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OUR MINERAL RESOURCES

In his book called *Minerals in Industry* W. R. Jones gives a table of contents listing 55 minerals. Of these, Canada has 38 in production and several of the others are known but not yet worked.

That is a measure — one measure — of the importance of minerals in Canada's economy.

This Monthly Letter can do no more than scratch the surface of a subject so vast, outlining in general terms the facts of an industry which, though basic to our home comforts, our standard of living, our productivity, and our international trade, is taken as much for granted as are our agriculture and our forests.

More than ever before, civilization depends for its continuance upon the minerals which sustain its physical existence. In an imaginary world without minerals we should at least have to do without such commonplace conveniences as railways, automobiles, telephones, electric light and power, central heating, china and glass, and large buildings.

Looking backward, we can see that every advance we made in a material way has been based upon new application of science through technology to mineral resources. Only by the aid of the mechanization of industry, commerce and agriculture have we been able to feed and clothe the world's increasing millions.

Kinds of Minerals

Canada Year Book, in which authoritative figures of production are to be found, lists minerals under four major headings: metallic, fuels, other non-metallic, and clay and other structural materials.

Among metallics, some are fundamental to our way of life: iron, copper, lead, zinc, nickel, aluminum and magnesium. Of almost equal importance are the alloying metals such as manganese, chromium, molybdenum and tungsten. The industrial minerals (limestone, sulphur, salt and fluorspar among others) supply the raw materials for much of our chemical industry, and the mineral fertilizers, phosphate rock and potash, are of vital importance in agriculture.

Iron in its many forms is still the most widely used metal, but minerals which were only scientific curiosities a few years ago have come into common use during the first half of this century. These minerals, with their peculiar qualities, have an importance out of all proportion to the amount consumed. Very small amounts of them have a profound effect when added to other metals: less than one per cent of vanadium, for example, makes steel suitable for uses involving strain, and one-twentieth of one per cent of tellurium gives lead increased resistance to frost when used for water pipes.

Little can be said of the more exotic minerals like radium and uranium, because statistics of their reserves and production are state secrets. It can be said that Canada was the first country outside of the United States to build and operate a sizable atomic pile.

Canada leads the world in the production of nickel, platinum, and asbestos. Outside the Communist dominated part of the world, for which figures are not available, Canada is the second largest producer of gold, cadmium, selenite (the largest selenium plant in the world is at Montreal) and tellurium; the third largest producer of silver and zinc; and the fourth largest producer of lead, cobalt and copper. We export more nickel, zinc and aluminum than any other country. The *Stock Exchange Gazette*, of London, said in March this year: "Taking all exports of these metals together, Canada takes first place by a long way."

Importance of Minerals

How important minerals are in providing the material basis for economic and social organization is indicated by the fact that historians commonly designate the major divisions of human history by reference to the mineral products which were most characteristic of the successive ages: copper, bronze, iron, and so on.

It is not only in money economy — although the mining industry's output is of the order of a billion dollars a year — but in subsidiary benefits reaching down to every home that minerals count.

Minerals are the food of industry. Manufacturing and construction depend largely upon products of the mine, and one third of the volume of freight handled by Canadian railways is accounted for by mine products.

More than half a million people are supported directly by mining in this country; mining communities buy nearly $100 million worth of food from farmers, and spend half as much again on clothing, furniture, shelter and other things which are made in all parts of Canada; and the mining companies themselves buy $100 million worth of supplies like lumber, machinery and electrical equipment.

Expansion programmes now under way involve expenditures of three-quarters of a billion dollars. "It is calculated," said V. C. Wansbrough, vice-president and managing director of the Canadian Metal Mining Association, "that for every man employed in mining, at least one other (some authorities place the proportion much higher than that) is ensured of some other form of employment."

In yet another way does the mineral industry serve Canada: it is pushing our frontiers northward. We now have thriving towns in parts of Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia, where a few years ago there was no habitation amid the rock and bush. From Bonavista in Newfoundland to Dawson in the Yukon there are hundreds of thousands of people who have hewed homes out of the wilderness, basing their livelihood upon the mining industry.

And, finally, the possession of so great resources of strategic minerals, uranium, nickel and iron, adds not only to Canada's national strength but to her importance in world affairs.

