

changed, probably for three reasons: the need for insulation for the new steam technology, the formation of an international trading company of Italian and English entrepreneurs, and the reopening of the chrysotile asbestos deposits of northern Italy and simultaneous exploitation of the vast chrysotile resources in Quebec. The supply for the first time was ample, and the market was ready.

The modern industry

The reopening of the asbestos deposits of northern Italy, deposits which had previously been worked as far back as Roman times, serves to mark the beginning of the modern asbestos industry. The Italian asbestos was unusually silky and long fibered³ and thus readily woven into textiles. The shrouds and cloths of antiquity may have been made from this asbestos.

By 1890 the modern asbestos industry was full blown, with hundreds of applications being introduced (Jones, 1890); by the turn of the century the large South African crocidolite deposits had been opened up, and the Russian deposits in the Urals were once again producing in large quantity. Within a few years, the amosite deposits of the Transvaal would be exploited.

From the time of the first recorded use of asbestos by Stone Age man to 1900, the total world production of all types of fiber was probably about 200,000 metric tonnes, certainly no more than 300,000 tonnes. Of this, 150,000 tonnes came from Quebec. By 1980 over 100 million tonnes of asbestos had been mined throughout the world; of this over 90 percent was chrysotile and over 5 percent crocidolite and amosite. Total production of anthophyllite asbestos to date is probably no more than 400,000 tonnes, 350,000 tonnes being produced by Finland alone. Production of tremolite asbestos has been sporadic; it was mined in various parts of the world for short periods of time. Total production to date for this

³Two samples of Italian asbestos on deposit at the U.S. National Museum are both chrysotile. One, U.S.N.M. No. 73539, is from "Piedmonte," Italy, and was acquired by the museum in 1900 from the Isaac Lea Collection. The fibers in this sample are up to 120 cm long! The second sample, U.S.N.M. No. R3172 (Roebbling Collection) is from Val Malenco, Sondrio, Lombardía, Italy. Fibers are up to 15 cm long in this specimen.

form of asbestos is probably no more than a few thousand tonnes. Commercial exploitation of actinolite asbestos is practically unknown.

The world asbestos production for 1978 is given in Table 3. Russia leads with 46.1 percent and Canada is second with 28.9 percent of the world output. Both countries mine only chrysotile asbestos, and most of the fiber comes from the Urals and Quebec. The third leading asbestos producer is the Republic of South Africa (7.1 percent); the asbestos ore consists of amosite, crocidolite, and chrysotile. These three countries furnished 82.1 percent of the world's asbestos in 1978. The other countries listed in Table 3 produce mostly chrysotile.

Modern asbestos uses

As alluded to before, heat insulation was one of the most important uses of asbestos during the early beginnings of the modern industry; apparently the first application for this purpose was in 1866 (Bowles, 1937, p. 9). The principal uses of asbestos in the United States in 1978 in order of importance were as follows: in cement pipe (145,800 metric tonnes), in flooring products (122,400), in friction materials (81,600), in roofing products (58,300), in asbestos cement sheet (29,200), in coatings and compounds (29,100), in paper (29,100), in packings and gaskets (23,300), and in insulation (14,300) (Clifton, 1979).

MAJOR GEOLOGICAL OCCURRENCES OF AMPHIBOLE ASBESTOS

There are many minerals, including the amphiboles and chrysotile, that are described variously as fibrous, asbestiform, acicular, filiform, and prismatic, terms which suggest an elongate habit. Although such minerals are extremely common, in only relatively few places do they obtain suitable physical and chemical properties to be valuable as commercial asbestos. Locally, amphibole minerals may show an asbestiform habit, for example in vein fillings and in areas of secondary alteration, but usually they do not appear in sufficient quantity to be profitably exploited.

Deposits of commercial asbestos are found in four types of rocks: (1) banded ironstones (amosite and crocidolite), (2) alpine-type ultramafic rocks, including ophiolites (anthophyllite, tremolite, and chrysotile), (3) stratiform ultramafic intrusions (tremolite and chrysotile),