Asbestos

By R. A. Clifton[1]

Shipments of asbestos (mostly chrysotile) in 1977 from mines in the United States decreased 11% from those in 1976. Imports were 8% lower than those in 1976 because U.S. demand continued to lag well below the peak year of 1973.

Canadian production in 1977 was 8% lower than that for 1976, and shipments from Canada to the United States were 6% less than those in 1976. Imports from the U.S.S.R. were 1% of total U.S. imports, and those from the Republic of South Africa accounted for 4%.

Table 1.—Salient asbestos statistics

		1973	1974	1975	1976	1977
United States:						
Production (sales)	short tons	150,036	109,091	98,654	114,842	101,704
Value	thousands	$16,288	$13,759	$14,220	$23,693	$25,267
Exports and reexports (unmanufactured)	short tons	66,442	61,723	36,447	46,923	37,637
Value	thousands	$9,342	$9,192	$10,667	$12,791	$11,731
Exports and reexports of asbestos products (value)	do	$40,777	$60,396	$60,776	$60,572	$78,822
Imports for consumption (unmanufactured)	short tons	792,473	766,164	538,553	657,851	607,022
Value	thousands	$98,914	$123,822	$111,011	$142,145	$145,146
Released from stockpile (unmanufactured)	short tons	6,761	28,851	6,877	552	207
Consumption, apparent[1]	do	882,908	845,825	607,637	726,322	671,543
World: Production	do	4,613,717	4,582,320	r4,562,624	r5,623,211	5,878,829

rRevised.
[1]Measured by quantity produced, plus imports, plus stockpile releases, minus exports.

Legislation and Government Programs.—Again, no date was set by the Occupational Safety and Health Administration (OSHA) for the public hearings mandatory for the proposed revisions to its asbestos standard for manufacturing. The proposal for a permissible-exposure level of 0.5 fibers per cubic centimeter (0.5f/cc) is well into its third year without the hearings.

On March 18, 1977, President Carter signed Public Law 95-12. This act repealed the Byrd Amendment, which had exempted strategic minerals from the economic sanctions in force against Southern Rhodesia.

The Consumer Products Safety Commission (CPSC) banned all consumer patching compounds and artificial emberizing materials that contain respirable free-form asbestos. The ban on emberizing materials became effective December 15, 1977, and that on patching compounds becomes effective January 16, 1978, for all such compounds manufactured after that date.

On November 10, 1977, the Environmental Protection Agency (EPA) gave advance notice of intention to propose an asbestos standard for the production and use of crushed stone.

Under a new State law, all California firms manufacturing asbestos products or using asbestos in their processes had to register that fact prior to September 1, 1977.

As shown in table 2, there was little change in stockpile inventories in 1977. Crocidolite was sold from the stockpile at $301 per ton.

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Table 2.—Stockpile goals and Government inventories as of December 31

(Short tons)

	Stockpile goals	Total inventories		Sales of excesses, 1977
		1976	1977	
Amosite	26,291	42,623	42,416	207
Chrysotile	--	[1]10,960	[1]10,960	--
Crocidolite	--	2,474	2,474	--
Total	--	[r]56,057	55,850	207

[r]Revised.
[1]Adjusted figure, Federal Preparedness Agency.

Environmental Impact.—Isolating the impact of environmental considerations on the demand for asbestos is difficult because of the many interacting variables. It is demonstrable, however, that in the past, asbestos consumption has risen with rising construction activity and declined with each decrease in construction activity. This is shown in figure 1, and is true for the 9 years preceding 1977. The sudden divergence in that year of the paths of new construction and asbestos consumption is quite likely the result of lessened demand brought on by the environmental problems associated with asbestos. Indications are that future asbestos consumption in the United States may have a nongrowth pattern, and that environmental considerations will be a causative factor.

DOMESTIC PRODUCTION

Mines in the United States shipped 11% less asbestos in 1977 than in 1976. Value was 7% higher than in 1976. Four States produced asbestos: California was the leader, with 74%, followed by Vermont, Arizona, and North Carolina. Total output was 101,704 tons valued at $25,267,000.

Output from the copperopolis mine made Calaveras Asbestos Corp. California's leading producer. At yearend, two mines were also active on the Joaquin Ridge near Coalinga. Atlas Asbestos Corp. worked its Santa Cruz mine in Fresno County and Union Carbide Corp. operated its Santa Rita mine in San Benito County, both on the ridge.

The Vermont Asbestos Group's Lowell mine in Orleans County, Vt., is no longer the mine with the highest production of asbestos in the United States. Its output was less than that of the Calaveras Corp. mine. The Lowell mine is owned and operated by an employee group which, though successful in its operation, is considering selling it.

Arizona production in 1977 was below the 1976 level. The Jaquays Mining Corp. in Gila County had the only active asbestos mine in the State.