Origin of Minerals

Our knowledge of the physical and chemical forces that shape the earth's crust is pitifully scant, though we know much more now than a century ago about the sources of ores, the chemistry of their formation, and the reasons for their concentration in ore bodies.

The spotty distribution of mineral deposits is most unfortunate in a disunited world. Some of the highly prized minerals require such special conjunction of geologic materials and processes that high-grade deposits have been formed at fewer than a dozen places throughout the world. Nature may have supplied enough of everything, but she did not parcel out minerals in equal shares within the artificial political boundaries of nations.

Some countries, like the United States and the Soviet Union, have adequate supplies of certain minerals, but none has a satisfactory supply of all the essentials to a well-balanced diet. Nearly all the world's nickel comes from a single district in Canada; for many years a mine in Colorado has produced most of the world's molybdenum, and Brazil supplies virtually all the quartz crystal used.

Not one of the industrially mature nations has within its own borders an adequate supply of tin, so essential in a mechanized economy. Every one of the rich tin sources is in a region inhabited by people who until lately, at least, had little or no need for it.

This is not all that must be taken into account. A mineral, when found, must be available in workable quantity. Uranium is a less rare constituent of the earth's crust than are lead, zinc and tin, but usable quantities are much less frequently found.

H. L. Keenleyside, speaking as Canada's Deputy Minister of Mines and Resources at a United Nations scientific conference in 1949, gave this informative comparison: "We know, with reasonable accuracy, what proportionate amounts of aluminum, iron, magnesium, titanium and other metals are to be found in the crust of the earth. We know, for example, that for every 100 units of lead there are 200 units of zinc, 400 units of uranium, 480 units of copper, 1,000 units of nickel, 1,800 units of chromium, 32,000 units of titanium, 248,000 units of iron, and 400,000 units of aluminum."

There are no adequate published estimates of world reserves of most minerals. We do know that geological conditions in the Canadian Shield have, on the whole, been favourable for mineral formation, and experience shows that here are concentrated many ores which are economically workable.

Discovery in Canada

Perhaps the first authentic reference to minerals in this part of the world was John Cabot's report on his return to Europe from Newfoundland in 1497. He had seen copper in possession of the natives.

Samuel de Champlain heard tales about wealth which might be found in the Kingdom of the Saguenay, but it remained for later generations to open up the treasures of New Quebec, to prove the Indians' stories.

What started Canada on the road to being a great mining country was the discovery of silver in the Cobalt area during construction of the Timiskaming and Northern Ontario Railway in 1903. Out of the wave of exploration which followed that discovery there grew mining camps at Cobalt, Porcupine and Kirkland Lake, Ontario; the Premier mine in British Columbia; the Siscoe mine in Quebec, and the Flin Flon mine on the Manitoba-Saskatchewan border.

The second big wave of exploration began with staking of the Horne mine at Noranda, Quebec, in 1921, and continued into the 1930's. Out of this period came the mines of the Noranda-Rouyn, Malartic and Val d'Or areas of western Quebec; gold camps in the Patricia district of western Ontario; the Sherritt Gordon mine in Manitoba, and the mining of pitchblende at Great Bear Lake in the Northwest Territories.

The third great effort to find minerals, starting with the end of the second world war, may be recorded as Canada's most ambitious. During last year alone,

promising discoveries were made in the Sudbury basin, in northern Saskatchewan, in Manitoba, in Quebec, in British Columbia, in Labrador, in the Yukon and in the Northwest Territories.

Summing up significant finds of recent years, *Canada Year Book* mentions the discovery of what is probably the largest known single source of titanium in the world at Lake Allard, Quebec; more than 200 million tons of unusually pure ilmenite have been proved (ilmenite is defined as containing 36.8 per cent iron and 31.6 per cent titanium). Other features of the period under review were: progress in development of copper-nickel deposits in Manitoba; establishment of reserves of natural gas in Alberta, sufficient to provide an exportable surplus; the bringing into production of a large deposit of asbestos in Ontario; and the discovery of occurrences of radioactive mineral on the north shore of Lake Athabaska, Saskatchewan and near Lake Superior in Ontario.

