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THE SWISS ALUMINIUM INDUSTRY

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While the use of the traditional metals copper, lead and tin has a history going back thousands of years, the history of aluminium, which today heads the list of industrial non-ferrous metals, did not begin till 1807. The stages involved in the discovery and development of aluminium, which accounts for 8% of the metals in the earth's crust, making it the most common of all commercial metals, can be sketched on the following broad lines:

The discovery of the English scientist *Humphry Davy,* who in 1807 succeeded in obtaining a small quantity of an aluminium-iron alloy by means of an electrolysis experiment on alumina, but without producing a pure metal, was continued by the Danish physicist *Hans Christian Oersted* and the German chemist *Friedrich Wöhler.* By 1825 Oersted was able to produce tiny splinters of white tin-like metal by decomposing aluminium chloride. However, the results obtained were not yet clearly identifiable as aluminium. In 1827 Wöhler succeeded in isolating aluminium completely. His experiments yielded a grey powder which could be polished and whose chemical properties he was able to ascertain. By 1845 Wöhler was producing by chemical means aluminium in the form of small, shiny globules whose physical properties were established. The process of discovery then switches via *Robert Wilhelm Bunsen,* who between 1852 and 1854 conducted decisive experiments to obtain aluminium by electrolysing alumina, to the French scientist *Henri Sainte-Claire Deville,* who had the support of Napoleon III. Improving on the methods of Wöhler, Deville devised in 1854 an expensive chemical process as a basis for extracting aluminium on a large scale. At the World Exhibition at Paris in 1855 he displayed a block of aluminium which weighed only a third as much as iron and copper. In view of the enormous production costs the price was accordingly high, a purity content of 96 to 97% commanding 1200 Swiss Francs per kilogramme. Needless to say, aluminium was at first classed as a " precious metal " and used mainly for ornaments, tableware, spectacle frames, watch and clock cases and military decorations. After the revolutionary invention of the dynamo by *Werner von Siemens* in 1866 the way was open for the technical application of electric power for producing aluminium. It took another twenty years before the discovery of the industrial electrolysis process, which brought about a radical change in aluminium production. In 1886 patents were registered independently in France by *Paul Toussaint Héroult* and in the United States by *Charles Martin Hall* for a process of obtaining aluminium by electrolytically decomposing aluminium oxide (alumina) by passing a current through molten cryolite. To this very day this is the accepted method of production used by aluminium works all over the world.

The electrolysis process developed by Héroult was first put into operation in Europe by the *Swiss Metallurgical Society* founded in 1887 at Neuhausen a/Rheinfall, being in fact the pioneer of the Swiss aluminium industry. In 1888 this company became the *Aluminium-Industrie-Aktien-Gesellschaft* (AIAG) or, as it is now styled, the *Swiss Aluminium Ltd.*

At the plant in Neuhausen the French inventor Héroult and his successor *M. Kiliani,* first technical manager of the AIAG, introduced further improvements on the electrolysis process.

By the middle of 1890 the premises at Neuhausen were ready to start operation. The newly installed cells were first used for producing aluminium bronze and aluminium brass. Even at this early stage series of scientific experiments were initiated to try and produce alloys with special properties. As a result of continual improvements on the original cell system successful attempts were made in the second half of 1890 to produce a purer form of the metal, which was vastly superior to the quality marketed by competitors.

Production at the first aluminium works in Neuhausen proceeded without interruption, the output for 1891 being 173 tons of pure aluminium. Up to the turn of the century output compared with the world figure as follows:

	Swiss Production: tons	*World Production:* tons
1892	243	480
1893	447	720
1894	615	1,240
1895	505	1,430
1896	602	1,800
1897	717	3,400
1898	843	4,100
1899	1,348	6,000
1900	1,890	6,690

During this period the price was reduced from Sfrs. 19.— per kilogramme, this being the figure reached since commercial production began, to Sfrs. 2.50. Subsequent close collaboration between scientists and technologists gave a rapid boost to the aluminium industry. Up to 1912 Switzerland retained its position as the largest producer in Europe. Industrial production at this time benefited from the development of the Bayer process for the chemical decomposition of pure alumina from the aluminium or bauxite, available in large quantities but only abroad, and the development of fusion electrolysis for obtaining metallic aluminium.