Powhatan Mining Co.'s mine in North Carolina was active, and a few tons of anthophyllite was mined and shipped in 1977. U.S. asbestos producers and mine sites follow:

State and company	County	Mine	Type of asbestos
Arizona: Jaquays Mining Corp	Gila	Chrysotile	Chrysotile.
California:			
Atlas Asbestos Corp	Fresno	Santa Cruz	Do.
Calaveras Asbestos Corp	Calaveras	Copperopolis	Do.
Union Carbide Corp	San Benito	Santa Rita	Do.
North Carolina: Powhatan Mining Co	Yancey	Hippy	Anthophyllite.
Vermont: Vermont Asbestos Group	Orleans	Lowell	Chrysotile.

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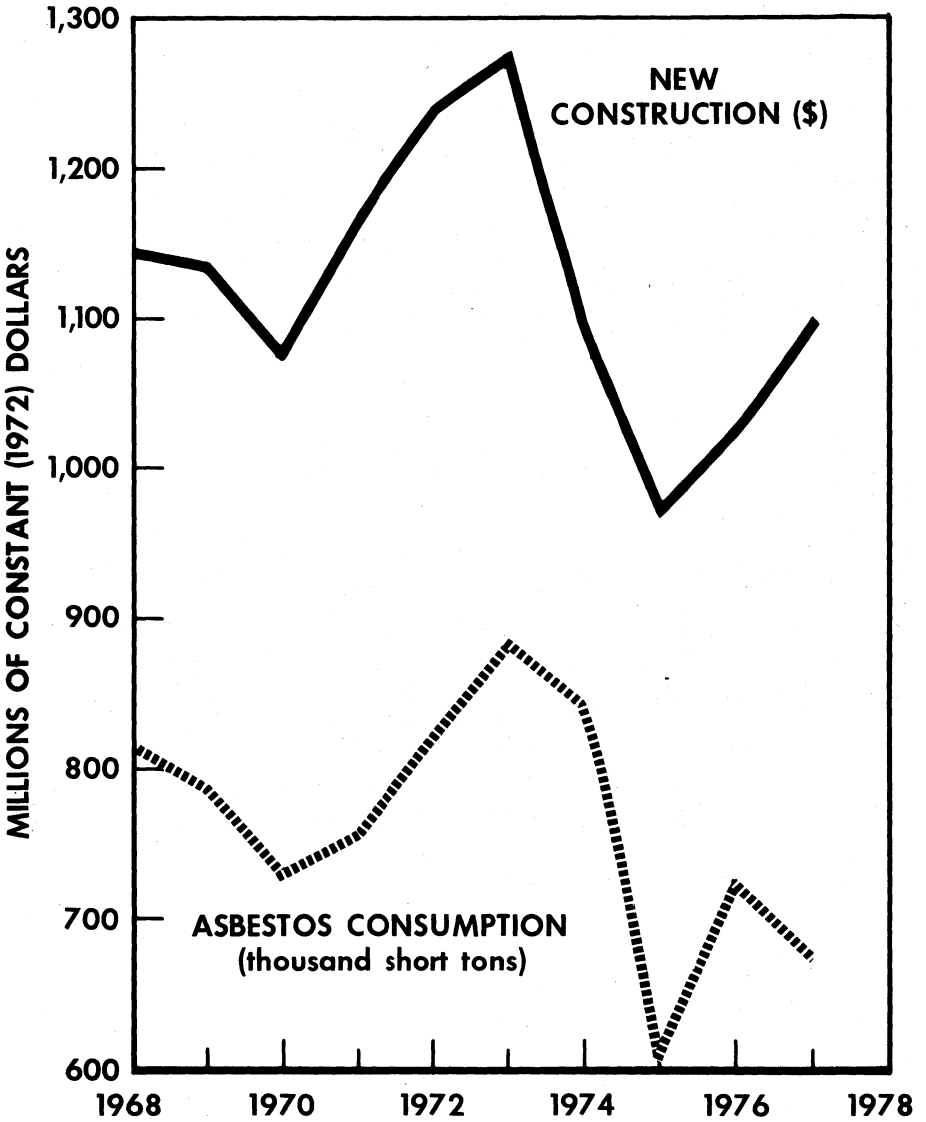


Figure 1.—Value of new construction versus asbestos consumption.

