5-4.5	.4-0.5
Miscellaneous ferro-alloys.....		5,000		50,000	10	6-9	.7-1.0
Smelting.....		10,000	10,000	100,000		.25-1	.01-0.8
Zinc.....	5,000		5,000			4-7	.45-0.8
Total.....	198,000	516,000	570,000	2,670,000			

¹ Hydrogen for the ammonia synthesis.

² Per kilo, or ton, combined nitrogen.

NITRATES

Available figures of production of nitrates (manufactured exclusively by Norsk Hydro) in Norway from 1927 to 1929 are given in the following table. In 1930 total production was 83,000 metric tons² of contained or fixed nitrogen, as compared with an average production of 30,000 tons of nitrogen in three years immediately preceding the war. Production in 1931 was 70,000 to 75,000 tons³ of nitrogen.

NORWEGIAN SYNTHETIC NITRATE PRODUCTION, 1927-1929

Year ¹	Calcium nitrate	Sodium nitrate	Sodium nitrite	Ammonium nitrate	Nitric acid	Total nitrates	
						Quantity	Value in crowns
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	
1927.....	159,120	29,921	3,726	10,230	7,933	210,930	39,400,000
1928.....	173,337	37,815	2,317	13,823	9,092	236,384	40,600,000
1929.....	148,237	26,724	663	15,030	10,755	204,409	32,200,000

¹ Ended June 30.

The foregoing figures cover periods from July 1 to June 30, the so-called nitrogen fertilizer year, generally observed in statistical compilations of nitrogen production in Europe. The following trade figures apply to calendar years.

² Figure supplied privately by Norsk Hydro Co.

³ Estimates based on an almost 9-month production before lockout beginning Apr. 15, 1931, at Norsk Hydro plants and extending to close of year ended June 30, 1931.

The bulk of the calcium nitrate produced by Norsk Hydro is the standard salt with 15.5 per cent contained nitrogen, while the same salt sold under the trade name "Norge Saltpeter" is a 13 per cent grade. Ammonia chalk nitrate, sometimes known as Nitamon-chalk, with 20.5 per cent nitrogen, in both ammonia and nitrate form, is also produced in considerable amounts. In ammonia chalk nitrate the ammonium nitrate is mixed with calcium carbonate, the latter analyzing the standard 36.4 per cent as in the equivalent salt turned out for the German nitrogen syndicate. Norsk Hydro also produces sodium nitrate and nitrite, as well as nitric acid.

Against an average output of 30,000 metric tons of contained nitrogen annually from 1927 to 1929, production figures have been practically trebled—to 90,000 metric tons, with a potential capacity of 100,000 tons of nitrogen. The increase, although actually effected, is not completely apparent in 1930 figures, since much was stocked for delivery later than 1930 figures show.

Preliminary trade figures for 1930 include reference to Norwegian exports of nitrates in that year. They show that after completion of Norsk Hydro plant extensions, exports of calcium nitrate gained by 159,000 metric tons, indicating an increase in exports of about 25,000 metric tons of contained nitrogen, against the actual increase of about 53,000 metric tons of nitrogen during the year. Preliminary figures for 1930 show neither countries of destination nor values. The following table shows exports of nitrates in 1929 and 1930.

NORWEGIAN EXPORTS OF NITRATES IN 1929 AND 1930

Item	Production, 1929 ¹	Export, 1929		Export, 1930
		Quantity	Value in crowns	
Calcium nitrate.....	<i>Metric tons</i> 148, 237	<i>Metric tons</i> 207, 548	30, 159, 113	<i>Metric tons</i> 366, 087
Sodium nitrate.....	26, 724	28, 184	4, 515, 981	23, 088
Sodium nitrite.....	663	866	299, 490	46
Ammonium nitrate.....	18, 030	5, 573	1, 753, 226	4, 822
Nitric acid.....	10, 755	6, 397	1, 639, 506	6, 476
Total.....	204, 409	248, 568	38, 337, 316	406, 839

¹ From July 1, 1928, to June 30, 1929.

The export figures for 1929, showing countries of destination, disclose Denmark as the chief customer for calcium nitrate, followed by Poland, France, Sweden, and Egypt. Russia took 9,626 metric tons of sodium nitrate, and the United States was first customer for ammonium nitrate. Exports of nitrates by countries of destination in 1929 were as follows:

Calcium nitrate:	Tons	Calcium nitrate—Continued.	Tons
Denmark.....	109, 231	East Africa.....	149
Poland.....	48, 010	Algeria.....	49
Sweden.....	17, 704	West Indies.....	23
France.....	14, 387	United States.....	6
Egypt.....	4, 421	Other countries.....	9, 106
United Kingdom.....	3, 316		
Spain.....	591	Total.....	207, 548
Russia.....	375		
Turkey, Asiatic.....	180		

Sodium nitrite:	Tons	Sodium nitrate—Continued.	Tons
France.....	403	Italy.....	1, 043
United Kingdom.....	183	Latvia.....	820
Spain.....	67	Sweden.....	568
Australia.....	51	United Kingdom.....	429
Germany.....	50	Brazil.....	252
Japan.....	46	Portugal.....	198
Italy.....	35	Czechoslovakia.....	148
United States.....	25	British India.....	65
Switzerland.....	6	Other countries.....	2
Total.....	866	Total.....	28, 269
Sodium nitrate:		Ammonium nitrate:	
Russia.....	9, 626	United States.....	4, 694
Spain.....	7, 222	United Kingdom.....	531
France.....	3, 587	Sweden.....	326
Japan.....	1, 969	Other countries.....	22
United States.....	1, 285	Total.....	5, 573
Greece.....	1, 055		

CARBIDE AND CYANAMIDE

Norwegian production figures of carbide and cyanamide are pooled. Carbide production, nevertheless, is exclusive of cyanamide production, except in a plant in Hardanger district belonging to the Odda Smelteverk A. S.

Carbide, the pioneer of electrochemical production in Norway, was started in 1899 by A. S. Hafslund, of Oslo, in its plant at Sarpsborg. Having introduced the manufacture of ferrosilicon in 1907, the plant combines carbide production with that of ferro-alloys. Its power consumption ranges from 17,000 to 25,000 horsepower. Present capacity is 45,000 metric tons of ferrosilicon annually (basis, 45 per cent silicon), and 20,000 metric tons of carbide. A. S. Hafslund owns, besides this operation, a pulp mill, A. S. Glommens Tresliberi, at Kykkelsrud.

The Odda Smelteverk A. S., at Odda, in Hardanger district, was founded in 908 and was owned formerly by Alby Carbide Factories, which were liquidated in 1921. It consumes about 35,000 horsepower against 65,000 formerly, supplied by A. S. Tyssefaldene, with a neighboring power plant. Part of its carbide production at the key plant at Odda is supplied to a neighboring plant making cyanamide.

Plants at A. S. Meraker Smelteverk, at Koppero, built in 1900, make carbide, ferrosilicon and ferrochromium, consuming now about 24,000 horsepower. This company is controlled by Dominion Metallurgical Co. (Ltd.), of Canada.

Carbide is also produced by Notodden Calcium Carbidefabrik, founded in 1899 and leased from 1905 to 1915 to the English Albion Products Co. It consumes some 4,500 horsepower. Its carbide production now averages 4,000 metric tons annually, against a capacity of 8,000 tons.

Another of five Norwegian carbide operations is Norsk Elektrokemisk A. S., in Kragero, established in 1907, with a 5,000 horsepower consumption.

Production of carbide and cyanamide and exports from 1927 to 1930 were as follows:

NORWEGIAN PRODUCTION AND EXPORTATION OF CARBIDE AND CYANAMIDE,
1927-1930

Item and year	Production	Exports	
		Quantity	Value in crowns
1927:			
Carbide.....	} 84,428	{ 20,522	6,370,500
Cyanamide.....			3,532,000
1928:			
Carbide.....	} 125,908	{ 25,271	4,501,500
Cyanamide.....			4,733,600
1929:			
Carbide.....	} 145,526	{ 31,907	5,756,400
Cyanamide.....			5,719,120
1930:			
Carbide.....	} 1 120,000	{ 23,310	(?)
Cyanamide.....			48,509

¹ Own estimate.

² Not available.

The chief customer for Norwegian carbide in 1929 was the United Kingdom, while Belgium was the first market for cyanamide, as will be seen from the following figures showing exports according to leading countries of destination in 1929.