Extent of Production

Canada's mineral production in 1952 was estimated by the Dominion Bureau of Statistics at $1,278 million, made up of: metals $727,916,000; oils and other fuels $262,098,000; other non-metallics $124,304,000; and structural materials $164,047,000.

The easiest way to comprehend Canada's progress in production is to view it per capita. In 1886 our mineral production was $2.23 per person, and by ten year periods thereafter: 1895, $4.08; 1905, $11.51; 1915, $17.18; 1925, $24.38; 1935, $28.80; 1945, $41.15. In 1952 it was $88.57.

As to provincial distribution, Ontario led with 34.3 per cent of mineral production in 1952; Quebec was second with 20.9 per cent; Alberta was third with 15.4 per cent, and British Columbia was fourth with 13.5 per cent. The other provinces followed: Nova Scotia 5.0 per cent; Saskatchewan 3.8 per cent; Newfoundland 2.6 per cent; Manitoba 1.9 per cent; New Brunswick 1.0 per cent; the Northwest Territories 0.7 per cent, and the Yukon 0.9 per cent.

This production represents a great amount of labour. It surprises the man in the street to learn the small amount of minerals obtained relative to the amount of rock brought to the surface. In the average successful gold mine five tons of rock must be broken, mined, hauled to the surface, crushed and chemically treated to produce a single ounce of gold. The proportion of rock to metal is even higher in the case of platinum and radium.

Distribution of Minerals

Every province, except Prince Edward Island, has its rich store of useful minerals, and all are becoming increasingly aware of the economic advantages of mining development.

Newfoundland is experiencing a great increase in exploration following completion of a study of mineral resources. Shale has been found suitable for production of structural clay products, a variety of talc is already bringing export orders, and there are mines producing zinc, iron ore, lead, copper, fluorspar, silver and gold. The output of fluorspar (used in steelmaking and aluminum production) far exceeded that credited to any other part of Canada. One of the world's largest base-metal mines yields copper, zinc and lead.

Nova Scotia has enjoyed significant increases in production of several industrial minerals. This province supplies about 98 per cent of the barytes produced in Canada. Ground barite is used principally as a pigment and filler in paints, as a filler in rubber goods, and in combination with other materials in drilling oil and gas wells. In the latter part of 1952 a new lead-zinc-copper mine came into production; gypsum is produced in great quantity, and coal continues as the outstanding feature of the province's mining industry.

New Brunswick is eagerly seeking new mineral resources, spurred on by establishment of a silver-lead-zinc producer, the first in the province. Coal is by far the outstanding item mined, but gypsum, natural gas and petroleum are also available. *The Maritime Advocate* lists the known metallic occurrences: lead, zinc, copper, silver, antimony, arsenic, tungsten, molybdenum, iron, nickel, manganese and gold.

Quebec produces a wide variety of minerals, with asbestos, gold, copper and zinc as outstanding contributors. The largest deposits of iron and titanium in the world are found on the north shore of the St. Lawrence river. In the Quebec-Labrador development (benefiting both this province and Newfoundland) about 500 million tons of high-grade iron ore have been definitely located. The first load will come over the newly-laid 360-mile railway next year. In December, announcement was made of a new iron ore discovery in Ungava.

Ontario, too, is distinguished by the diversity of its minerals. Attention is focussed at present on base metal deposits, and the province is undergoing its most active period of exploration and development. Nickel ranks next to gold in the amount contributed to the value of output since 1900, followed by copper, silver and platinum metals. Salt, quartz, structural materials and clay products; fluorspar, nepheline syenite and graphite are also produced. When International Nickel Company achieves its objective for this year — 13 million tons of ore — it will have established a record as the largest non-ferrous underground operation in the world.

Manitoba has had copper, gold and zinc among the metals; gypsum and salt among the industrial minerals, and cement in the structural mineral field, as its leading mineral products for a number of years. Production of nickel is anticipated this year, the most outstanding development being that of copper-nickel ore bodies at Lynn Lake, necessitating the building of a power plant and a 150-mile railroad.

Saskatchewan has been on the copper-gold-zinc-silver map since 1930, with a great mine at Flin Flon, on the border of Manitoba. Among the out-of-the-

way minerals boasted by this province is volcanic dust, used in scouring and cleaning aids. Coal and sodium sulphate are also produced.