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Table 3.—U.S. asbestos distribution by end use, grade, and type, 1977

(Short tons)

	Chrysotile											
	Grades 1 & 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Total chrysotile	Crocidolite	Amosite	Anthophyllite	Total asbestos
Asbestos-cement pipe	--	--	86,500	41,600	3,000	--	--	131,100	25,400	3,000	--	159,500
Asbestos-cement sheet	--	--	8,000	14,100	11,200	9,000	--	42,300	--	1,200	--	43,500
Flooring products	2,700	--	--	67,500	100	84,100	--	154,400	--	--	--	154,400
Roofing products	--	--	300	3,600	14,900	44,500	--	63,300	100	--	--	63,400
Packing and gaskets	300	3,100	3,900	13,800	1,500	5,000	--	27,600	100	--	--	27,700
Insulation:												
Thermal	--	1,700	500	400	8,400	5,500	--	16,500	--	--	--	16,500
Electrical	--	200	--	2,200	1,000	300	--	3,700	--	--	--	3,700
Friction products	100	1,600	2,500	30,100	10,900	45,400	300	90,900	--	--	700	91,600
Coatings and compounds	--	--	200	400	1,100	34,100	--	35,800	--	--	--	35,800
Plastics	--	100	--	1,100	--	5,900	--	7,100	900	--	--	8,000
Textiles	1,100	8,400	200	--	--	--	--	9,700	--	--	--	9,700
Paper	--	--	1,700	1,200	16,200	4,800	--	23,900	500	--	--	24,400
Other	100	200	1,000	4,000	7,000	19,000	--	31,300	--	--	2,000	33,300
Total	4,300	15,300	104,800	180,000	75,300	257,600	300	637,600	27,000	4,200	2,700	671,500

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CONSUMPTION AND USES

The end use data on asbestos fiber as reported by respondents to the Bureau of Mines questionnaire remain difficult to analyze. Patterns of use that may be indicative of trends are not apparent. The data may represent a major market readjustment that started with the economic recession and Canadian strike in 1975 and was complicated by the environmental picture, or the lack of clarity may be due to inconsistency of reporting. If the former is true, then the readjustment period is still taking place. Three-fourths of the end uses showed increases in asbestos consumption; the others decreased. The asbestos used in asbestos cement pipe increased 14% and that in asbestos cement sheet, 92%. Further increases were in flooring products (36%), packing and gaskets (38%), thermal insulation (150%), electrical insulation, (61%), coatings and compounds (80%), and textiles (31%). The asbestos used in roofing products in 1977 was reported at just 25% of that in 1976, asbestos used in plastics was only 37% of the 1976 level, and in paper, 79%.

Asbestos cement pipe, which represented 24% of the total asbestos consumption, and flooring products, which represent 23%, were the largest end uses of asbestos. Friction products totaled 14%, and roofing products, the 1976 leader, was fourth at 9%. Other major asbestos-using end products were asbestos cement sheet (6%), coatings and compounds (5%), packing and gaskets, as well as paper (4%), insulation (3%), plastics and textiles (1% each), and other end uses (6%).

The following, from a Canadian trade publication, indicates the amount of asbestos used in some of the end products and its contribution to the cost of the article:[2]

Product	Weight-percent	Approximate percent of cost
Asbestos waterproofing products and antileak joints	50-70	15-20
Friction material (molded)	50-60	15
Friction material (woven)	70	30
Asbestos textiles (cloth, yarn)	85-90	40
Asbestos papers (felts)	80-90	60
Asbestos finished sheets	10-15	30
Asbestos pipes	16	45
Asbestos-vinyl tiles	8-14	6

PRICES

Quoted prices for Quebec asbestos, all chrysotile, were raised 14% during 1977. The last rise was effective on July 1, 1977. British Columbia asbestos chrysotile prices rose 12.8% on that date.

Prices for Vermont chrysotile asbestos rose 4% on January 1, 1977. Arizona prices did not increase during 1977. The latest prices are still those that went into effect on July 1, 1976, and quotations, f.o.b. Globe, are shown below:

Grade	Description	Per short ton
Group 1	Crude	$3,000
Group 2	do	1,800
AAA	do	1,300
Group 3	Nonferrous filtering and spinning	$750-840
Group 4	Nonferrous plastic and filtering	750-840
Group 7	White shorts	100-200

As of January 1, 1977, Vermont chrysotile asbestos, f.o.b. Morrisville, was priced as follows:

Grade	Description	Per short ton
4T	Fiber	$477
5D through 5R	do	$314-369
6D	Waste	228
7D through 7T	Shorts	95-182
7TF	Floats (shorts)	82
8S	Shorts	62
Hooker No. 1	Packaged in 50-pound woven polyvinyl bags	1,110
Hooker No. 2	Packaged in 100-pound woven polyvinyl bags	555

Quotations for Canadian (Quebec) chrysotile, f.o.b. mine, as of July 1, 1977, follow:

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Grade	Description	Per short ton	
Group 1	Crude	Can$3,300-	Can$4,000
Group 2	do	1,800-	2,175
Group 3	Spinning fiber	850-	1,700
Group 4	Asbestos-cement fiber	530-	700
Group 5	Paper fiber	315-	400
Group 6	Waste, stucco, or plaster	245-	275
Group 7	Refuse or shorts	90-	200