After the elimination of initial marketing difficulties the many outstanding features of aluminium, but particularly the lower selling price achieved as a result of reduced manufacturing costs, secured for it a firm footing in nearly every branch of industry and the metalworking trades. The advantages of the new metal were duly recognised and it was used successfully for the first time for a wide variety of purposes (field kitchen material, kitchen utensils, household articles, shipbuilding, airship construction, bicycle manufacture, power lines, equipment manufacture, lithography, roofing, powder for the dyestuffs industry, etc.) Aluminium underwent improvements to include properties called for as the need arose in practice, such as hardness, strength, ductility and flexibility. Methods were invented for satin finishing, polishing, and providing the metal with a bright finish. The study of alloys proceeded apace, and the number of patents taken out every year in this connection kept increasing. More and more accurate knowledge was obtained on the effects of adding a number of different metals to aluminium.

Up till 1905, when Héroult's patents lapsed, the entire world aluminium production was the sole preserve of the two French aluminium companies, " Compagnie des Produits Chimiques d'Alais et de la Camargue" and "Société Electrométallurgique Française", the "Pittsburg Reduc-

tion Company", which held the Hall patents, the "British Aluminium Company" established in 1894, and the Swiss aluminium industry.

The alumina supplied by Southern France, Italy and West Germany as well as Guinea is transported by rail in silo waggons to the Swiss aluminium works. When the first Swiss and, at the same time, European aluminium works established at Neuhausen in 1888 was shut down in 1944, Switzerland's aluminium works have been centred in the Rhone Valley, in the interests of rationalisation, concerning mainly the distribution of alumina imports. The works at Chippis (started production in 1908) and at Steg (started production in 1962) belong to the Swiss Aluminium Ltd. In addition, there is at Martigny an aluminium reduction plant belonging to the *Aluminiumfabrik Martigny AG,* which started aluminium production shortly before the outbreak of the Second World War. The three Swiss aluminium works have a present capacity of about 60,000 tons, enough to cover the domestic demand for the next few years.

However, the Swiss aluminium industry is not confined to the production of raw aluminium and alloys. It is also heavily engaged in supplying semi-manufactured and finished products. Semi-manufactured products were first turned out in 1892 when a small rolling mill was started at Neuhausen to dispel any doubts lingering in the minds of interested quarters as to the feasibility of rolling aluminium into sheets. These modest beginnings have since been consolidated by dedicated effort and a true pioneering spirit to build up a semi-manufacturing and finishing industry which has earned aluminium a prominent position in the Swiss economy. The reason for this phenomenal growth was that early recognition of the importance of research led to the development and patenting of various brands of alloys. Other important advances were the invention of the aluminium welding process in 1906, and the introduction of the corrosion protection by anodizing in 1933.

With the very latest facilities at its command in its modern research institute at Neuhausen the Swiss aluminium industry is equipped to play an active part in tackling the problems which keep cropping up.

Aluminium produced in Switzerland is subjected to the first processing stage in the rolling mills and the pressing and drawing works. Normal commercial qualities of aluminium with a purity range of 99 to 99.99% as well as aluminium alloys of widely varying compositions, some of which can be made as strong as steel, are rolled here to produce sheets, strips, blanks and foils suitable for a considerable range of purposes. Sections, tubes and rods are turned out by the pressing and drawing works. These semi-manufactured aluminium products are used for anything from the tiniest machine component via the zip-fastener to aircraft and bridge construction. Both pure aluminium and aluminium alloys of high tensile strength are drawn to make thin wire and twisted into cable and stranded wire, these products being used increasingly by the electrical engineering industry as conductors.