Calcium carbide:	Metric tons	Cyanamide:	Metric tons
United Kingdom.....	17,667	Belgium.....	49,990
Chile.....	6,169	Netherlands.....	9,470
Argentina.....	1,719	Germany.....	1,781
British India.....	1,664	United Kingdom.....	1,692
Denmark.....	974	British India.....	1,044
Peru.....	789	Denmark.....	739
Netherland East Indies....	632	Portugal.....	438
Australia.....	552	Spain.....	374
Irish Free State.....	447	Other countries.....	30
Mexico.....	300		
Germany.....	194	Total.....	65,558
Portugal.....	160		
Greece.....	100		
Other countries.....	540		
Total.....	31,907		

OTHER PRODUCTS

Phosphorus.—A. S. "Jan" Kemiske Fabrik, near Fredrikstad, built in 1906, with a consumption of 1,400 horsepower, produces red and white phosphorus. This production permitted an export of 277 metric tons in 1929, valued at 462,608 crowns, against 385 metric tons valued at 691,000 crowns in 1928, and 229 metric tons valued at 590,000 crowns in 1927.

Caustic soda.—A. S. Saugsbrugsforeningen, of Halden, a pulp and paper combine, built a caustic-soda layout in 1929, operating the Krebs process, with an announced capacity of 1,600 metric tons annually. After it began production, 1930 imports were 1,400 metric tons, against 2,405 metric tons (577,200 crowns) in 1929.

Soda crystals.—A. S. Saugsbrugsforeningen also produces annually some 2,500 metric tons of soda crystals, made from imported calcined soda ash, the latter registering an import of 35,030 metric tons in 1930, against 25,262 metric tons (3,031,500 crowns) in 1929. A

number of other small enterprises are engaged in production. Norway's production of soda crystals permits a trifling export.

A. S. Vadheim Elektrokemiske Fabriker, of Bergen, makes electrolytic sodium, chiefly for special alloys.

Gases.—Several pulp plants produce their own chlorine, while the Norsk Hydro company produces its electrolytic hydrogen for the Haber-Bosch ammonia synthesis. A. S. Norsk Surstof og Vandstof-Fabrik, of Oslo, makes oxygen also. De Nordiske Fabriker (De-No-Fa), of Fredrikstad, hydrogenates its fish oils.

Carbon dioxide works include Norske Kulsyrefabriker A. S., Oslo; Oslo Kulsyrefabrik A. S., Oslo; and Norsk Kulsyreindustri, Moss.

Production of compressed gases increased from 603 metric tons in 1927 to 670 metric tons in 1928 and 742 metric tons in 1929, with a value of 998,964 crowns in the latest year.

Other production.—The sole Norwegian producer of superphosphate (and chamber sulphuric acid) is Lysaker Kemiske Fabrik, near Oslo, established in 1859.

Norsk Svovlsyrefabrik A. S., at Verpen, on the Oslo Fjord, established in 1915, produces contact sulphuric acid (by the Tentelew principle) of high concentration, for manufacture of explosives. This plant is owned by Norsk Sprengstofindustri A. S.

Before the war, certain plants produced iodine and potash salts by burning seaweed. All but two plants (works at Skaalevigen, near Bergen, built in 1898, and Lofoten Kemiske Fabrik, at Stamsund, established in 1909) were closed down during the war.

Norwegian statistics group superphosphates, other artificial fertilizers, and miscellaneous chemicals (including sulphuric acid and iodine) in one class, with a total value of 3,034,769 crowns, although quantities are separated as follows:

NORWEGIAN PRODUCTION OF MISCELLANEOUS CHEMICALS IN 1927-1929

Item	1927	1928	1929	
			Quantity	Value
Superphosphate.....	Metric tons 13, 835	Metric tons 14, 600	Metric tons 25, 100	Crowns 3, 034, 769
Other artificial fertilizers.....		654	635	
Miscellaneous chemicals, including sulphuric acid and iodine.....	11, 641	13, 571	13, 539	7, 300
Other chemicals.....				

EXPLOSIVES, AMMUNITION, AND MATCHES

In its comparative evaluation of chemical production, Norway lists its output of explosives, ammunition, and matches as second in importance—after electrochemicals. Eight plants in this field produced slightly over 8,000 metric tons in 1929 valued at 11,346,463 crowns, or 14 per cent of the total value, (81,000,000 crowns) of chemical production in that year. As in Sweden, Norwegian production of explosives is determined by the country's requirements for blasting in ore and stone recovery.

NORWEGIAN PRODUCTION AND EXPORTATION OF EXPLOSIVES,¹ AMMUNITION,
AND MATCHES, 1927-1930

Item and year	Production		Net export ¹	
	Quantity	Value	Quantity	Value
1927:	<i>Metric tons</i>	<i>Crowns</i>	<i>Metric tons</i>	<i>Crowns</i>
Explosives	6,429	10,600,000	2,396	3,042,000
Matches			1,431	1,623,000
1928:				
Explosives	7,041	11,800,000	2,018	2,515,000
Matches			1,485	1,108,000
1929:				
Explosives	8,141	11,300,000	2,119	2,078,000
Matches			1,983	1,588,000
1930:				
Matches	(²)	(²)	1,471	(²)

¹ Includes black powder, ballistite, dynamite, ammonium gelnite, and other explosives.

² Not available.

More specific subdivisions of production are not given, as manufacturers prefer not to disclose the amount of production of individual plants.

Norwegian production of explosives is largely controlled by Norsk Sprengstoffindustri A. S., founded in 1917, which has a majority interest in the dynamite plants at Engene and Haao, on the Oslo Fjord, and at Gullaug, near Drammen, as well as the Nitedals Krudtverk (powder).

The Norwegian Government owns and operates a powder and cartridge plant, Raufoss Patronfabrik, at Raufoss.

Besides these, there are Hofs Krudtverk, near Honefos, and the Grubernes Sprengstoffabrik A. S., at Ski, near Oslo.

MATCHES

Norway's match factories at Bryn, Halden, and Nitedal, all near Oslo, are now combined in one company, Bryn-Halden & Nitedals Taendstikfabrik, controlled in turn by International Match Corporation, a connection of the Swedish match trust.

A small independent factory is the Agnaes Taendstikfabrik, at Brunlanes, near Stavern.

Norway's exports of matches were around 1,400 metric tons in 1927 and 1928, respectively, and over 1,900 metric tons in 1929. This is a significant decline from exports of around 5,000 metric tons before the war.

PIGMENTS, PAINTS, AND VARNISHES

The third production group within the Norwegian chemical industry is that of paints and varnishes, output of which by 11 establishments was valued at 7,255,452 crowns in 1929, in comparison with 9,485,000 crowns in 1928 and 8,118,000 in 1927. It can be assumed that 1930 figures will be even less, because of the abandonment of manufacture of titanium white. Dry pigments (titanium and zinc white) accounted for over 26 per cent of the total value of paint production in 1929.

NORWEGIAN PRODUCTION OF PAINTS AND VARNISHES, 1927-1929

Item	1927	1928	1929	
			Quantity	Value
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Crowns</i>
Oil paints.....	1, 278	1, 572	1, 910	1, 803, 628
Enamel lacquers, etc.....	136	160	342	657, 362
Driers.....	28	36	32	30, 500
Lacquers and oils, except linseed oil.....	634	767	933	1, 264, 862
Industrial lacquers.....	104	126	138	172, 600
Water and composition colors.....	58	61	67	47, 000
Marine paints.....	692	1, 013	792	956, 382
Spirit and cellulose lacquers.....	64	68	68	166, 288
Miscellaneous dry pigments.....	4, 340	4, 963	1, 919	1, 879, 599
Miscellaneous.....	433			277, 231

The decline in manufacture of titanium white is emphasized in available trade figures, which show an export of but 277 metric tons in 1930, against 971 metric tons (value, 939,309 crowns) in 1929, 3,254 metric tons (value, 2,585,000 crowns) in 1928, and 3,293 metric tons (value, 2,660,000 crowns) in 1927. It is said that the Titan A./S., of Fredrikstad, founded in 1916, has assigned manufacture of the dry powder to German interests.

The oldest pigment manufacturer, the A. S. Den Kemiske Fabrik "Norden" of Oslo, established in 1886, makes various pigments and paints, especially a marine paint by the trade name "Norden Kobberstof." Den Norske Zinkhvidtfabrik, of Oslo, established in 1891, specializes in production of zinc white.

Among smaller companies making pigments, paints, and lacquers are Monopol Kemiske Fabrik, of Bergen, established in 1884, and Alf Bjereke, at Alnabru, a suburb of Oslo.

CHEMOTECHNICAL PRODUCTS

The Norwegian classification of "chemotechnical products," detailed below, attained a production value of 3,811,003 crowns in 1929 in 18 plants.