Prices for chrysotile asbestos from British Columbia and the Yukon Territory, Canada, effective July 1, 1977, f.o.b. Vancouver, follow:

Grade	Description	Per short ton
	CASSIAR MINE	
C-1	Crude	Can$3,621
AAA	Nonferrous spinning fiber	2,000
AA	do	1,600
A	do	1,050
AC	do	913
AK	Asbestos-cement fiber	770
AS	do	670
AX	do	580
AY	do	420
AZ	do	320
	CLINTON MINE	
CP	Asbestos-cement fiber	Can$730
CT	do	650
CY	do	420
CZ	do	320

African asbestos producers privately negotiate sales, thereby ruling out market quotations. The following tabulation shows the average value per short ton of South African imports, regardless of grade, calculated from U.S. Department of Commerce data:

Type	1973	1974	1975	1976	1977
Amosite	$188	$228	$395	$461	$534
Crocidolite	213	251	427	518	528
Chrysotile	234	282	940	235	440

The increased demand for and the shortage of most types of asbestos, and the increased mining costs resulted in price increases in almost all categories. Other price rises were expected early in 1978.

FOREIGN TRADE

There was a 23% increase from 1976 to 1977 in the value of exports of asbestos products manufactured in the United States. The number of articles exported increased.

Major groupings of exported products and their share of the total value were textiles and yarns, 22%; friction products, packing and gaskets, and asbestos-cement products, 17% each; insulation products, 5%; and other products, 22% (table 4).

In 1977, 62% of the cost of imported asbestos was recovered by exporting and reexporting fibers and products.

In 1977, the United States imported 90% of its asbestos consumption. This was slightly below the 1976 percentage. Canada provided more than 94% of the imports, the Republic of South Africa provided 4%, the U.S.S.R. provided 1%, and four other countries provided the remainder. Chrysotile, with 98%, dominated the imported types. The dollar value of imported fibers was 2% higher than that in 1976.

Table 4.—Countries importing U.S. asbestos products in 1977, by type

(Thousand dollars)

	Canada	Germany, Federal Republic of	Mexico	Australia	United Kingdom	Other	Total
Friction products	10,436	927	62	121	153	3,398	15,097
Packing and gaskets	3,602	266	552	469	326	9,725	14,940
Asbestos-cement products	1,934	1,825	32	58	54	11,782	15,685
Textiles and yarn	4,282	1,767	4,939	718	162	8,200	20,068
Insulation products	1,103	13	93	40	49	3,373	4,671
Other	2,458	5,148	498	273	726	10,487	19,590
Total	23,815	9,946	6,176	1,679	1,470	46,965	90,051

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Table 5.—U.S. exports and reexports of asbestos and asbestos products

Products	1976 Quantity	1976 Value (thousands)	1977 Quantity	1977 Value (thousands)
EXPORTS				
Unmanufactured:				
Crude and spinning and nonspinning fibers short tons	21,470	$7,179	17,906	$7,433
Waste and refuse do	24,847	5,461	19,484	4,268
Total do	46,317	12,640	37,390	11,701
Products:				
Gaskets and packing do	2,460	11,330	3,784	14,940
Brake linings do	6,239	11,536	6,381	12,968
Clutch facings, including linings number	1,007,551	1,660	1,110,280	2,129
Textiles and yarn short tons	7,522	7,907	8,782	11,323
Shingles and clapboard do	10,610	3,547	7,206	2,484
Articles of asbestos cement do	15,151	6,326	24,454	13,201
Protective clothing	NA	898	NA	1,312
Insulation, heat and sound	NA	4,819	NA	4,671
Manufactures, n.e.c	NA	12,253	NA	15,322
Total	XX	60,276	XX	78,350
REEXPORTS				
Unmanufactured:				
Crude and spinning and nonspinning fibers short tons	606	151	--	--
Waste and refuse do	--	--	247	30
Total do	606	151	247	30
Products:				
Gaskets and packing do	4	19	12	126
Brake linings do	221	251	197	197
Clutch facings, including linings number	28,143	23	720	7
Textiles and yarn short tons	--	--	8	35
Shingles and clapboard do	12	3	--	--
Articles of asbestos cement	--	--	--	--
Manufactures, n.e.c	--	--	NA	107
Total	XX	296	XX	472

NA Not available. XX Not applicable.