The next stage, immediately prior to the end-use, is transforming pure aluminium, aluminium alloys and semi-manufactured aluminium products into finished products. The following gives some examples of these.

In the *aluminium foundries* pure aluminium and aluminium alloys are shaped by die, sand, pressure, centrifugal and compound casting to produce a wide range of consumer goods for everyday use as components for equipment and machine construction.

The *foil rolling mills* employ special roll frames for rolling aluminium strips into foil of uniform width and as thin as 0.005 mm. These strips which can be left plain, given a bright finish, coloured or provided with all kinds of printed and embossed designs, prove ideal material for packaging foodstuffs, tobacco, etc., as well as chemicals. In addition, aluminium foil is also used extensively in industry, mainly for condensers, cables and equipment.

The holloware, household gadgets, technical appliances and sports equipment produced in *Swiss holloware and metalware factories* from aluminium sheets and rounds are esteemed for their quality all over the world.

The *aluminium tube factories* from aluminium slugs produce, by impact extrusion, rigid or collapsible tubes for the foodstuffs and chemical industry as well as for cosmetics. *Cans* for aerosols, beer, chemicals, drugs, greases and oils are also made by deep drawing.

Boilermaking shops, welding shops and appliance factories use mainly rolled aluminium products for making containers, machines and appliances for breweries, dairies and the foodstuffs and chemical industries. Aluminium also figures prominently in the manufacture of machinery, appliances and components for the textile industry. The *Swiss aluminium container and appliance industry* has reached a standard of technical development which has earned it an excellent reputation.

Aluminium alloys of high strength and corrosion protection are vital material in factories and workshops constructing *rail and road vehicles* as well as in *shipyards.* Another important feature is the low density of aluminium.

Metal construction firms are using an increasing amount of aluminium sheets and sections, improved combining processes having proved decisive for the metal's widespread use in architecture.

Special works for surface treatment are concerned with such processes for protecting aluminium as anodisation, varnishing, stove enamelling, cladding, printing, etc.

There is hardly a branch of industry in Switzerland today which does not use aluminium in some form or other in its production programme.

The Swiss aluminium industry's exports

Right from its inception the Swiss aluminium industry was geared for export. As early as 1890 the groundwork was laid for the export of aluminium and aluminium products by establishing an extensive sales organisation and agencies abroad, as the market demand in Switzerland was not sufficient to absorb domestic production because of the initial market conditions. Up till 1939 exports, from the virgin metal to finished products, accounted for an average of about 75% of Swiss production. The following figures give a survey of the development and value of exports of aluminium and aluminium products:

	Virgin Metal tons	*Semi-manufactured products* tons	*Finished products* tons	*Value in millions of Francs*
1899	610	—	—	1.6
1909	1,687	136	10	3.0
1919	5,451	209	461	33.4
1929	15,517	1,345	2,857	55.6
1939	20,380	6,624	3,616	69.1

With the outbreak of the Second World War the position underwent a radical change which affected the different products in various ways. As a result of increased scope for application the demand for raw aluminium by Swiss processing industries grew, with the result that less was available for export. Whereas until 1939 virgin aluminium accounted for the bulk of aluminium exported, the trend in exports since then has come to rest more heavily on semi-manufactured products, about a seventh of the output now being earmarked for foreign markets. The finished product and foil industries also export a large part of their production. The following table shows the development of exports of virgin aluminium, aluminium alloys, semi-manufactured and finished aluminium products and aluminium foils since the end of the Second World War:

	Virgin aluminium		*Aluminium alloys*		*Semi-manufactured aluminium products*		*Finished aluminium products and foils*	
	tons	million Francs	tons	million Francs	tons	million Francs	tons	million Francs
1946	402	0.8	401	0.6	3,707	13.5	2,540	19.2
1950	9,563	14.5	2,475	3.2	3,157	10.2	3,678	18.9
1955	4,596	8.7	2,667	4.8	4,085	16.3	7,453	45.5
1960	7,459	18.0			9,060	36.1	9,324	60.6
1962	8,562	21.3			7,057	30.6	10,137	66.8