NORWEGIAN CHEMOTECHNICAL PRODUCTION, 1927-1929

Item	1927	1928	1929	
			Quantity	Value
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Crowns</i>
Mouth washes, tooth paste, hair tonic, etc.....	87	90	100	1, 394, 162
Cleaning and washing powders.....		738	670	410, 943
Metal polish.....	(¹)	(¹)	12	16, 336
Shoe polish.....	(¹)	(¹)	(¹)	611, 450
Glue.....	189	206	211	233, 124
Rubber solutions.....	(¹)	² 68, 936	² 91, 623	80, 702
Bone fat and bone meal.....	(¹)	284	376	123, 607
Extracts and essences.....	43	44	51	232, 318
Baking powder, pudding meal, etc.....	18	13	12	36, 019
Chemotechnical chemicals:				
Miscellaneous spices.....	(¹)	46	62	104, 312
Miscellaneous chemicals.....	(¹)	(¹)	(¹)	132, 192
Miscellaneous unspecified.....	(¹)	(¹)	(¹)	133, 384
Other.....	(¹)	(¹)	(¹)	252, 409
Total value.....				3, 811, 003

¹ Indicated by value only.² Liters.

PHARMACEUTICALS

A production of pharmaceuticals and cosmetics (exclusive of soap) in 1929 valued at 1,725,000 crowns gives these a minor position in Norway's chemical industry. Production of pharmaceuticals amounts to a value of 1,589,462 crowns and of other cosmetics to 134,765 crowns. Norwegian pharmaceutical plants include Apothekernes Laboratorium A. S., Skoyen, Oslo, and A. S. Nyegaard & Co., Oslo.

The chemical classifications in this country's production figures exclude soaps (grouped with oils and fats) and coal tar (gas plant).

SOAPS AND TOILET PREPARATIONS

In addition to the 10 producers named below, most wholesalers and a large number of barber shops make shampoos and lotions for their own use. Norwegian manufacture of perfumery is rated at 1.7 metric tons, valued at 24,000 crowns.

Soaps, cosmetics, and perfumes are produced chiefly by the following:

- Lilleborg Fabriker A. S., Oslo (toilet and shaving soaps).
- Barnengens Tekniske Fabrik, Norsk A. S., Oslo (lotions, creams, shaving soaps).
- Nordstrøm & Due, Oslo (creams and toilet soaps).
- A. S. Si-Ko, Oslo (eau-de-cologne, toiletries).
- A. S. Biochemisk, Oslo (lotions).
- I. Graarud, Bergen (toilet soaps and creams).
- Wdm. Schioldborg, Oslo (toilet and shaving soaps).
- M. Zadig A. S., Oslo (toilet soaps).
- H. Chr. Gregersen A. S., Oslo.
- Carl A. Hoyer, Oslo (tooth paste).

NORWEGIAN PRODUCTION OF SOAP, 1927-1929

Soap	1927	1928	1929	
			Quantity	Value
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Crowns</i>
Toilet.....	1,270	1,378	1,534	3,100,000
Other.....	13,073	13,675	14,191	8,300,000

TAR

Production data on tar refer to wood-treating plants using tar and exclude coal-tar production of the gas works. Eight establishments are listed as operating, with a value of product of 3,600,000 crowns in 1929, of which 2,400,000 crowns was the value of the wood treated and 1,200,000 represented the value of more than 5,000 metric tons of diverse tars.

Production of the gas plants, which are not included in Norwegian chemical statistics, was 36,000,000 cubic meters of gas in 1927, with by-products of 75,000 metric tons of coke, 5,000 metric tons of coal tar, and 210 metric tons of ammonium sulphate.

NORWEGIAN CHEMICAL MARKETS

PLACE OF AMERICAN PRODUCTS

Norway imports approximately \$10,000,000 worth of chemicals and allied products. The total amount from the United States is not available. Part of the Norwegian-American trade is cleared through

North Sea free ports and so recorded, so that an amount of imports from the United States is not apparent. This is especially true of sulphur, since the United States shows no direct exports of this commodity, although an appreciable amount of American sulphur is sold in Norway. According to United States statistics, direct exports of chemicals and allied products to Norway have averaged around \$700,000 the past few years, a figure somewhat below imports exceeding \$1,000,000.

Rosin occupies an important place in direct sales to Norway by the United States. The United States sold direct to this market 2,413 tons (value, 814,700 crowns) out of Norway's total receipts of 3,308 tons (value, 1,157,700 crowns).

Sulphur also occupies an outstanding position in American chemical sales to Norway, but the true figure of tonnage and value is concealed in transshipments, via Germany and the Netherlands, and thus recorded as originating in the latter countries. The Norwegian market, with its highly developed chemical-pulp industry, took 17,833 metric tons of sulphur in 1929 (value, 1,961,000 crowns), of which but 2,545 metric tons (value, 280,000 crowns) are recorded as direct purchases from the United States, while Germany, which does not produce sulphur except in waste coal gas recoveries, is credited with an export to Norway of 9,797 metric tons (most of which is unquestionably of American origin) and the Netherlands with 4,514 metric tons.

The American celluloid and film industry also enjoys a sizable market in Norway for celluloid and film—17.7 metric tons, valued at 353,300 crowns, out of a total import in 1929 of 33 metric tons, valued at 649,000 crowns.

Another important figure is an import from the United States of 27 tons of spirit varnishes valued at 115,700 crowns, out of total imports of 68 metric tons, valued at 291,600 crowns.

Out of a total import of 68 metric tons of pomades and cosmetics valued at 679,300 crowns, the United States supplied 15.7 tons valued at 156,700 crowns.

The French supplied most of the phosphate rock which entered into Norway's 1929 production of 25,000 metric tons of superphosphate; the United States supplied 2,216 tons (value, 88,600 crowns) out of total imports of 15,825 metric tons valued at 633,000 crowns.

CHEMICAL SPECIALTIES

Local representation is widening the Norwegian market for chemical specialties (toilet preparations, polishes, and pharmaceuticals) of American origin. A half dozen Oslo and other dealers have agencies for American lines.

It must be borne in mind that Norway, with its population of less than 3,000,000, is the most thinly settled country of Europe, and that markets in the chief communities are gaged by their populations. The chief cities are Oslo, the capital, 250,000; Bergen, 98,000; Trondhjem, 56,000; Stavanger, 47,000; Drammen, 25,000; Kristiansand, 19,000.

The extent of Norwegian manufacture of toilet preparations has already been referred to. Imports in 1928 and 1929 are shown below.

NORWEGIAN IMPORTS OF TOILET PREPARATIONS, 1928 AND 1929

Item	1928		1929	
	Kilos	Value in crowns	Kilos	Value in crowns
Alcoholic toilet waters.....	29,757	267,500	29,887	239,100
Other toilet waters.....	5,760	20,100	5,664	19,800
Toilet soaps.....	69,757	261,600	80,254	288,900
Hair oils.....	2,034	8,100	1,241	4,300
Pomades and cosmetics.....	63,485	634,485	67,926	679,300
Deodorants, perfumes, and paper.....	343	2,700	361	2,200

The United States shares the market for three of the foregoing classifications—miscellaneous toilet waters, toilet soaps, and pomades and cosmetics.

Higher duties on lotions have lessened the foreign sales of these products in recent years. This resulted in the effort to ship such preparations in light metal containers for packing in glass bottles by the importer. Imports of eau de cologne meet increasing competition from domestic producers, notably from the "Si-Ko" brand.

American, German, and French face powders are sold, particularly in compacts. Darker shades are preferred. Norwegian women affect sun tan in this country, which is sparing of warm sunshine, even if it is more intense than elsewhere during the comparatively brief summer period.

Sales of American toilet creams, especially those packed in tubes, are increasing. Talcum powder in metal boxes or glass bottles is sold, chiefly by France, although one American brand is on the market. The darker shades of lip rouge have gained popularity in the last two years. Two American beauty specialists have representatives operating through Oslo's leading department store.

Domestic production of toilet soaps has increased because of the activity of the following firms: (1) Lilleborg, (2) Nordström & Due, and (3) I. Graarud. One American soap company which has won over the Swedish market has also gained considerably in Norway.

Despite strong domestic competition, an American shaving cream has made great progress in the Norwegian market.

FERTILIZERS AND INDUSTRIAL CHEMICALS

Lacking sufficient domestic supplies of phosphate and potash fertilizer, Norway pays over 5,000,000 crowns annually for its imports of artificial fertilizer. Imports of potash, chiefly from Germany, were 25,065 metric tons in 1930, against 22,686 (value, 2,450,100 crowns) in 1929. Imports of superphosphate, chiefly from the Netherlands, were 30,476 metric tons in 1930, against 33,620 (value, 1,681,000 crowns) in 1929; 15,223 metric tons of basic slag were imported in 1930, chiefly from Belgium, against 10,251 (value, 543,300 crowns) in 1929. Imports of Chile saltpeter are negligible in view of domestic production of the synthetic salt, having been but 7 metric tons in 1930, against 84 tons in 1929 (value, 13,600 crowns). An import, in 1929, of 1,293 metric tons (value, 339,500 crowns) of the German dye trust's "Nitrophoska," is noteworthy. There was also an importation of 207 metric tons of ammonium sulphate.

