Asbestos

By J. M. West [1] and Victoria R. Schreck [2]

ALTHOUGH the United States consumed 24 percent of the world output of asbestos fiber, it supplied only 7 percent of its own requirements. The Nation ranked seventh among world producers and contributed 2 percent of the total output.

LEGISLATION AND GOVERNMENT PROGRAMS

A revised national stockpile purchase specification, P–4–R3, was issued on January 23, 1962, by the Office of Emergency Planning for Government procurement of amosite asbestos. The new specification superseded the one dated August 4, 1959.

Deliveries of Arizona No. 2 chrysotile for the stockpile were completed by one of three contracting operators. The Government continued to acquire amosite and crocidolite asbestos for stockpiling under barter agreements through the U.S. Department of Agriculture.

TABLE 1.—Salient asbestos statistics

	1953–57 (average)	1958	1959	1960	1961	1962
United States:						
Production (sales)—short tons	46,322	43,979	45,459	45,223	52,814	53,190
Value—thousands	$4,740	$5,127	$4,391	$4,231	$4,347	$4,677
Imports for consumption (unmanufactured)—short tons	696,740	644,331	713,047	669,496	[1] 616,529	676,027
Value—thousands	$59,722	$58,314	$65,006	$63,345	$58,942	$64,150
Exports (unmanufactured) [2]—short tons	2,720	3,026	4,461	5,525	3,799	2,949
Value—thousands	$375	$424	$793	$857	$759	$598
Exports of asbestos products (value) [2]—thousands	$12,875	$13,233	$12,921	$13,703	$13,825	$14,274
Consumption, apparent [3]—short tons	740,342	685,284	754,045	709,194	[1] 665,544	726,268
World: Production—do	1,850,000	2,055,000	2,270,000	2,440,000	2,770,000	3,055,000

[1] Revised figure.
[2] Includes reexports.
[3] Measured by quantity produced, plus imports, minus exports.

DOMESTIC PRODUCTION

Asbestos production in the United States increased 1 percent in quantity and 8 percent in value compared with 1961. Most of the rise in value came from California and Vermont sales, although

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the quantity of California fiber sold declined. An estimated 1.1 million tons of rock was mined to produce the 53,000 tons of fiber marketed.

Vermont Asbestos Mines Division of Ruberoid Co. operated its deposit at Belvidere Mountain near Hyde Park, Vt., and continued to be the largest U.S. producer. A small quantity of spinning-length fiber entered into electrolytic cell construction.

Shipments from mines in the Globe district, Arizona, were reported by four companies: Jaquays Mining Corp., Phillips Asbestos Mines, Metate Asbestos Corp., and Pan American Fiber Corp. Jaquays Mining Corp. continued to be the major producer in Arizona. Some fiber was sold for filter purposes. Asbestos Manufacturing Co. mill processed fiber from Phillips Asbestos Mines.

The following California companies reported production and shipments: Jefferson Lake Asbestos Corp., Calaveras County; Coalinga Asbestos Co., Inc., and Todd Industries, Inc., Fresno County; and Asbestos Bonding Co., Napa County. In addition, Union Carbide Nuclear Co. produced and shipped crude ore from its deposit near Coalinga, Fresno County, for experimental purposes in preparation for processing tests at the company's Kings City, Calif., pilot plant (under construction). Two companies discontinued mining operations, Rawhide Asbestos Corp. in Tuolumne County and Todd Industries, Inc., in Fresno County. Small quantities of chrysotile were produced and sold by the Coast Asbestos Co., from its Grant County, Oreg., mine. The Burnsville mine of Powhatan Mining Co., located in Yancy County, N.C., was the only domestic source of amphibole asbestos.