During this period the virgin aluminium and aluminium alloys produced in Switzerland were exported mainly to the Benelux countries, Scandinavia, the Federal Republic of Germany, Great Britain, Italy, Spain, Austria and the United States, as well as to some of the South American states. Because of their high standard of quality Swiss semi-manufactured and finished aluminium products are in high demand abroad. The geographical distribution of exports presents the following picture:

Semi-manufactured exports

	Europe tons	*Africa* tons	*Asia* tons	*North America* tons	*Central & South America* tons	*Austral-asia* tons	*Misc.* tons
1950	2,566.4	9.6	184.8	18.6	371.5	6.0	
1955	3,357.8	63.4	267.5	255.9	140.1	0.1	
1960	6,751.8	921.9	121.7	680.1	561.8	6.4	16.5
1962	5,119.3	1,171.7	216.4	304.1	214.2	4.5	27.0

Exports of finished products and foils

(Tariff items: 7604.10/31, 7605/07-16, 8214.20, 8215.20, 8301.10, 8306.20, 8313,20, 8314.10 and 8417.20-26)

	Europe tons	*Africa* tons	*Asia* tons	*North America* tons	*Central & South America* tons	*Austral-asia* tons	*Misc* tons
1950	2,065.2	247.7	815.5	136.0	413.1	0.4	
1955	4,531.0	701.7	1,061.1	473.8	626.3	59.2	
1960	5,732.0	369.3	770.0	966.6	1,030.7	410.5	45.3
1962	6,190.0	858.3	743.1	1,332.1	828.7	133.6	51.2

The industrialisation encouraged by the Second World War brought about remarkable structural changes in the export markets. Countries which had previously imported aluminium products from Switzerland started to set up their own production facilities. However, because the prices for Swiss aluminium could be kept remarkably stable despite rising wages and raw material costs, and also because semi-manufacturing factories were quick to adapt themselves, Swiss semi-manufactured and finished products were still able to retain their share of overseas markets in the face of powerful foreign competition.

(From "Swiss Industry and Trade", September 1963.)

EXPO 1964

The press was recently asked to attend the showing near Zurich of the "total" camera, the first of its kind in the world. With its fifty-seven objectives, this new device looks like an oversized porcupine. Affixed to a special pylon, the camera shoots not only the entire surrounding scenery but also the sky above. This panorama or ball camera was developed and put to action upon the initiative of the Swiss National Tourist Office for the purpose of taking "total" photographs of Swiss landscapes famed for their scenic beauties. The true-to-life colour reproductions are to be shown at the forthcoming Swiss National Exhibition in Lausanne (30th April to 31st October, 1964). They will be projected from outside on a hemispheric structure of sixty feet in diameter above a special podium for the spectators. In this novel Holiday Pavilion which promises to be a major attraction at the "Expo 64" visitors will be entertained by a rich programme of panoramic views and appropriate artistic sketches.

[S.N.T.O.]

ADMISSION — WITHOUT SHOES ONLY!

A bright Sunday in October produced the colourful background for the festive inauguration in St. Gall of the completely renovated "Waaghaus", the town hall formerly known as "Kaufhaus". The stately building with its typical gable roof dates back to 1581 and is one of the very few historic buildings which survived industrial expansion of the Swiss textile metropolis in the nineteenth century. Thousands came to see the building gaily decorated with flags and waited patiently to be admitted. Inside, high heels were taboo and gallant policemen helped the ladies put on protective overshoes. The public proved very understanding, and long rows of "parked" shoes like outside a Buddhist temple are quite a common sight while visitors in stocking feet pay tribute to the lovely parquetry floors.

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