In 1929 there were imports of 2,874 metric tons of sulphuric acid, valued at 316,100 crowns. There is a heavy demand for sulphuric acid for use in the manufacture of explosives.

INDUSTRIAL CHEMICALS

Norwegian imports of industrial chemicals in 1929 include soda ash (25,262 metric tons, valued at 3,031,500 crowns), potash liquor (3,079 metric tons, valued at 831,400 crowns), glycerine (812 metric tons, valued at 689,800 crowns), sodium sulphate (11,154 metric tons, valued at 669,200 crowns), caustic soda (2,405 metric tons, valued at 577,200 crowns), caustic potash (883 metric tons, valued at 485,400 crowns), alum (4,643 metric tons, valued at 417,800 crowns), and liquid chlorine (1,689 metric tons, valued at 371,300 crowns).

Norwegian importers generally receive a 30-day credit; payment is by sight draft. Discounts are granted to wholesaler and to retailer. Large customers get an extra bonus, generally at the end of the year.

The most effective sales promotion is considered to be the appointment of a general agent for Norway, with headquarters at Oslo. Representation for all the Scandinavian countries by an agent in one country is not recommended, as Norwegians prefer to deal with a fellow-countryman. As Norwegian dealers do not generally maintain large stocks, but sell according to immediate demand, it is advisable to maintain consignment stocks. Because of the comparatively high cost of traveling over the great distances between important centers, a 10 per cent commission is generally paid. Stocks from which agents draw their goods are usually paid for after sales are made.

NORSK HYDRO-ELEKTRISK KVAELSTOFAKTIESELSKAB

Norsk Hydro-Elektrisk Kvaelstof A. S. (Norwegian Hydro-Electric Nitrogen Co.), with headquarters at Oslo and with three nitrate plants (at Rjukan, Notodden, and Eidanger) and auxiliary power stations, raised its capital by authority of general meeting of November 28, 1929, from 76,852,800 to 104,300,100 crowns. It now has the largest announced capital of all Norwegian enterprises.

Norsk Hydro, as it is often called, was established on December 2, 1905, with a 7,000,000-crown capital, which has been raised successively since. Its distinction is that of having first undertaken on an industrial scale the production of nitrates from atmospheric fixation by using an electric arc to effect the direct combination of nitrogen and oxygen to form nitric oxide, which was first absorbed in water to dilute nitric acid (30 per cent) and then passed over limestone to form calcium nitrate. This process was operated exclusively until 1928, when most of the plant was adjusted to the Haber-Bosch process of direct ammonia synthesis, effecting thereby a cheaper fixation.

It is understood that this transaction, which involved license of the German I. G.'s Haber-Bosch ammonia synthesis to Norsk Hydro on a 25-year operating contract, was accompanied by a share exchange with the German I. G., which thus acquired about one-fourth interest in the Norsk Hydro operations. The I. G. also disposes of the nitrogen produced in Norway for export, as has been observed, pooling it with German I. G. production, while Norsk Hydro disposes of the comparatively small quantity taken by the Norwegian market.

ANNUAL PRODUCTION

The production increase effected by Norsk Hydro in its plant extensions from 1928 to 1930 was from 30,000 metric tons of fixed nitrogen to 90,000 metric tons. The local administration of this company is authority for the statement, however, that the announced 90,000 tons capacity is minimum, and that 100,000 tons of nitrogen can be produced annually in existing plant equipment. This production is divided as follows:

	Metric tons of fixed nitrogen
Calcium nitrate, 15.5 per cent nitrogen	70, 000-80, 000
Sodium nitrate, 16 per cent	5, 000
Ammonium nitrate	3, 000
Concentrated nitric acid	2, 000

Norsk Hydro also makes Ammonium nitrate chalk, with 20.5 per cent nitrogen, sometimes known as nitamon-chalk, a mixture of ammonium nitrate with limestone, or calcium carbonate. This is the same grade made by the German dye trust, and known as Leuna-salpeter.

The center of Norsk Hydro production is at the key plant at Rjukan, with a capacity of 80,000 metric tons of nitrogen in synthetic ammonia. This is now the master Haber-Bosch plant. The Rjukan plant makes ammonia calcium nitrate and concentrated nitric acid. Half of its ammonia production, however, is shipped to neighboring Eidanger, where the main production is calcium nitrate and ammonium nitrate chalk (ammonium nitrate and lime).

The remaining 10,000 metric tons of nitrogen are produced at the Notodden plant, where ammonium nitrate is a specialty. The necessary hydrogen for the synthesis of ammonia is produced by electrolysis. At the power stations at Rjukan 180,000 horsepower have been adjusted to direct current for this production.

POWER SUPPLY

Six stations supply electrical power to the Norsk Hydro nitrate plants. Combined, the power stations are harnessed to a development of around 480,000 horsepower. Another power station, the Tyin plant, at Sogne, with a development of about 85,000 kilowatts, is in course of building and will add its service to that already available.

POWER STATIONS SUPPLYING NORSK HYDRO

Station	Year established	Average development	Installed horsepower
Froistul	1926	<i>Kilowatts</i> 19, 000	34, 200
Vemork (Rjukan I)	1911	108, 000	194, 500
Saasheim (Rjukan II)	1916	98, 000	161, 000
Svaelgtos I	1907	} 33, 000	60, 000
Svaelgtos II	1913		
Lienfos	1911		
Total		272, 000	470, 100

OPERATION AND HOLDINGS

The report on Norsk Hydro operation for the year ended June 30, 1930, states that extensions (transformation to direct ammonia synthesis) had been completed and that production results had even

surpassed expectations. As a matter of fact production by Norsk Hydro in 1929-30 amounted to 83,000 metric tons of fixed nitrogen. The general lockout which was in effect at Norsk Hydro works after April 15, 1931, probably reduced the output of nitrogen in 1930-31 to around 75,000 metric tons.

Unlike the situation in other countries producing nitrogen for export, no visible limitation has been put on production in Norway. This is due to the cheap production costs obtaining in Norway. The report also refers to normal reconstruction following damage done at a slide at the Tyin power plant.

Norsk Hydro paid 8 per cent dividend on available net profits of 7,450,922 crowns for its year ended June 30, 1930.

NORSK HYDRO HOLDINGS

Name of holding ¹	Nominal capital, in crowns	Owned by Norsk Hydro		Purpose
		Crowns	Per cent of total	
A. S. Industriforsikring.....	2,000,000	1,999,200	10.0	Insurance.
A. S. Labrador.....	2,000,000	² 700,000	(²)	Do.
A. S. Lillo Verk.....	210,000	210,000	5.0	Do.
A. S. Norsk Hydros Handelsselskap.....	100,000	100,000	10.0	Trading.
Norsk Hydros Salgskontor for Danmark A. S.....	200,000	197,000	10.0	Sales to Denmark.
Norsk Transport A. S.....	4,000,000	3,999,800	7.0	Transportation.
A. S. Norsk Tjereprodukter.....	1,050,000	1,048,250	7.0	Tar products.
A. S. Nybu.....	20,000	19,900	7.0	Do.
A. S. Rjukanfos.....	60,000,000	59,998,000	14.5	Power plants.
A. S. Skiensjordens Kalkbrud.....	30,000	30,000	10.0	Quarries.
A. S. Svaelgfos.....	300,000	798,000	6.5	Power plants.
A. S. Tyinfalløene.....	12,000,000	11,998,000	-----	Do.
A. S. Tyin Byggeselskab.....	60,000	58,000	2.5	Building.
Total.....	82,470,000	81,156,150	11.34	

¹ The home offices of all the above are in Oslo, except Norsk Hydros Salgskontor for Danmark A. S., which has its headquarters in Copenhagen.

² The shares are written down to 700,000 crowns (35 per cent of 2,000,000), so that Norsk Hydro owns all.

The following paragraphs are quoted from an illustrated jubilee brochure, issued by Norsk Hydro before the plant extensions and construction of 1928 to 1930.

