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The iron and steel industries of Canada were so affected by the general business recession that began about eight years ago that in 1933, four years later, the value of the output of this group of industries, as recorded by the Dominion Bureau of Statistics, was only $211,961,908, at factory prices. Every branch of the industry had been affected; new rails and new equipment were not being purchased by our railways; farm implements were not in demand because of low prices for farm products combined with drought conditions in the West; building construction was low; the demand for sheet metals, general hardware and automobiles all showed marked declines; the mining and the chemical industries had not yet got into their stride. The Dominion Bureau records declines in various industries varying from 87% for agricultural implements, 51% for wire and wire goods (compared with 1926 as a normal year) to only 7% in automobile parts. This last relatively small decline would suggest that car operators were making old cars last a year or two longer.

In 1933 the apparent consumption of pig iron was only

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216,641 tons; the production of steel ingots and direct steel castings was 409,979 short tons. Most of the steel was in ingot form (open hearth 378,666 tons), and direct castings accounted for 5,017 tons. Electric furnace ingots totalled 15,393 tons and electric castings 10,615 tons; converter steel was only 288 tons, all used for direct castings.

Three years later (1936) pig iron production had increased to 599,875 tons, with an additional output of 56,616 tons of Ferro-alloys, not separately recorded in 1933; ingot steel had increased to 909,186, of which 36,742 tons were made in electric furnaces; direct steel castings weighed 32,341 tons, of which 22,577 tons were electric. At the end of December five blast furnaces, with rated daily capacity of 2,050 long tons of pig iron per day, were in operation, being 51% of installed capacity; six furnaces, comprising 49% of available capacity, still remained idle. This very marked improvement in the production of primary iron and steel marks a corresponding improvement in general business affairs and more especially in the many industries which require these products.

Not only has there been marked improvement in production but imports have greatly increased. Imported rolling mill products were valued at about $3,000,000; machinery $7,000,000; farm implements $3,500,000; miscellaneous products of iron and steel account for a balance, making the total imports about $16,000,000. Incidentally, there has also been a

marked improvement in our exports of scrap iron and steel, blooms, billets and ingots, machinery and tools.

Monthly reports for the first half of 1937 show further improvements in several directions; at present six furnaces of a rated daily capacity of 2,525 tons (64%) are in blast, and four are idle (36%).

Most of the steel made in Canada is made by the basic open hearth process, usually a low carbon mild steel used for many purposes; some alloy steels, chiefly for use in the automobile industry, are also made in open hearth furnaces; a large quantity of steel is also made in electric furnaces, generally alloy steels or special steels as required for various industrial purposes; no production of acid open hearth steel is recorded for 1936, and bessemer steels only to the amount of 645 tons were used, apparently only for making special castings.

The steel used in Canada is made from pig iron and scrap; the relative proportions vary considerably, being determined by various practical considerations, such as the relative amounts of iron available, relative costs and the specifications for the finished products. About three-quarters of the pig iron produced in blast furnaces in Canada is utilized in the steel making departments of the producing companies, a very considerable portion of the other quarter of the blast furnace production is sold to makers of special purpose steels.

No domestic iron ore, for use in blast furnaces, has been produced since 1924; the blast furnaces in Cape Breton obtain most of their ore from Newfoundland, only relatively small amounts of manganese-bearing ores being secured from other sources, usually from north Africa; blast furnaces in Ontario obtain their iron ore from Lake Superior points. While a small tonnage of specially processed ore, on which a provincial bounty will be paid, will probably be available two years hence (1939) its production will not do away with the necessity of importing large tonnages of various other grades of ore from present sources of supply. Hence the primary steel producing industry of Canada is dependent, for most of its chief raw material, upon foreign sources of iron ore. Scrap metal for the steel industry is chiefly of local origin; here again special grades of scrap are imported.