Alberta's mineral output is comprised almost entirely of fuels and structural materials. Its oil wells, brought into heavy production a few years ago (*Monthly Letter* November, 1949), have attracted world wide attention, and coal production is at the rate of 9 million tons a year.

British Columbia has its mighty silver-lead-zinc smelter, the heart of a long-established and progressive mining industry which had its roots in the historic gold rushes to the Klondike and the Cariboo districts. Antimony, bismuth, cadmium, tin and sulphuric acid are obtained as by-products in the mining and smelting of base-metal ores.

Yukon Territory contributes gold, silver, lead and zinc, while the *Northwest Territories* yield gold, radium and uranium. Whitehorse is the supply base of a mining district spread over 90,000 square miles, and is only 300 miles from the world's biggest silver-lead mine.

How Long Will They Last?

How long will the mineral resources of the world hold out in face of the increasing use we are making of them? Mr. Keenleyside was quite clear in drawing a line between "critical" shortage and just a shortage. The former, he said, means a shortage of such proportions that the essential needs of the world cannot be met, with the consequence that the material progress of humanity must be slowed down or directed toward new objectives.

Examined in these terms, there are in the world today no critical mineral shortages, but certain warning signals are flying.

Reserves of minerals range from some that are adequate for thousands of years to others which may be used up in ten or twenty years. Taking the long view, the world is short of zinc, lead, tin, mercury, platinum, petroleum, quartz crystal, mica and industrial diamonds.

The current rates of consumption present an altogether new problem for which past experience provides no certain solution.

The truth is, as attested by statements made by eminent geologists and mineralogists, that we have extracted and used a greater quantity of mineral resources during the past half century than throughout all the preceding millennia of human history.

If everyone in the world lived on the same standard as in the United States, it would require 925 million tons (of 2,000 pounds each) of iron to supply the earth's 2½ billion people. That would exhaust the estimated reserve of the great Cerro Bolivar iron deposits in Venezuela (half a billion tons of ore) in six months. On the same basis, world copper requirements would be 20,790,000 tons, but the world-wide output of copper in 1947 was only 2,425,000 tons, and world reserves were estimated at 110 million tons — enough for five years if everyone used copper on the same scale as people in the United States. The story is similar with reference to lead and zinc: the world's reserves would be exhausted in five years.

What is to be Done

There are, however, two points of view. From one, we see the increasing demands made upon mineral resources by the new uses found for minerals and the widening demand for products of minerals; from the other we see the use of substitutes, some of chemical origin.

We in our generation have learned to take nitrogen out of the air, where it exists in practically unlimited amounts, and transform it into food for plants; we have learned to take magnesium from sea water and alloy it with aluminum for airplane frames; and we have even penetrated atoms and made available their energy. Perhaps people of the twenty-first century will be able to solve similar problems in their day.

Whatever we think about the subject, there is no excuse for wasteful living. With some severity, Evan Just, a geologist who has had world-wide experience in mineral exploration, writes in *Technology Review:* "Having no conscience in regard to posterity that prevents our using tin for dog-food cans, sinking battleships for target practice, or allowing immense soil and fertilizer values to drain into the ocean, we at least know that, at a price, these wastes can be avoided."

Our vision has become blurred by the words "inexhaustible" and "unlimited." We are making little provision in these fat years for the leaner years which undoubtedly lie ahead. We are doing little to avoid the disastrous consequence of mineral depletion suffered by many once-powerful nations.

Mineral resources are not renewable. They are not annual income, like field crops, but stored capital. The geological processes responsible for their presence continue to operate today, it is true, but the rate at which these processes produce results is so slow that it has required hundreds of thousands of years to provide the mineral resources that men now use in a single year.

This inescapable fact points up the need not only for exploration to uncover new resources but for study of ways to conserve and substitute.

Conservation may be achieved by various means, among them avoidance of waste and development of more efficient ways of withdrawing the minerals from the rocks. Re-use of scrap metal may effect great saving in new ore. Preservation of metal by proper use of coatings to prevent corrosion would be a help.

Forestry, agriculture, fisheries and other fields of resource development have made progress in recent years in the direction of conservation. Similar efforts in mineral production and use would be a significant contribution to continuance of our way of life.

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