The Norsk Hydro-Elektrisk Kvaestofaktieselskab of Christiania, Norway, has the honor of being the first to have undertaken, on an industrial scale, the production of nitrates from atmospheric nitrogen. Long recognized as scientifically possible, the problem was solved in a commercial way by Birkeland and Eyde in 1903. By means of 14,500-horsepower water-driven turbines, coupled direct to electrogenerators, an electric disk flame of 7 feet diameter is produced in fireproof brick furnaces. Air is blown through these furnaces, the heat of which, exceeding 3,000° C., brings about combustion of the nitrogen of the air, resulting in the formation of nitric oxide. These gases are passed through granite water-absorption towers, where nitric oxide is absorbed and a dilute nitric acid (30 per cent) is produced. The acid is passed over limestone, and a solution of nitrate of lime is formed, which is concentrated in evaporators, solidified by cooling, and reduced by means of granulators to commercial nitrate of lime.

It is obvious that an abundant and cheap source of power is essential for such a process. This was obtained by harnessing the gigantic Norwegian waterfalls, few of which had up to that time been utilized.

In 1905 the first furnaces were started at Notodden, in the Province of Telemark. In 1908 the Svaelgfos (or Svaelg waterfall), which is near Notodden, was harnessed, and energy totaling 40,000 horsepower was obtained and utilized in the production of nitrate of lime. Since then both Lienfos and Svaelgfos II have been harnessed, and the total quantity of power now in use at the factories at Notodden is 68,000 horsepower.

In 1909 the harnessing of the largest waterfall in Norway, the Rjukanfos, which lies higher up in the mountains of Telemark, was commenced. In 1912 the first power station, Rjukan I, with its appurtenant factories, was finished and had started running, and in 1916 the second power station, Rjukan II, was completed. Together these power stations now supply about 295,000 horsepower. A total of about 360,000 horsepower is being utilized in the manufacture of nitrate of lime.

In order to transport the product to the port of Menstad, near Skien, it was necessary to build a railway 87 miles in length, including the 19-mile ferry across the Tinn Lake. The towns of Notodden (population 8,000) and Rjukan (population 10,000) were also built, most of the latter being built at the company's expense.

Nitrate of lime, of which up to 200,000 metric tons can be produced annually, is the chief product, but several nitrogen compounds which are in great demand are made, according to needs. These include sodium nitrite, which is used in the dye industry, and pure sodium nitrate. These two products are obtained from the nitric oxide which has escaped absorption in the water towers, by passing it into towers filled with a solution of soda, whereby the acid is combined with soda instead of lime.

The 30 per cent nitric acid produced in the water towers is also sold as such, or is concentrated to various required degrees of strength. By the combination of ammonia (which is obtained either from gas liquor ammonia works, or produced from calcium cyanamide at the company's own ammonia works at Notodden) with nitric acid, ammonium nitrate is produced. This compound is used extensively in the manufacture of safety explosives.

DENMARK

Denmark, unlike Norway and Sweden, is relatively unimportant as a chemical-producing country, but, considering its area of 16,574 square miles and population of 3,500,000, it is somewhat important as a consumer of chemicals and allied products. Imports approximated \$27,900,000 in 1929 and exports \$3,000,000. No values are available for 1930.

The country being preeminently agricultural (that is, 95 per cent cultivated—including forests, covering 10 per cent of the area), without valuable domestic mineral resources and without convertible mechanical energy, its chemical industry is limited in scope. It produces soap, superphosphate, paints, matches, explosives, pharmaceuticals, and industrial gases, with related products of tar board, asphalt emulsion, and cryolite. Annual production is valued at the following amounts: Soaps, 20,000,000 crowns,¹ superphosphate, 13,500,000 crowns; paints, 10,000,000 crowns; matches and explosives, 8,000,000 crowns; pharmaceuticals, 2,500,000 crowns; oxygen and hydrogen, 600,000 crowns; and cryolite, 5,000,000 crowns.

The country's wealth of domestic animals furnishes by-products which are utilized as the basis of certain chemicals. Since 1916, for example, the "Rosco" company, formerly Knapfabriken Haime, of Roskilde, has made buttons from the dried blood of cattle. Another sizable industry produces rennet, a ferment from the dried stomach of cattle and sheep, used as an aid in curdling milk for cheese production. The glands of domestic animals also furnish the raw material for certain pharmaceuticals. Production of insulin is of some importance.

A Danish chemical enterprise, Øresunds Chemiske Fabriker, of Copenhagen, deals annually in over 20,000 metric tons of cryolite (a form of calcium fluoride), solvent for aluminum oxide. The dis-

¹ Par value of Danish crown (krone), \$0.26798.

covery of this property made possible commercial production of cheap aluminum. The cryolite originates in deposits in Greenland, owned by Denmark. Local operators refine it in Denmark, primarily for reexport to the aluminum-producing countries.

IMPORTS OF CHEMICALS

Danish dependence on imports of primary and manufactured chemicals and chemical materials is evident when it is considered that this country imported, according to its own statistics, chemicals valued at 27,239,000 crowns in 1930, and exported chemicals totaling in value 8,339,000 crowns, resulting in a net import valued at 18,900,000 crowns. Furthermore, Denmark imported fertilizers valued at 61,737,000 crowns in 1930 and exported a value of but 916,000 crowns, leaving a net import of 60,821,000 crowns. The excess chemical import in 1929 was valued at 17,564,000 crowns, and net artificial fertilizer import, at 65,109,000 crowns.

Imports of chemicals by Denmark in 1930 were chiefly from Germany, which furnished a value of 17,614,000 crowns, or 65 per cent of total chemical imports: Great Britain, 2,661,000 crowns, or 10 per cent; the Netherlands, 1,562,000 crowns, or 6 per cent; Switzerland, 1,164,000 crowns, or 4 per cent; and the United States and Sweden, each 855,000 crowns, or 3 per cent.

Imports of chemical fertilizer in 1930 were chiefly from Germany (nitrates, potash, and superphosphate), which supplied a value of 24,351,000 crowns, or 40 per cent; Norway (nitrates) 16,166,000 crowns, or 26 per cent; France (superphosphate) 5,439,000 crowns, or 9 per cent; Netherlands, (superphosphate) 3,335,000 crowns, or 5 per cent; Belgium (basic slag and superphosphate) 1,380,000 crowns, or 2 per cent; and the United States 953,000 crowns, or 1.5 per cent.

The chief Danish imports of chemicals are fertilizers, the total value of which in 1929 was about 66,000,000 crowns, consisting chiefly of calcium nitrate, 23,000,000 crowns; superphosphate, 10,000,000 crowns; potash, 9,000,000 crowns; ammonium sulphate and sodium nitrate, 8,000,000 crowns each; phosphate rock, 5,000,000 crowns; and Nitrophoska, 1,400,000 crowns. Imports of basic slag from Belgium and the Netherlands were valued at 413,000 crowns.

Other chemical imports of lesser values were dyestuffs, about 2,500,000 crowns; caustic potash, 1,919,000 crowns; soda ash, 1,837,000 crowns; pharmaceuticals, 1,829,000 crowns; and zinc white, 1,411,000 crowns.

The value of imports of nitric acid in 1929 was 285,000 crowns; of hydrochloric acid, 152,000 crowns; and of sulphuric acid, only 78,000 crowns.

FERTILIZERS

SUPERPHOSPHATE

Denmark now produces around 265,000 metric tons of superphosphate annually, but has excess imports of 160,000 metric tons additional to meet the local demand. This constitutes a consumption of around 425,000 metric tons annually, or about 75,000 tons P_2O_5 (18 per cent).

Production figures were not published prior to 1929, when production of superphosphate and ammonium sulphate² was given at 267,875 metric tons, valued at 13,400,000 crowns.

The sole Danish producer of superphosphate is A. S. Dansk Svovlsyre og Superphosphatfabrik, capitalized at 15,000,000 crowns,³ with plants at Aalborg, Fredericia, Norre-Sundby, and Kalundborg. At the latter location a plant with a capacity of 100,000 tons annually has been completed recently at a cost of 6,000,000 to 7,000,000 crowns, to supersede former uneconomical production of this company's plant in Kastrup, which was closed down in 1927. New operation of the Kalundborg plant will tend to diminish the country's imports of superphosphate, which formerly originated in the Netherlands, Germany, Sweden, Belgium, and France. Of total imports of 187,950 tons in 1929, valued at 10,103,000 crowns, the Netherlands furnished 78,523 tons (4,110,000 crowns); Germany, 52,325 tons (2,937,000 crowns); Sweden, 22,082 tons (1,258,000 crowns).

DANISH IMPORTS OF SUPERPHOSPHATES, 1913 AND 1927-1930

Year	Imports	Exports	Net imports
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>
1913.....	110,155	683	109,472
1927.....	105,882	23,264	72,618
1928.....	126,434	27,129	99,305
1929.....	187,956	3,907	184,043
1930.....	176,222	16,825	159,397

PHOSPHATE ROCK

The United States supplies direct about 20 per cent of the Danish imports of phosphate rock, of which total imports were 190,536 metric tons in 1930, against 159,089 metric tons in 1929, valued at 4,966,000 crowns. The only other considerable source of supply at present is Morocco, which in 1929 supplied 117,719 tons, valued at 3,764,000 crowns.