Mention should also be made of the fact that most of the metallurgical coke used in Ontario is either imported as such from the United States, or is made in Ontario from coking coals from the same source; local limestones are utilized in southern Ontario, but limestone from the United States is used at Sault Ste. Marie; Newfoundland limestone is used in Cape Breton. Most of the alloying elements used for special steels are imported in raw ores, which include ores of manganese, chromium and phosphorus; ferro-silicon, ferro-manganese, high-carbon ferro-chrome and ferro-phosphorus are

made in Canada; metallic cobalt, nickel and copper are also produced here; ferro-tungsten, ferro-titanium, ferro-vanadium, low-carbon ferro-chrome and other ferro alloys occasionally required in small quantities are imported, as is calcium molybdate.

During the last decade, and especially within the last five years, there have been numerous changes, new developments, or expansion in many of our steel producing industries. These changes have been brought about by the general improvement in business and by the development of sizable domestic demands for certain new products. The general run of steel products made in Canada remains as it was; primary products, after ingots and castings, are billets, blooms, slabs, merchant bars, horseshoe bars, concrete bars, rails, light structural shapes, and a very great variety of rods, and wires, from which are made spikes, bolts, rivets, nuts, nails, tacks and many hundreds of other products; pipes and pipe fittings; tank and boiler plate, black sheets and galvanized sheets.

A relatively new development in 1929 was the installation of cold rolling equipment for the production of plate (21" in width) in coils, afterwards cut into sheets and coated with tin. A second unit, producing coils 42" in width, was installed in 1936; the two units are capable of producing at the rate of 40,000 tons per annum. They were operating at capacity towards the end of the year producing tin plate for use chiefly in food packing industries.

While the building industries in Canada consume considerable tonnages of structural steel girders, until recent years only light weight sections (up to 6") were available. In 1935 the plant at Sault Ste. Marie, formerly a large producer of heavy rails, began a program of expansion by equipping one of its mills to produce heavier and larger sections; there are now available 8", 12", and 15" beams and channels (80' mill lengths) as well as steel sheet piling and centre sill zee bars. The small demand for structural steel of larger sizes and heavier weights per lineal foot has still to be satisfied by importations from the United States or Great Britain.

The sheet metal industries are now able to secure in this country black sheets, hot rolled; white sheets cold rolled; galvanized sheet; and tin plate; as well as coated rivets and wires.

The great growth of the mining industry has created a demand for many kinds of steel products, especially alloy steels; these latter are usually made largely from scrap metal in electric furnaces. Manganese steel castings of many kinds, including jaws for crushers, dies, stamp heads, balls, liners, are now made in Canada; drill steels and tool steels of varying characteristics can also be obtained from domestic sources. As our mines grow deeper a demand will arise for light weight, high tensile strength rustless structural shapes and sheets for use in constructing

skips, hoisting equipment, and cars. At present these products are not rolled in Canada; the demand is low and only a very small quantity has been imported.

The growth of the automobile industry has created a demand for a large variety of alloy steels. Production of these steels was initiated in 1923 and the business has been steadily expanding; two firms employ the basic open hearth furnace process and produce a variety of steels to meet consumers' specifications; these steels include nickel, chrome, vanadium, nickel-chrome, chrome-vanadium, chrome-molybdenum, manganese, silicon, and related products. Other firms produce alloy steels, including tool and die steels, in electric furnaces. Steels made by both processes are used, largely by the automobile industry but also by other industries, for the production of axles, crank shafts, gears, and other forged parts; for valves, rods, bolts and nuts of many varieties; for cutting, machining, and drawing, and numerous other applications where steels of special properties are required. In making steels it is possible to secure from domestic sources the principal alloys required, such as ferro-manganese, high-carbon ferro-chrome, silico-manganese, silico-spiegel, low-carbon manganese, ferro-silicon of several grades; ferro-phosphorus, nickel, cobalt, aluminium and copper; other alloys and metals required only in relatively small quantity have to be imported.