A number of articles were published about new mining and milling operations in California.[3]

The new plant of Jefferson Lake Asbestos Co., located near Copperopolis, went into production late in 1962 with capacity rated at 70,000 tons of fiber annually. Several shipments went to Japan, which was expected to be an important market, especially for grades 5R and 6D, used in the manufacture of asbestos cement sheet. The Coalinga Asbestos Co. mill, northwest of Coalinga, began operating at an initial capacity of 12,000 tons per year, and the first shipment of fiber was made in March to the Johns-Manville Corp. tile plant in Louisiana. Prices on two floor tile grades, a "Red" and a "Blue" brand, were quoted at $75 and $100 per ton, respectively. A "Green" brand was also produced. Hidden Splendor Mining Co., a subsidiary of Atlas Corporation, began work on a mill to have an initial capacity of 15,000 tons expandable to 25,000 tons of fiber per year at its property northwest of Coalinga in Fresno and San Benito Counties. Claims held by Asbestos Corporation, Ltd., were investigated.

[3] Chemical and Engineering News. New Mills Set To Turn Out California Asbestos. V. 40, No. 22, May 28, 1962, pp. 36–37.
Huttl, John. Jefferson Lake—California's Premier Asbestos. Eng. and Min. J., v. 163, No. 10, October 1962, pp. 84–89.
Merritt, Paul C. California Asbestos Goes To Market. Min. Eng., v. 14, No. 9, September 1962, pp. 57–60.
Mining World. Asbestos Awakens Mother Lode. V. 24, No. 10, September 1962, pp. 22–27.
Munro, Robert C., and Kenneth M. Reim. Coalinga—Newcomer to the Asbestos Industry. Min. Eng., v. 14, No. 9, September 1962, pp. 60–62.
Utley, Harry F. Asbestos Boom in California. Pit and Quarry, v. 55, No. 6, December 1962, pp. 76–80, 85.

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CONSUMPTION AND USES

Consumption of chrysotile asbestos increased from 666,000 tons in 1961 to 726,000 tons. Short-fiber asbestos, consumed largely in the manufacture of asbestos cement and asphalt building materials, comprised 97 percent of all fiber used. Domestic mines supplied 8 percent of all short-fiber chrysotile consumed. Crocidolite consumption, represented by imports, decreased from 18,000 tons in 1961 to 17,000 tons.

STOCKS

On December 31, national stockpile inventories were as follows: Amosite, 11,705 tons; chrysotile, 6,222 tons; and crocidolite (soft), 1,567 tons. Supplemental and Commodity Credit Corporation stockpiles, including asbestos obtained under barter, contained the following: Amosite, 20,597 tons; chrysotile, 5,532 tons; and crocidolite, 19,486 tons. Also, 2,348 tons of non-stockpile-grade chrysotile was held in the Defense Production Act stockpile. Maximum objectives remained at 45,000 tons for amosite and 11,000 tons for chrysotile. No objective was set for crocidolite. Government stocks of chrysotile were 230 tons higher on December 31, 1962, than on December 31, 1961.

PRICES

Canadian (Quebec) chrysotile asbestos prices, f.o.b. mine, were unchanged as follows:

Grade:	*Per short ton*
Crude No. 1	Can$1,410 to Can$1,475
Crude No. 2—Crude run of mine and sundry	610 to 875
No. 3—Spinning fiber	350 to 650
No. 4—Shingle fiber	180 to 245
No. 5—Paper fiber	120 to 150
No. 6—Waste, stucco, or plaster	86
No. 7—Refuse or shorts	40 to 80

Prices for British Columbia chrysotile asbestos, f.o.b. Vancouver, from Cassiar Asbestos Corp., Ltd., were as follows:

Grade:	*Per short ton*
No. 1 crude (C–1)	Can$1,522
AAA	787
AA	625
A	470
AC	325
AK	220
AS	181
AX	142
Talus	210

Vermont asbestos prices, f.o.b. Hyde Park or Morrisville, remained unchanged as follows:

Grade:	*Per short ton*
Group No. 3—Spinning and filtering	$345 to 402
Group No. 4—Shingle fiber	181 to 320
Group No. 5—Paper fiber	120 to 142
Group No. 6—Waste, stucco, or plaster	86
Group No. 7—Refuse or shorts	40 to 75

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Asbestos magazine published Arizona asbestos prices, f.o.b. Globe, as follows:

Grade:	Per short ton 1961	Mar. 10, 1962
No. 1 soft	$1,650 to $1,800	$1,475 to $1,650
No. 2 soft	800 to 1,000	800 to 1,000
Group 3—Filtering and spinning	375 to 450	425 to 450
Group 4—Plastic and filtering	225 to 250	385 to 400
Group 5—Plastic and filtering	190 to 225	225 to 375
Group 7—Refuse and shorts	58 to 90	58 to 90

Market quotations were not available for African, Australian, and South American asbestos because sales were negotiated privately. The following average values were calculated from U.S. Department of Commerce import data:

Imports:	Per short ton 1961	1962
Amosite	$163	$164
Crocidolite:		
Bolivia	182	---
Australia	209	201
South Africa, Republic of	202	221

FOREIGN TRADE [4]

Imports of amosite and chrysotile increased 36 and 9 percent, respectively, and crocidolite decreased 4 percent, resulting in an overall increase of 9 percent in total asbestos imports in 1962.

Low-iron chrysotile imports of spinning-length fibers from British Columbia decreased from 5,374 tons in 1961 to 5,077 tons. Ninety-seven percent of all chrysotile imported was short fiber of less than spinning length.

The Republic of South Africa supplied crocidolite and chrysotile and was the only source of amosite. Imports from Australia consisted solely of crocidolite. The total of crocidolite imports from these two countries was 17,127 tons. An additional ton was imported from Bolivia. Finland supplied anthophyllite, and only chrysotile was imported from other countries.

Exports of unmanufactured asbestos decreased from 3,572 tons in 1961 to 2,824 tons.

Imports included 7,633 tons of amosite and 8,270 tons of crocidolite acquired for the Government's supplemental stockpile.

[4] Figures on imports and exports compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign Activities, Bureau of Mines, from records of the U.S. Department of Commerce, Bureau of the Census.

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TABLE 2.—U.S. imports for consumption of asbestos (unmanufactured), by classes and countries [1]

Year and country	Crude (including blue fiber)		Textile fiber [2]		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1961:								
North America: Canada	437	$60,097	16,903	$6,163,364	552,713	$44,713,557	570,053	$50,937,018
South America: Bolivia	50	9,090					50	9,090
Europe:								
Finland					[3] 165	14,500	[3] 165	14,500
Italy [2]	[3] 3	[3] 6,120			110	16,530	113	22,650
Portugal [2]	8	645					8	645
Yugoslavia	5,194	173,260					5,194	173,260
Africa:								
Rhodesia and Nyasaland, Federation of [2 4]	[3] 2,469	[3] 616,424			[3] 753	[3] 132,559	[3] 3,222	[3] 748,983
Union of South Africa [2]	[3] 33,335	[3] 6,182,426	18	5,349	[3] 2,057	[3] 365,388	[3] 35,410	[3] 6,553,163
Oceania: Australia	2,314	482,764					2,314	482,764
Total	[3] 43,810	[3] 7,530,826	16,921	6,168,713	[3] 555,798	[3] 45,242,534	[3] 616,529	58,942,073
1962:								
North America: Canada	232	55,411	14,816	5,875,484	608,757	49,003,906	623,805	54,934,801
South America: Bolivia [5]	1	300					1	300
Europe:								
Finland					440	18,150	440	18,150
Italy [2]	9	10,585			28	5,123	37	15,708
Portugal [2]					23	2,374	23	2,374
Yugoslavia	3,444	119,614			11	542	3,455	120,156
Africa:								
Rhodesia and Nyasaland, Federation of [2]	4,171	859,177			1,908	366,056	6,079	1,225,233
South Africa, Republic of [2 6]	30,250	5,514,426			4,412	803,274	34,662	6,317,700
Oceania: Australia	7,525	1,515,323					7,525	1,515,323
Total	45,632	8,074,836	14,816	5,875,484	615,579	50,199,425	676,027	64,149,745