DANISH IMPORTS OF PHOSPHATE ROCK, 1913 AND 1927-1930

Year	Total	From United States	From Morocco
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>
1913.....	55,876	24,067	31,809
1927.....	151,576	39,987	111,589
1928.....	130,820	25,775	105,045
1929.....	159,089	29,334	117,719
1930.....	190,536	(¹)	(¹)

¹ Morocco, Algeria, and Tunis.

² Not available.

BASIC SLAG

Consumption of phosphate fertilizer is supplemented slightly by that of basic slag, of which Denmark imported 11,835 tons in 1930, against 8,987 tons in 1929, valued at 413,000 crowns. These

³ Ammonia (NH₃) production of Danish gas plants was 1,023 tons in 1929; this computes to about 4,000 tons of ammonium sulphate.

⁴ Increased from 10,000,000 crowns in 1929 to finance building of the new Kalundborg plant.

imports originate in the steel mills of Belgium, the Netherlands, and Germany.

Denmark also imported 7,292 tons of the fertilizer mixture, Nitrophoska, in 1930, against 5,507 tons in 1929, valued at 1,396,000 crowns. Different grades of Nitrophoska analyze from 13 to 30 per cent phosphoric acid.

NITRATES

Practically devoid of a domestic nitrate industry (except for a production of 1,000 tons of gas-plant ammonia annually), Denmark imported in 1930 a total of 217,795 metric tons of calcium nitrate, ammonium sulphate, Chile saltpeter, and cyanamide, against a total of 241,105 tons of these products in 1929.

Of a 1929 import of 147,000 tons of calcium nitrate, valued at 23,149,000 crowns, 70 per cent originated in Norway, from production of the Norsk Hydro Elektrisk Kvaelstof A. S., while the other 30 per cent was supplied by the German dye trust.

Germany supplied in 1929 the entire Danish import of 48,598 metric tons of ammonium sulphate, valued at 8,259,000 crowns.

Chile supplied direct and via Hamburg in 1929 about 90 per cent of Denmark's import of 45,133 tons of sodium nitrate, valued at 7,937,000 crowns, but Norway claimed practically all the rest of the market, with its synthetic salt from Norsk Hydro production.

Norway supplied 75 per cent of Denmark's comparatively small market (860 tons, valued at 140,000 crowns) for cyanamide in 1929.

DANISH IMPORTS OF NITRATES, 1913 AND 1927-1930

Year	Calcium nitrate	Ammonium sulphate	Sodium nitrate	Calcium cyanamide	Total
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>
1913.....	1 5, 066	524	35, 049	(¹)	40, 639
1927.....	91, 179	50, 077	15, 237	767	157, 260
1928.....	105, 975	44, 011	33, 363	650	183, 999
1929.....	146, 514	48, 598	45, 133	860	241, 105
1930.....	131, 772	37, 900	46, 691	1, 432	217, 795

¹ Air-fixed nitrogen.

POTASH

Denmark imported 79,383 metric tons of potash in 1930, of which over 95 per cent was 40 per cent K₂O concentration, against 78,620 tons in 1929. Of these quantities, averaging around 30,000 tons K₂O, Germany supplied about 54 per cent and France 42 per cent. A small lot in 1929 was reshipped from Sweden. The value of potash imported in 1929 was 8,924,000 crowns.

SUMMARY OF FERTILIZERS

Denmark imports annually superphosphate to a value of about 10,000,000 crowns; phosphate rock, 5,000,000 crowns; Nitrophoska and basic slag, 2,000,000 crowns. Its production of superphosphate and ammonium sulphate was valued at 13,400,000 crowns in 1929. Imports of nitrates are close to 40,000,000 crowns in value, while the purchases of potash involve another 9,000,000 crowns. The total supply then amounts to imports valued around 66,000,000 crowns, or \$18,000,000, and domestic superphosphate production valued at 13,400,000 crowns, or \$3,600,000.

Denmark's mean annual consumption of the fertilizers appears to amount to around 35,000 tons of primary nitrogen, 75,000 tons P_2O_5 , and 30,000 tons K_2O —a very rough ratio of 1:2:1.

Importation of artificial fertilizers is carried on partly through private concerns and partly through a cooperative. The largest private importer is the Danske Godningskompani, Copenhagen, while the cooperative is Dansk Andels Godningsforretning, Copenhagen, with almost 1,500 distributors throughout the country. The members of this cooperative number around 75,000 and control about 1,000,000 hectares of cultivated land; this organization controls about 40 per cent of Denmark's fertilizer trade.

PIGMENTS, PAINTS, AND VARNISHES

Denmark produced about 8,000 metric tons of paints and paint products in 1929 in its 18 plants. Domestic production is of cheaper grades while imports are of quality products. The effort is apparent, however, to improve quantity and quality production from imported raw materials, as the country lacks all prime materials of the paint industry except chalk.

DANISH PRODUCTION OF PAINTS AND VARNISHES, 1928 AND 1929

Item	1928		1929	
	Metric tons	Crowns	Metric tons	Crowns
Pigments.....	200	200,000	273	196,000
Paste paints (oil).....	1,731	1,190,000	2,061	1,410,000
Tube colors.....	11	67,000	14	82,000
Enamels.....	600	1,030,000	686	1,190,000
Ship paints.....	784	808,000	919	1,088,000
Varnish and lacquers.....	2,945	3,418,000	3,177	3,745,000
Driers.....	246	263,000	243	264,000
Putty.....	332	89,000	372	108,000
Other.....		353,000		239,000
Total.....	6,849	7,416,000	7,745	8,320,000

DANISH PAINT PRODUCERS

The following are the leading producers of paint in Denmark:

- P. Christiansens Eftf., Copenhagen.
- Danske Farve og Lakfabrikker, Copenhagen.
- Dansk Lakfernisfabrik, Copenhagen.
- Drubin (Ltd.), Copenhagen.
- De forenede Malermestres Farvemolle (Ltd.), Copenhagen.
- I. C. Hempels Skibsfarve, Copenhagen.
- F. J. Nielsen & Bronnum, Copenhagen.
- Johs Nordsigs Fabriker, Copenhagen.
- Sadolin & Holmblad (Ltd.), Copenhagen.
- A. Stelling, Copenhagen.

A. S. Villiam Jorgensens Farvehandel was established in 1929, with a capital of 40,000 crowns, to produce oil paints.

A. S. Sadolin & Holmblad has completed considerable extensions of its production apparatus for nitrocellulose lacquers and enamel colors.

S. Dyrup & Co. A. S., specialists in lacquers, has also modernized its plants in connection with Denmark's effort to further increase domestic production of finished products.

IMPORT TRADE IN PAINTS

The main item of this group of imports is varnishes and lacquers, of which Denmark imported 929 metric tons in 1930, against 835 metric tons in 1929 valued at 1,511,000 crowns, of which Germany supplied 397 tons (610,000 crowns); Great Britain, 164 tons (301,000 crowns); Netherlands, 163 tons (346,000 crowns); and the United States, 90 tons (206,000 crowns). Denmark exported 122 metric tons (250,000 crowns) of these lacquers in 1929, chiefly to Finland and Italy.

The next considerable import is zinc white, of which 2,130 metric tons were imported in 1930, in comparison with 2,447 metric tons valued at 1,411,000 crowns in 1929, chiefly from Germany, 1,404 tons (819,000 crowns); Netherlands, 463 tons (274,000 crowns); and the United States, 198 tons (105,000 crowns).

The United States also shares the market in mixed paints, of which Danish imports were 289 metric tons (value, 923,000 crowns) in 1929, and of which Great Britain supplied 133 tons (386,000 crowns); Germany, 67 tons (316,000 crowns); and the United States, 43 tons (89,000 crowns). Denmark exported almost as much (287 metric tons), but the value of but 280,000 crowns was less than one-third the value of imports, as Denmark does not produce paints equal in quality to those imported.

Denmark's exports of marine paints are somewhat greater than imports. Practically none of these are bought from the United States. In 1929 imports were 107 metric tons valued at 104,000 crowns, while exports were 126 metric tons valued at 163,000 crowns.

The 1,186 metric tons of lithopone imported in 1930, in comparison with 1,153 (value, 456,000 crowns) in 1929, was supplied by Germany, Netherlands, and Belgium.

Imports of 584 metric tons of red lead in 1930, against 564 metric tons in 1929 (value, 319,000 crowns), originated chiefly in Great Britain and Germany.