Table 6.—U.S. imports for consumption of asbestos from specified countries, by grade

(Short tons)

Grade	1976 Canada	1976 Republic of South Africa	1976 Southern Rhodesia	1977 Canada	1977 Republic of South Africa	1977 Southern Rhodesia
Chrysotile:						
Crude	635	1,745	3,451	134	3,810	2,451
Spinning fibers	5,872	61	247	6,685	3,764	--
All other	611,068	6,557	--	561,985	2,360	345
Crocidolite (blue)	--	10,177	--	71	11,968	--
Amosite	20	1,554	--	1	582	--
Total	617,595	20,094	3,698	568,876	22,484	2,796

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Table 7.—U.S. imports for consumption of asbestos (unmanufactured), by class and country

Year and country	Crude (including blue fiber)		Textile fiber		All other		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1976								
Australia	99	$46	--	--	--	--	99	$46
Canada	655	272	5,872	$4,613	611,068	$121,977	617,595	126,862
Germany, Federal Republic of	--	--	--	--	1,909	383	1,909	383
Hong Kong	--	--	--	--	2	(1)	2	(1)
Mexico	378	209	--	--	1,091	146	1,469	355
Rhodesia, Southern	3,451	2,099	247	208	--	--	3,698	2,307
South Africa, Republic of	13,476	6,932	61	38	6,557	2,616	20,094	9,586
U.S.S.R	--	--	--	--	12,421	2,324	12,421	2,324
United Kingdom	564	282	--	--	--	--	564	282
Total	18,623	9,840	6,180	4,859	633,048	127,446	657,851	142,145
1977								
Canada	206	90	6,685	6,224	561,985	124,940	568,876	131,254
Mexico	--	--	--	--	3,615	139	3,615	139
Rhodesia, Southern	2,451	2,368	--	--	345	199	2,796	2,567
South Africa, Republic of	16,360	7,721	3,764	309	2,360	1,273	22,484	9,303
Sweden	--	--	--	--	1	(1)	1	(1)
Taiwan	--	--	--	--	312	7	312	7
U.S.S.R	--	--	2,190	443	6,748	1,433	8,938	1,876
Total	19,017	10,179	12,639	6,976	575,366	127,991	607,022	145,146

[1]Less than 1/2 unit.

WORLD REVIEW

Industrial Minerals magazine discussed the asbestos market, the recession, and environmental factors by describing the "uniqueness" of a mineral that maintains a reasonably strong demand in spite of an intensive campaign to either ban or limit its use at a time of industrial recession.[3]

The world market for asbestos is apparently in a period of transition away from the older, longer established trends. Canada has been supplanted as the world's number one producer and the United States as the number one consumer; the Soviet Union enjoys premiership in both areas.

Consumption growth rates in the more developed countries are, at least for now, on the decline, but consumption is increasing in developing countries. This is indicated by the 8% reduction in U.S. consumption and 12% reduction in British imports, but world production rose 4.5% from 1976 to 1977.

There is even the possibility that there are trend changes among the grades of choice in the marketplace. During much of 1977, there were inventories of the spinning grades available from producers; during part of that time, shorts (grade 7) were also available. Demand for the cement grades, however, continued to exceed supply throughout the world.

Australia.—Although production for the year ended June 1977 more than doubled the record high set in 1972, the future of the Woodsreef Mines Ltd. mine at Barraba, New South Wales, still does not seem assured. New on-site reserves of fibers have been found, and the Baryugil property remains promising, but the receivership has not been vacated.

Canada.—The eight companies that produce and ship asbestos in Canada reported a 7% decrease in shipments to the United States and Western Europe. The Canadian Government established an emission standard of 2 fibers per cubic centimeter of air for air surrounding crushing, drying, milling, and storage operations of the asbestos mining industry. The standard will become effective on December 31, 1978.

In Quebec, the Provincial government's interest in the asbestos industry was greatly clarified by the end of 1977. Instead of the industrywide takeover reported earlier, only one company (Asbestos Corp. Ltd.) is now targeted for acquisition by the new $Can250,000,000 crown corporation, Société Nationale de l'Amiante, being proposed in the legislature. Asbestos Corp. Ltd., with 35% of the Province's production capacity, is not a willing seller. Improvement of the

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industry's health and safety standards remains a goal of the Government, as does job creation, by having more provincial manufacturing of asbestos-containing products.

In this regard, a study financed by the Quebec Asbestos Mining Association isolated five product areas as the most promising for local manufacturing: Molded friction products, asbestos-cement pipe, asbestos-cement sheet, asbestos papers, and asbestos flooring felts. Details of the second phase of the study were unavailable at yearend, but the study was not expected to promise much hope of achieving the Government's goal of 20% of Quebec fibers being used in local manufacture.

United Asbestos Inc. was placed in default by its bondholders and bank in March, and the mine at Midlothian, Ontario, closed. At yearend, Woodsreef Minerals, Ltd., was studying the property relative to acquisition, and was doing some testing at its facility in Australia.

Asbestos Corp. Ltd. closed its Normandie mine in September, reserves were depleted.

Canadian Johns-Manville Co., Ltd., at first reconsidered, then reinstituted its announced plan to spend $77 million over the next 5 years for facility development at its Jeffrey mine in Asbestos, Quebec.

