

Europe where facilities exist for fabricating them into metals, some of which are then imported by Canadian industries. Platinum is a good example: Canada is the world's third largest producer of platinum ores and concentrates (it is produced as a by-product in the treatment of nickel-copper sulphide ores), but imports all of its fabricated platinum metals, largely from the United States.

Because of current domestic production and extensive reserves, Canada does not directly share the insecurity felt by its allies about future access to adequate supplies of many of the minerals in Table 1. Cobalt is often considered a particularly high-risk mineral because a single manifestly unstable country, Zaire, accounts for over half of world mine production and for a much larger share of exports. The 1978 incursion by Katangan rebels into Zaire's copper-producing Shaba province (cobalt is generally obtained as a co-product of copper), which curtailed cobalt deliveries to the Western countries and precipitated a very sharp increase in its price, was a recent instance of supply interdiction that set off alarm bells in several Western capitals about excessive minerals dependence on the southern African region. Another mineral widely perceived as posing security-of-supply dangers to the West is platinum. The Republic of South Africa and the Soviet Union each account for almost half of world mine output, and South Africa occupies an even more prominent position as a supplier to the OECD countries because of heavy Soviet domestic requirements. Since Canada is self-sufficient in the crude forms of both of these minerals, the country's vulnerability is presumably less than that of its allies. Nor does Canada have much to fear in the cases of nickel, zinc, copper, iron ore and tungsten, all of which it produces and exports in abundance. Moreover, the country's future self-sufficiency is guaranteed for most of these minerals because Canada enjoys relatively generous reserves (defined as known ore deposits that can be economically exploited given existing technology and prices).

**The critical four**

Turning to the four minerals from Table 1 for which Canada (like its allies) is almost completely dependent on imports, it is evident that all four of these have something in common: they are largely produced and exported by non-Western countries (South Africa being here classified as non-Western). This fact, combined with the importance of these minerals in numerous industrial uses and the difficulties of effecting substitution in many cases, leads to the inclusion of chromium, manganese, bauxite and tin in most lists of "strategic minerals." However, most analysts regard chromium and manganese as more susceptible to serious supply dislocation than bauxite or tin. Several factors account for this. First, as Table 2 makes clear, there are a larger number of significant suppliers of bauxite and tin than of the other two minerals. Reserves are also more dispersed. This is important since, for any commodity, 1), collusion among producers to manipulate supply is facilitated by a concentration of production, and 2), the fewer are the number of major producers, the less likely it is that a serious curtailment in exports from one will be made up by greater exports from others.

Second, chromium and manganese have few if any substitutes in most of their current industrial uses, whereas tin must increasingly compete with aluminium, glass, paper and other substitutes. In the case of bauxite, while it is

currently by far the most important aluminum-bearing ore, there are several known non-bauxitic sources of aluminum that could be readily exploited if bauxite prices rose drastically or if it were unavailable. Third, interruptions in the supply of bauxite and tin appear to be much less likely than in the cases of chromium and manganese, partly because the major exporters are more stable, and partly because they recognize that short-term gains from deliberate price-raising collusive action would be more than offset by the longer-term costs as consumers searched for substitutes and new, high cost producers entered the market. For all these reasons, an exploration of Canada's vulnerability can be most usefully and economically undertaken by looking more closely at the situation facing the country as an importer of chromium and manganese.

**Chromium and Manganese: the African connection**

Chromite ore (from which chromium is derived) has often been called the "quintessential strategic mineral" because of its indispensability for many industrial and military purposes. It is irreplaceable in stainless steels and high-temperature-resistant alloys, and has no known substitutes for many of its high-technology applications. Chromite is mainly found in South Africa and the Soviet Union. Zimbabwe, the Philippines, Albania and Turkey are minor suppliers (see Table 2). Owing to its domestic chromium needs, Soviet exports typically account for less than

**Shares of World Non-Fuel Mineral Production and Reserves, 1979-1980**  
(Based on actual mine production)

MINERAL	COUNTRY	PRODUCTION (percent of world)	RESERVES (percent of world)
BAUXITE	AUSTRALIA	31.8	19.7
	GUINEA	14.8	28.5
	JAMAICA	13.0	8.7
	SURINAM	5.7	2.1
	SOVIET UNION	5.2	1.3
	YUGOSLAVIA	3.5	1.7
	HUNGARY	3.4	1.3
CHROMIUM	SOVIET UNION plus ALBANIA	36.8	less than 1
	SOUTH AFRICA*	34.7	67.5
	PHILIPPINES	5.9	less than 1
	ZIMBABWE	5.6	29.7
	TURKEY	4.6	less than 1
MANGANESE	SOVIET UNION	41.1	44.4
	SOUTH AFRICA	20.5	40.7
	GABON	7.3	2.9
	AUSTRALIA	6.7	6.1
	INDIA	6.7	less than 1
	BRAZIL	6.6	1.7
TIN	MALAYSIA	25.3	12.0
	THAILAND	14.9	12.0
	SOVIET UNION	13.6	10.0
	BOLIVIA	10.8	4.8
	INDONESIA	10.3	15.1
	CHINA (P.R.)	9.3	15.5
	AUSTRALIA	4.6	3.5
BRAZIL	3.4	4.1	

\*Note that South Africa processes most of its chromium ore into ferrochromium prior to export. It accounts for over 60 percent of world ferrochromium exports.

Source: Mineral Commodity Summaries, 1981 (Washington: Bureau of Mines, U.S. Department of the Interior).

**TABLE 2**

twenty-five percent of the world total, a figure which has been steadily trending downwards for several years. South Africa is the world's largest exporter, with about thirty percent of the market for chromium, but it accounts for over sixty percent of world exports of processed ferrochromium, a key input into high-technology steel production. Moreover, South Africa, which has most of the world's reserves, is expected to become increasingly dominant as a supplier of both chromium and ferrochromium to the OECD countries in future years.

Like chromium, manganese is also crucial in the pro-