Denmark's imports of mineral earth pigments amount to around 2,000 metric tons annually (value, 592,000 crowns in 1929), and Germany is the chief supplier.

The United States furnishes direct over one-half Denmark's market for carbon black, of which the paint industry consumed 125 metric tons in 1929. Imports, however, were 212 metric tons (value, 272,000 crowns), of which the United States supplied 117 tons (136,000 crowns), exclusive of its share in transshipments from Germany, which is given as the country of origin of 68 tons valued at 125,000 crowns.

The United States sold to Denmark in 1929 the comparatively small item of 12 tons of putty (valued at 13,000 crowns, out of total imports of 328 tons valued at 90,000 crowns).

The Danish vegetable-oil industry produced 2,151 metric tons of linseed oil (1,443,000 crowns) in 1929, against its record postwar production of 4,242 metric tons (2,642,000 crowns) in 1928. An additional 1,000 metric tons (698,000 crowns) of linseed oil were imported in 1929, chiefly from the Netherlands, for consumption by other industries, chiefly that of soap making.

The United States shares in the Danish market for common rosin. Total imports of rosin were 2,884 metric tons in 1930, against 2,807 metric tons (value, 974,000 crowns) in 1929, of which the United

States sold 499 tons (163,000 crowns) direct, and, it may be assumed, most of the 1,371 tons (472,000 crowns) which entered via German freeports. France sold 883 tons, or 31 per cent of the importation, in 1929.

RENNET

Production of rennet, a ferment from the dried stomach of cattle and sheep and an accelerator in the production of cheese, is a unique branch of enterprise in this highly agricultural country. While production figures are not given, the importance of this product is apparent in Denmark's export trade.

DANISH EXPORTS OF RENNET, 1913 AND 1927-1929

Year	Kilos	Crowns
1913.....	828, 100	994, 000
1927.....	608, 850	2, 169, 000
1928.....	615, 800	2, 164, 000
1929.....	635, 900	2, 101, 000

The leading producers of rennet in Denmark are the following:

Blauenfeldt & Tvede (Danish Butter Color Co.), Copenhagen.
 Kaseinfabriken Danmark, Copenhagen.
 Richard Ellersen (Ltd.), Copenhagen.
 "Flora Danica," Teknisk-kemisk Laboratorium, Odense.
 L. C. Glad & Co., Copenhagen.
 Chr. Hansens Laboratorium (Ltd.), Copenhagen.
 N. Kjaergaard Jensens Rennet Factories, Copenhagen.
 Reymann & Lovengreen, Copenhagen.
 G. C. Starups Kemiske Fabrik, Copenhagen.
 Alfred Jorgensen, Laboratory for the Physiology and Technology of Fermentation, Copenhagen.

MATCHES

Two interlocking Copenhagen enterprises associated with the Swedish match trust produce around 1,700 metric tons of matches annually. Production in 1929 was valued at 2,298,000 crowns.

Producing insufficient for its domestic requirements, Denmark had an excess import of 436 metric tons of matches in 1930, against 261 metric tons (value, 120,000 crowns), in 1929, supplied chiefly by Russia, Sweden, and Finland. In the Danish match trade in 1929 transshipment goods accounted for 61 tons.

DANISH MATCH SUPPLY, 1913 AND 1927-1930

Year	Production	Net import	Supply available
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>
1913.....	1, 850	1 109	1, 721
1927.....	1, 736	603	2, 339
1928.....	1, 914	499	2, 413
1929.....	1, 674	261	1, 935
1930.....		436

¹ Net export.

The local producers are Gosch & Co., Copenhagen, established 1898, capital 2,000,000 crowns; and Hellerup & Glødefri Taendstikfabrik, Copenhagen, founded 1901, capital 600,000 crowns.

Only safety matches are sold in Denmark; sales of other kinds are prohibited.

Imports of matches are assessed a customs duty of 25 ore (100 ore equal 1 crown) per kilo.

EXPLOSIVES

Two Danish enterprises, Haerens Krudtvaerk, Frederiksvaerk, and K. W. Nielsen, Copenhagen, are identified with production of explosives, which amounted to a value of 6,514,000 crowns in 1929. Raw materials for their manufacture were largely imported and included 1,337 metric tons (285,000 crowns) of nitric acid, 725 metric tons (78,000 crowns) of sulphuric acid, and 90 metric tons (206,000 crowns), of nitroglycerin and dynamite. Exports of finished products are negligible.

TAR AND ASPHALT EMULSION

Danish production of structural and road-building materials, particularly road-building tar and asphalt emulsion, shows an increase. In 1929 the United States furnished direct 6,210 metric tons of petroleum-asphalt, valued at 809,000 crowns, out of total Danish imports of 25,785 tons, valued at 2,833,000 crowns.

While producing 23,000 tons of coal tar in its gas plants in 1929, Denmark had excess imports of about 5,000 metric tons, valued at 375,000 crowns, supplied largely by Germany and Great Britain. Consumption of tar in 1929 is given at 25,755 metric tons, which accounts for all but something over 2,000 tons. The Danish gas plants produced 201,497,700 cubic meters of gas, 255,645 metric tons of coke, and 1,023 metric tons of ammonia; the total value of these products was 43,506,000 crowns.

PHARMACEUTICALS

Conspicuous in its wealth of domestic animals, Denmark features in its pharmaceutical development the production of glandular preparations. This is apparent in a production of insulin valued around 500,000 crowns, out of a total production of pharmaceutical preparations estimated at over 2,000,000 crowns. Danish producers of insulin include Nordisk Insulin Laboratorium, Leo Insulin Co., and Novo Therapeutisk Laboratorium, all of Copenhagen.

The comparatively high value of its medicinal preparations gives Denmark a favorable trade balance, considered by value, if unfavorable on the basis of tonnage. Exports of 82 metric tons of pharmaceuticals in 1929 were valued at 2,041,000 crowns, while imports of 170 metric tons (or more than twice the tonnage of exports) were valued at but 1,829,000 crowns.

Germany, Great Britain, and the United States are leading sources of supply. The United States sold Denmark 15 metric tons of pharmaceuticals, valued at 86,000 crowns, or 5 per cent of the imports. Sweden and Norway are the chief customers for Danish exports of pharmaceuticals.

In 1929 Denmark imported 230 metric tons of crude drugs, valued at 400,000 crowns, almost all from Europe. The United States was credited with only 12 tons, valued at 69,000 crowns. Imports of pharmaceuticals into Denmark by nonprofessional houses are discouraged by the State control of this traffic. The Danish pharmacy law (Dansk Apothekerlov) requires imports and sales to be confined to recognized drug wholesalers, pharmacists, and two Government institutions—the Statens Serumsinstitut and the Serum Laboratoriet, both of Copenhagen. The Danish Health Office supervises, under permit license, the import of narcotics.

The leading Danish manufacturers of pharmaceuticals are the following:

Alfred Benzon, Copenhagen.
 Dansk Chemo-Therapeutisk Selskab, Copenhagen.
 Dansk Medicinal Eksport (Ltd.), Copenhagen.
 Det Danske Medicinal- & Kemikalie-Kompagni (Ltd.), Copenhagen.
 Ferrosan (Ltd.), Copenhagen.
 Leerbech & Holm, Copenhagen.
 Th. Lohse & Co., Copenhagen.
 "Miradium" v. Ole Frederiksen, Copenhagen.
 Løvens Kemisk Fabrik, Copenhagen.

SOAP

While producing in its 28 major plants not only sufficient to supply the domestic market but a surplus of toilet and laundry soaps for export, Denmark has excess imports of some soap for technical use and a relatively large excess import of soap powder. The latter involved a gross import of 1,533 metric tons in 1930, in comparison with 2,328 tons net in 1929, valued at 1,955,000 crowns.

DANISH SOAP PRODUCTION, 1927-1929

Item	1927	1928	1929	
			Quantity	Value in crowns
	<i>Metric tons</i>	<i>Metric tons</i>	<i>Metric tons</i>	
Soft soap.....	18,950	18,344	20,218	8,007,000
Hard (perfumed).....	2,930	2,980	2,906	4,640,000
Household (laundry).....	2,533	2,750	2,619	1,898,000
Soap chips.....	2,664	3,080	3,590	3,786,000
Soap powder.....	1,788	2,115	2,126	1,535,000
Total.....	28,844	29,228	31,459	19,866,000

Though production of soap chips and soap powder is increasing, this increase is not sufficient to prevent imports from Germany and Great Britain. Furthermore some foreign soap producers are strengthening their position by manufacture in Norway. Henkel & Co., of Germany, have a plant in Copenhagen, and the British Lever Bros. one at Glostrup. One American plant has made a substantial gain on the Danish market, as it has on other Scandinavian markets, while other American fancy soaps are prominent in retail trade. A large American company has assigned a manufacturing license to a Copenhagen firm which also maintains 900 toiletry chain stores in Denmark.