Carey-Canadian Mines Ltd. completed a $3 million air purification plant for its 230,000-ton-per-year-capacity mill. The company employed 550 people at its open pit mine and mill.

Cassiar Asbestos Corp. Ltd. announced formation of its own marketing department, closure in 1978 of its Clinton mine, and resumption of exploration of its Kutcho Creek deposit in northern British Columbia.

Among the asbestos properties either undergoing exploration or awaiting development or financing decisions are Abitibi Asbestos Mining Co. Ltd. and its property at Amos, Quebec; Great Northern Pulp and Paper Group Ltd. and its Daffodil property in Deloro Township, Ontario; Hollinger Mines Ltd. and its discovery in Newton Township near Timmins, Ontario; McAdam Mining Corp. Ltd. and its own chrysotile property at Roberge Lake, McCorkill Township, near Chibougamau, Quebec, and a joint exploration with Campbell Chibougamau Mines Ltd. on its discovery at McKenzie Bay, Roy Township, Quebec; and Pathfinder Resources Ltd. and its 750-acre Lili property in Cleveland Township, Quebec.

Greece.—In January 1977, Cerro Corp. sold its rights in the Zindanion asbestos mines near Kozani to the Government's Hellenic Industrial Development Bank (ETVA). The bank's own company, Asbestos Mines of Northern Greece, Mining Society Anonyme, will carry out the Government's priority for development of the mine. In November, the company applied formally to the Government for a $68 million investment to establish a 100,000-ton-per-year asbestos plant. A Canadian consulting firm has been retained as technical advisor for plant construction, and at yearend, the firm was conducting site-selection tests.

Japan.—An article discussed the role of asbestos in Japanese industry.[4] As seen in the following tabulation, Japan, like the United States, is largely dependent on foreign sources for its asbestos.

	Short tons				
	1972	1973	1974	1975	1976
Production	13,088	7,489	4,654	4,184	6,988
Imports:					
Canada	107,083	130,637	123,994	62,443	130,773
South Africa, Republic of	90,932	101,782	112,621	90,567	87,676
U.S.S.R	37,379	42,284	58,933	65,681	49,293
Italy	17	--	30	1,258	11,974
United States	4,173	7,179	5,782	4,086	9,157
Australia	11,546	27,329	14,297	4,204	3,947
China, People's Republic of	45	69	1,265	1,092	2,034
Cyprus	861	--	--	--	--
Mozambique	485	--	1,820	--	--
Total	252,521	309,280	318,742	229,331	294,854
Exports	688	233	163	1,958	3,202
Apparent consumption[1]	264,921	316,536	323,233	231,557	298,640

[1]Measured by quantity produced, plus imports, minus exports.

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The source countries are of interest, with the exception of 1975, the major suppliers share of the Japanese market has not varied widely in several years. In 1975, the year of the Canadian strike, Canada's share dropped from a nominal 45%-50% of the market to 27%; the U.S.S.R. rose from a nominal 14%-17% share to an alltime high of 29%. The Republic of South Africa's share is normally about 30% of the market, and the United States captures 2% to 3%. Canada, the Republic of South Africa, and the U.S.S.R. had more than 90% of the market in 1976.

Usage of asbestos in Japan differs significantly from that in the United States, and is undergoing changes. It is reported that currently, asbestos-cement sheet uses between 50% and 60% of the total consumption of asbestos. This is down from 66% of the 1973 level of consumption. In 1973, 88% of the consumption went into asbestos-cement products. Two reports of product composition seem noteworthy: One states that a few thousand tons of reprocessed asbestos is used each year in asbestos-cement sheets; this is the only report of asbestos recycling use. The other reports that the chrysotile-to-crocidolite ratio in asbestos-cement pressure pipe is always 1:1, which is a higher than normal usage of crocidolite.

Kenya.—Under contract to the Kenyan Government, a joint Kenyan-Austrian team is geologically surveying and mapping a 20,000-square-mile area near Taita-Taveta which is known to have reserves of asbestos and other minerals.

Oman.—Exploration of an asbestos discovery in the northern mountains near Saham continued. The Government hopes to use the fibers in its new 36,000-ton-per-year-capacity asbestos-cement pipe factory.

South Africa, Republic of.—Although the South African asbestos industry is experiencing larger yearend inventories than anticipated, its growth continued. The inventories forced some layoffs in both amosite and crocidolite production personnel. The asbestos production-machinery industry received a 1-million-Rand order for a milling plant in Turkey. South Africa remains firmly in third place among the world's asbestos producers.

Swaziland.—Havelock Asbestos Mines Ltd. announced that, without further adjacent ore body acquisition, its reserves would be exhausted by 1988. The fact that the Swaziland Government is a 40% partner with Turner and Newall Ltd. in the venture may prove helpful.