Canada has witnessed a marked expansion in its chemical industries during the last decade, not only in the group engaged in the production of chemical wood pulps (three kinds) but also in those which produce such products as newsprint, celluloseiproducts in great variety, explosives, heavy chemicals, fine chemicals and pharmaceuticals. Secondary industries using chemical processes also require corrosion-resistant materials; such industries are soap making, textile dyeing, rubber manufacture, photographic products, paints and varnishes, tanning, electroplating, making of solvents, and many other products; several synthetic processes requiring special apparatus are also in operation, notably the production of acetic acid and acetone. These and related manufacturing industries require containers, conduits or pipe lines, reaction vessels, heat-resistant materials, and many other kinds of equipment, all of which must be resistant to corrosion by the products being handled at temperatures which vary above and below normal atmospheric conditions; otherwise the operations could not be carried on or such products as could be made would be impure.

There are many corrosion-resistant materials on the market, designed for various purposes, both ceramic products and alloys of non-ferrous metals. Within the last seven years several Canadian manufacturers have been developing alloy irons and steels especially designed for service in chemical plants.

Duriron is not a steel but is a high silicon iron alloy (about 14.5% silicon) that is resistant against very many of the chemical products used in numerous industries; the product is melted in an electric furnace and is cast; it has to be machined by grinding owing to its hardness, and it can be welded by experienced operators; it is made in Canada under licence from the owners of the patents.

A great variety of acid-resisting and heat-resisting products, usually steel alloys with high chromium and nickel content, is also available to Canadian industries from domestic sources. These steels, some of which are called stainless steels, vary somewhat in composition according to the commercial use to which they are to be applied. The alloying materials used, in addition to low-carbon ferro-chromium and metallic nickel, vary according to consumers' requirements, but include ferro-alloys of the elements molybdenum, titanium, tungsten, silicon and columbium; of these only nickel and ferro-silicon are at present produced in Canada. At present they are obtainable in castings or in ingot form, some of the latter being suitable for forging. Stainless steel bars, rods, and sheets are not yet produced in this country. Before use most of these alloy steels have to be subjected to special heat treatments at known and controlled temperatures, to bring out properties especially desirable in the particular use to which each is applied.

The adaptation of this group of heat- and acid-resisting alloys to the requirements of special industries is a highly technical engineering problem. Behind the industry is an accumulation of much technical knowledge, in part developed in other countries, and in part the work of the efficient staffs of the Canadian manufacturers. Consumers' problems are rarely exactly alike, and the fact that trained technical staffs are now available in Canada to assist consumers in securing alloy steel products suitable to their needs is of equal or greater importance to industry as a whole than is the mere fact that a particular product is made in this country.

The Dominion Bureau of Statistics reports 38 firms in Canada engaged in the primary iron and steel industries; three of these firms not only make pig iron but also make a large variety of steel products largely from iron of their own production; one firm, which only operates seasonally, makes several kinds of pig iron; there are 10 installed blast furnaces of which six are in operation. Apart from ownership, the number of plants in operation are — four plants making pig iron; thirty plants equipped with 81 steel furnaces making various kinds of steels; sixteen plants are rolling steel products; ferro-alloys are made in three plants, apart from some low-grade by-product ferro-silicon derived from the electrothermic abrasive industry; no record of the number of forging units is available.

In conclusion, it may be recorded that during the last decade there has been a notable expansion in the variety of steel products made in this country; while the tonnage of new products made, in comparison with the tonnage of the older established steel industries, is not very large, the most notable developments are the production of steel sheets, tin plate, galvanized sheet and plate, heavy-section structural steel and sheet piling, and the manufacture of alloy steels and alloy steel products for the three leading industrial groups — mining, chemical industries, and machinery, including automobiles. Closely associated with these developments is the establishment and training of a skilled personnel in several works who are capable of developing other products to meet the demands of domestic industry. It has not been possible to describe all new developments in this article, but general trends have been noted and many of the new products have been mentioned to show how these industries have grown during the past few years. So long as essential raw materials, both iron ores and alloying elements, are not obtained from domestic sources this industry will remain dependent upon foreign supplies; it is gradually developing within our boundaries to the point where most of the requirements of the steel consuming industries can be filled from domestic sources once the primary materials are secured.

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