Danish imports of soap are not especially significant, except imports of soap powder. Imports of perfumed soap had attained a gross weight of but 51 metric tons in 1929 (a loss in comparison with previous years); laundry soap, 159 metric tons; industrial soap, 134, and washing powder, 2,399 metric tons. Corresponding exports (in metric tons) were perfumed soap, 597; laundry soap, 843; industrial soap, 30; and washing powder, 71. The total value of all soaps was 1,533,000 crowns, compared with 1,593,000 crowns in 1928.

Leading Danish producers of soaps, candles, perfumes, and cosmetics include:

C. J. Aggerbeck, Horsens (toilet and laundry).
 Arnisan Co., Copenhagen (toilet).
 O. F. Asp (Ltd.), Copenhagen.
 Barnaengens Kemiske Fabriker (Ltd.), Copenhagen.
 N. N. Blumensaadts Fabriker (Ltd.), Oeense (toilet and laundry).
 Bruun & Andresen (Ltd.), Copenhagen (toilet).
 Dansk Saebeindustri (Ltd.), Copenhagen (toilet and laundry).
 Danske Oliemøller og Saebe Fabriker A. S., Copenhagen (toilet, flakes, and laundry).
 Falkonergaardens Fabriker, Copenhagen (toilet).
 J. Fisker & Co., Copenhagen.
 Heyman Bloch & Co., Copenhagen.
 L. P. Holmblad (Ltd.), Copenhagen.
 Kaalunds Saebefabriker (Ltd.), Kolding (toilet, laundry, and powder).
 E. Mehls Fabrik, Aarhus (toilet).
 Noma Soaps (Ltd.), Copenhagen.
 C. Rafus Fabriker (Ltd.), Aalborg.
 C. Schous Fabriker (Ltd.), Copenhagen (toilet, chips, and laundry).
 Thor's Kemiske Fabriker (Ltd.), Copenhagen (laundry).
 Worning & Petersen (Ltd.), Vejle (toilet).
 Palsgaard Saebefabriker (Ltd.), Copenhagen.

INDUSTRIAL CHEMICALS

Production of industrial chemicals is small, being confined chiefly to such establishments as the superphosphate company, which makes its own sulphuric acid, and soap plants, which make soda crystals.

SULPHURIC ACID

Danish production of sulphuric acid, the bulk of which is made by the superphosphate company for its own consumption, is dependent for raw material on pyrites imported from Spain and Sweden. Imports in 1929 of 71,873 metric tons show 68,047 tons as originating in Spain and 3,795 tons as imported from Sweden. Following are the imports of sulphur pyrites:

	Metric tons		Metric tons
1913.....	28, 776	1929.....	71, 873
1927.....	65, 490	1930.....	107, 696
1928.....	77, 788		

Soap plants in some instances produce soda crystals. Total Danish production of soda crystals in 1929 was 20,443 metric tons valued at 1,539,000, chiefly by the A. S. Sodafabriker, belonging to A. S. Danske Oliemøller og Saebefabriker.

The item of 317 metric tons of crude glycerine (88 per cent), with a value of 396,000 crowns is also evident in 1929 production.

CRYOLITE

Owning Greenland, where cryolite, a solvent for aluminum oxide, is deposited, Denmark has a unique control of this raw material for the manufacture of aluminum, glass, and enamel. Danish trade in this product is monopolized by the Øresunds Chemiske Fabriker, which imports it for refining and exports practically all the refined product. Production of the refined product is therefore apparent from imports and subsequent exports.

DANISH TRADE IN CRYOLITE, 1913 AND 1927-1930

Year	Imports of crude cryolite		Exports of refined products (metric tons)
	Metric tons	Value in crowns	
1913	8,466		7,616
1927	14,316	3,390,000	12,539
1928	16,174	3,706,000	15,508
1929	21,509	4,847,000	17,886
1930	27,785		

DANISH CHEMICAL MARKETS

The dearth of chemical-processing industries in Denmark—unlike neighboring Sweden and Norway, with their paper pulp, metallurgical, and other production—is reflected in smaller imports from the United States of some primary materials entering production in the most highly industrialized European markets. This is evidenced by smaller imports of naval stores and in the almost negligible import of sulphur (450 metric tons, 25 tons of which originated in the United States) in 1929.

It must be taken into account that Danish figures of imports from the United States do not always give a true picture of actual amounts originating in this country, as a considerable tonnage is consigned to Hamburg or some other North Sea free port and then reexported, with the country of reexportation given as country of origin. This circumstance affects the heaviest articles in Danish-American trade, such as phosphate rock and asphalt.

Phosphate rock.—The leading chemical imported by Denmark direct from the United States is phosphate rock for the production of superphosphates. The United States sold Denmark direct about 30,000 tons of rock, valued at 886,000 crowns, in 1929, out of a total importation of 160,000 metric tons, valued at 5,000,000 crowns.

Varnish and rosin.—The United States sold Denmark 90 tons of varnishes and lacquers in 1929, out of total imports of 835 metric tons, valued at 1,511,000 crowns. The United States is given as the country of origin of 499 tons of gum rosin, valued at 163,000 crowns, out of total imports, in 1929, of 2,807 metric tons, valued at 974,000. The fact that Germany is given as the source of 1,371 metric tons (472,000 crowns) is an example of reexport of goods that may be assumed as chiefly of American origin, although France shares in this trade. The point is, however, that Denmark imports far more rosin from the United States than is apparent in official import figures.

Carbon black.—Carbon black occupies next place in American chemical products selling on the Danish market. Direct purchases

from the United States are given at 117 tons, valued at 136,000 crowns, out of total imports of 212 metric tons, valued at 272,000 crowns.

Zinc white, paints, and putty.—Two other items whose values are given at more than 100,000 crowns each in direct purchase from the United States are zinc white and unspecified chemotechnical products. While importing from the United States 198 tons of zinc white, valued at 105,000 crowns, out of total imports of 2,447 metric tons, valued at 1,411,000 crowns in 1929, Denmark also bought from the United States 43 tons of mixed paints (89,000 crowns) out of a total import of 289 metric tons (923,000 crowns), along with 12 tons of putty (mastic), valued at 13,000 crowns, out of total imports of 328 metric tons, valued at 90,000 crowns.

Vaseline.—Vaseline leads items whose value by direct purchase from the United States in 1929 fell short of 100,000 crowns; the 61 tons of American vaseline imported were valued at 99,000 crowns, out of a total of 131 metric tons, valued at 140,000 crowns. The American share in direct sale was over 70 per cent, on the basis of value.

Pharmaceuticals and soap.—Pharmaceuticals and soaps of American origin figure in import statistics. Direct sales of American pharmaceuticals are given at 86,000 crowns (15 tons) out of a total of 1,829,000 crowns (170 tons) in 1929. American toilet soap (8 tons, valued at 33,000 crowns, out of 50 tons, valued at 236,000 crowns), cake laundry soap (13 tons, valued at 12,000 crowns, out of 107 tons, valued at 87,000 crowns), and soap powder (34 tons, valued at 13,000 crowns, out of 2,399 tons, valued at 2,030,000 crowns) are also modest contributions by direct shipment from the United States. (Tons as used in the foregoing are metric units.)

The United States in 1929 made direct sales of 322 tons of soda ash (83,000 crowns) out of Denmark's total imports of 14,202 metric tons (1,837,000 crowns), and of 40 tons caustic soda (15,000 tons) out of Denmark's import of 3,403 metric tons (862,000 crowns). The market for heavy chemicals, on which Denmark is so largely dependent, is supplied chiefly by Germany.

AMERICAN CHEMICAL SPECIALTIES

Many American chemical specialty lines are represented in Denmark by Copenhagen agents, who generally draw from consignment stocks maintained for them. One American soap manufacturer has a licensing arrangement with a Danish "perfumery" chain-store organization which produces this product for local consumption; one organization mixes an American face lotion in Denmark, while another American concern assembles photographic apparatus, importing film from its producing factory in Germany. The circumstance of American manufacture in Germany in certain cases results in Danish importers purchasing from that source a profitable volume of trade invisible in American export statistics.

In Denmark, as elsewhere, the alcohol monopoly affects direct importation of products that have even a trace of alcohol in them. Such a trace causes the product to be assessed with the high duty on alcohol; this may be escaped by mixing alcohol with the product locally. As previously pointed out, the import of pharmaceutical lines is confined to representatives of the profession.