United Kingdom.—Imports of asbestos into the United Kingdom were 12% less in 1977 than in 1976, and it was a general rather than patterned, decrease. Each supplying country lost some market. The major supplying countries were Canada, with 69%; Swaziland, with 12%; the Republic of South Africa, with 11%; Cyprus, with 6%; and Italy, with 1%. The Asbestos Advisory Committee (ACA) issued the following interim recommendation for exposure to asbestos: 0.2 fiber per cubic centimeter of air for exposure to crocidolite measured over a 10-minute period; and 2.0 fibers per cubic centimeter for other types of asbestos when averaged over a 4-hour period.

U.S.S.R.—The following tabulation is based on planned production data supplied by the Johns-Manville Corp. after some of its officers visited and consulted with Soviet officials during the summer of 1977:

Complex	Thousand short tons		
	1976	1981	1986
Uralasbest:			
Groups 1-6	1,700	1,700	1,700
Group 7	500	500	500
Dzhetygara	725	850	850
Tuvaasbest	100	250	250
Kiembayev	--	275	550
Total	3,025	3,575	3,850

The Molodezhyy asbestos deposit complex was designed in 1974 for construction when the western section of the Baykal-Amur railway is built.

The following, also based on data from Johns-Manville, shows expected U.S.S.R. export distribution, in thousand short tons:

Year	Eastern Europe	Market economy countries	Total exports
1976	275	325	600
1981	375	375	750
1986	500	450	950

Of real interest is that of the planned 825,000-ton increase in production by 1986; less than half is scheduled for export, and only 125,000 tons of the increase is destined for market economy countries.

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Table 8.—Asbestos: World production, by country

(Short tons)

Country[1]	1975	1976	1977[p]
North America:			
Canada (shipments)	1,163,673	1,693,250	1,700,000
Mexico	29	1	--
United States (sold or used by producers)	98,654	114,842	101,704
South America:			
Argentina	1,238	980	972
Brazil	81,547	102,187	[e]105,000
Europe:			
Bulgaria	24,251	[e]22,000	22,000
Finland[2]	3,073	--	--
Italy	[r]162,034	181,649	[e]170,000
U.S.S.R.[e]	2,090,000	2,520,000	2,710,000
Yugoslavia	[r]13,451	14,330	9,994
Africa:			
Egypt	528	1,208	[e]1,210
Rhodesia, Southern[e]	180,000	180,000	220,000
South Africa, Republic of	391,001	407,679	419,059
Swaziland[3]	45,436	46,128	[e]50,000
Asia:			
China, People's Republic of[e]	165,000	190,000	220,000
Cyprus	39,015	38,050	[e]38,600
India	[r]21,999	24,965	22,375
Japan	5,084	8,491	[e]8,800
Korea, Republic of	4,790	5,249	6,812
Taiwan	1,915	940	[e]660
Thailand	--	16	[e]16
Turkey	17,081	10,557	[e]11,000
Oceania: Australia	[r]52,825	60,689	60,627
Total	4,562,624	5,623,211	5,878,829

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the countries listed, Czechoslovakia, North Korea, and Romania also produce asbestos, but output is not officially reported, and available general information is inadequate for the formulation of reliable estimates of output levels.

[2]Includes asbestos flour.

[3]Exports.

TECHNOLOGY

Environmental Research.—At least three papers in 1977 commented on the lack of specificity in the light optical method of identifying asbestos.[5] Because this method is the only one in present OSHA and MESA (Mining Enforcement and Safety Administration) regulations for use in the working environment, enforcement of the regulations is difficult. The National Institute for Occupational Safety and Health (NIOSH) document, for example, states, "This technique is not specific for asbestos fibers or any other fiber type." These papers demonstrate the need for further research in this area. The Rohl document proposes another method of identification, using electron microscopy to count all fibers, including the very short fibers, but acknowledges that the scientific community does not yet know anything of the biological activity of short chrysotile fiber.[6] Another paper reporting on such research describes both the transmission electron microscope (TEM) and the scanning electron microscope (SEM) as equally capable of counting asbestos fibers in circumstances where specificity is not required.[7]

There has been much research aimed at producing asbestos-dust-monitoring equipment for the workplace, and some sophisticated instruments have been developed by at least four companies. One, using beta ray attenuation, has been selected by the Quebec Asbestos Mining Association for both site and personal monitoring. These instruments are also nonspecific for asbestos, and are not useful for identifying asbestos among other particulate matter.

