I. Introduction: Occurrence, Production and Uses

Cobalt, atomic number 27, takes its name either from the German Kobold, meaning hobglobin, house spirit, or gnome or from the Greek cobalos, meaning mine (Schroeder 1967). It is widely distributed naturally in rocks, soils, water, and vegetation (Nilsson et al. 1985), and always occurs in nature in association with nickel and usually with arsenic. The most important cobalt minerals are smaltite (CoAs$_2$) and cobaltite (CoAsS); however, the chief technical sources of cobalt are residues called “speisses,” which are obtained...
in the smelting of arsenical ores of nickel, copper, and lead (Cotton and Wilkinson 1968).

The extraction of cobalt from the parent ores is by chemical and electrolytic techniques involving many stages, and the methods employed depend on the nature of the original ore (Payne 1977).

Cobalt is not commonly found in drinking water. In the U.S., of 720 river water samples examined, only 37% contained traces of cobalt in the 1 to 5 μg/L range, 5 μg/L being the limit of solubility. Because it is found in low concentrations, no drinking water limit has been set (Calabrese et al. 1985). In soils, the cobalt concentration ranges from 1 to 40 mg/kg. Atmospheric concentrations of cobalt in remote areas are usually below 1 ng/m³ (Nilsson et al. 1985). In industrial areas cobalt levels in air were around 1 ng/m³, while levels up to 10 ng/m³ have been occasionally reported (Elinder 1984).

Cobalt has been used for the coloring of pottery and glass since 1450 BC when the Babylonians and Egyptians used it extensively. Not until the 20th century was cobalt used in alloys. Their high melting points, great strength at elevated temperatures, and resistance to oxidation by hot gases have increased demand for cobalt for such essentials as jet engines, rocket nozzles, and gas turbines. More than 75% of the world's production of cobalt is used in the manufacture of alloys (Nilsson et al. 1985; Payne 1977). Other uses have been for cemented tungsten carbides and high-speed steels. The cobalt compounds, oleate, resinate, and linoleate, have been used as drying agents for lacquers, varnishes, paints, inks, pigments, enamels, and glazes. Cobalt compounds are powerful driers by virtue of their action as oxidizing catalysts for the polymerization of unsaturated glycerides. Apart from its action as a drying agent, cobalt is an important catalyst source for the petroleum industry. Another catalytic use has been in the after-burners of internal combustion engines to reduce atmospheric pollution (Payne 1977).

II. Nutritional Importance of Cobalt. Dietary Intake

Cobalt is a vital trace element in animal nutrition. The first evidence that cobalt was a dietary essential was obtained about 60 years ago as an outcome of Australian research into the cause of two naturally occurring debilitating diseases of sheep and cattle known locally as "coast disease" and "wasting disease." Ruminant animals, in contrast to humans and some other monogastric mammals, have an intestinal microflora which can utilize cobalt in the formation of vitamin B₁₂ (Elinder 1984). Normal growth and health of sheep and cattle have been secured by the administration of small oral doses (0.1 mg to 1.0 mg of Co/d) of a cobalt salt (Underwood 1975). Prior to this, researchers in New Zealand had shown that a disease of cattle, known as "bush-sickness," could be cured and prevented by the oral administration of large amounts of crude iron salts and ores (Underwood 1975).