In a health-related matter, a National Academy of Sciences (NAS) publication states that, ". . . evidence of the toxicity of ingested particles of asbestos minerals is not conclusive. Further research is necessary to resolve this problem."[8] While the

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foregoing report was being written, a U.S. Army group was writing another, demonstrating that if the fibers in Lake Superior were asbestos, and if they represented a health hazard, the standard U.S. Army Water Purification Equipment (ERDLater Unit) could be used to completely remove them.[9] The process is interesting: A positively charged cationic polyelectrolyte is added to the water. The electrolyte neutralizes the negatively charged single particles, which then aggregate or"bridge" on the long chain polymer. The resulting larger aggregates are easily filtered out when passed through diatomite.

The effort to isolate the health effects of the various types of asbestos continued. It was made difficult by the fact that most asbestos workers in the manufacturing segment of the industry were probably exposed to two or more types if they worked in that environment long enough to have passed the long "latent" stage of the asbestos-related diseases. The importance of this work lies in the fact that some evidence clearly indicates that at least crocidolite is much more dangerous than chrysotile. Some interesting evidence comes from the Journal of Occupational Medicine, in which a 30-year historical cohort mortality study was made of workers exposed only to chrysotile asbestos.[10] The data demonstrate a favorable mortality experience, and the author concludes that the study suggests that the hazard of chrysotile in asbestos-products manufacturing is minimal and that the study is consistent with what is known of the relative dangers of crocidolite, amosite, and chrysotile, with chrysotile being the least dangerous.

Substitutes.—Although synthesis research on asbestos is still being done, environmental problems involving asbestos have aroused interest and research into finding substitutes. A comprehensive research paper in a leading journal reemphasized that no economic route to asbestos synthesis has been found.[11] The high temperatures (300° to 400° C), hydrothermal pressure, and long time (up to 30 days) for synthesis of submicroscopic chrysotile demonstrate the impracticality, so far, of this approach.

Industrial Minerals magazine, in a mid-year comment, hypothesized that due to the essential nature of asbestos-containing products, limitation on asbestos usage would be possible only when acceptable alternatives exist.[12] The appearance of true alternatives in some areas, such as alkali-resistant glass fiber for reinforcing cement, is acknowledged, but they are said to have a long way to go on both technical and economic grounds. In August, Turner and Newall Ltd. of the United Kingdom announced a new research unit with a first-year budget of $1.3 million for the sole purpose of accelerating the development of asbestos substitutes.

DuPont Co. announced plans for a multimillion dollar Nafion intermediates plant at Fayetteville, N.C., to start production of four intermediate materials necessary to the production of its Nafion perfluorosulfonic acid copolymers. Films of these copolymers are finding increasing use as asbestos replacements in chlorine-caustic diaphragm cells. Japan's planned replacement of all of its mercury cells with asbestos or membrane diaphragms by March 1978 may be delayed by 2 to 3 years owing to the need to evaluate fully the technologic and economic feasibility.

Some uses of alkali-resistant glass fiber being proposed as an asbestos substitute were discussed in an article in The Glass Industry.[13] The two advantages cited were higher impact strength and shatter resistance, plus the lack of known health hazard. Limitations of cost, fiber strength, durability, and incompatibility with asbestos-cement machinery were not discussed. A later announcement by the British firm, Stelmo International Ltd., of three installations being built in Iran may overcome one of these, at least partially. Stelmo claims that the plants are fully automated and can produce glass-fiber-reinforced cement sheets at high speed. A West German design team developed an experimental structure having a load-bearing hyperbolic paraboloid roof in which glass fibers replace the reinforcing steel.[14]

Cape Board and Panels Ltd., a subsidiary of Cape Asbestos Fibers Ltd., developed a new fire-resistant, noncombustible, insulating board comparable to its Asbestolux, but containing no asbestos. Details are sketchy, but probably cellulose fibers and vermiculite in a calcium silicate binder may be major ingredients.

General.—The Quebec Natural Resources Department announced a new method of extracting magnesium from asbestos tailings. However, query of the researchers revealed that although the work looked promising, the announcement was premature.

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Asbestos is among the minerals amenable to the photometric sorting technique developed by Rio Tinto Zinc Ltd. This method uses electronic processing of reflectance measurements to actuate air jets, thereby deflecting selected pieces of ore to another conveyor.

Asbestos cement is the material of choice in building hyperbolic cooling towers. It was used in building Europe's largest towers at the Gösgen nuclear power station in the Federal Republic of Germany. This 499-foot-high tower can reduce the temperature by 14° C of 114,000 cubic meters of water per hour at the station's rated output.

Asbestos-cement pressure pipe was also the material of choice to carry the cooling water necessary for underground transportation of power at a 380-kilovolt range from a West Berlin power station to substations around the city.

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[12]Work cited in footnote 3.

[13]Jones, J. Glass Fiber Reinforced Cement. Glass Ind., v. 58, No. 6, June 1977, pp. 26-28.

[14]Engineering News-Record. Glass Fiber Reinforces Self-Supporting Concrete Roof. V. 198, No. 17, Apr. 28, 1977.

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