[1] In Minerals Yearbook 1961, page 285, table 2, the 1960 total of short fibers should read 472,164 short tons instead of 5,472,164 short tons.
[2] Data reported by the Bureau of the Census have been adjusted by the Bureau of Mines.
[3] Revised figure.
[4] All believed to be from Southern Rhodesia.
[5] Reported by the Bureau of the Census as Chile.
[6] Effective Jan. 1, 1962; formerly Union of South Africa.

Source: Bureau of the Census.

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TABLE 3.—U.S. imports for consumption of asbestos, from specified countries, by grades

(Short tons)

Grade	1961			1962		
	Canada	Southern Rhodesia [1]	Union of South Africa [2]	Canada	Southern Rhodesia [1]	Republic of South Africa [2 3]
Chrysotile:						
Crudes	437	[4] 2,469	2,856	232	4,171	413
Spinning or textile	16,903		18	14,816		
All other	552,713	[4] 753	2,057	608,757	1,908	4,412
Crocidolite (blue)			[4] 15,501			9,602
Amosite			14,978	[5]		20,235
Total	570,053	[4] 3,222	[4] 35,410	623,805	6,079	34,662

[1] Reported by the Bureau of the Census as Federation of Rhodesia and Nyasaland. Believed to be from Southern Rhodesia. Excludes data adjusted by the Bureau of Mines.
[2] Includes data adjusted by the Bureau of Mines.
[3] Effective Jan. 1, 1962; formerly Union of South Africa.
[4] Revised figure.
[5] Excludes data adjusted by the Bureau of Mines.

TABLE 4.—U.S. exports [1] and reexports [2] of asbestos and asbestos products

Product	1961		1962	
	Quantity	Value	Quantity	Value
Exports:				
Unmanufactured:				
Crude and spinning fibers, short tons	1,064	$281,444	655	$162,130
Nonspinning fibers, do	1,084	256,261	968	204,797
Waste and refuse, do	1,424	170,755	1,201	211,456
Total unmanufactured, do	3,572	708,460	2,824	578,383
Products:				
Brake lining and blocks—molded, semimolded, and woven	[3]	4,192,908	[3]	4,645,844
Clutch facing and lining, number	1,452,435	1,149,299	2,277,461	1,561,659
Construction materials, n.e.c., short tons	11,300	2,980,726	9,064	2,343,404
Pipe covering and cement, do	2,627	1,485,640	2,890	1,242,752
Textiles, yarn, and packing, do	1,288	3,106,542	1,453	3,311,355
Manufactures, n.e.c.	[4]	889,625	[4]	1,164,908
Total products		13,804,740		14,269,922
Reexports:				
Unmanufactured:				
Crude and spinning fibers, short tons	108	24,175	95	14,193
Nonspinning fibers, do	106	26,003		
Waste and refuse, do	13	594	[5] 30	5,437
Total Unmanufactured, do	227	50,772	125	19,630
Products:				
Brake lining and blocks—molded, semimolded, and woven	[3]	1,580	[3]	1,905
Construction materials, n.e.c., short tons	63	18,353	7	1,756
Textiles, yarn, and packing, do	1	228		
Total products		20,161		3,661

[1] Materials of domestic origin, or foreign material that has been milled, blended, or otherwise processed in the United States.
[2] Material that has been imported and later exported without change.
[3] Values have been summarized; quantities not shown.
[4] Quantity not recorded.
[5] Adjusted by Bureau of Mines.

Source: Bureau of the Census.

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WORLD REVIEW [5]

NORTH AMERICA

Canada.—Asbestos shipments in 1962 set a record of more than 1.2 million tons. More than 95 percent of 1961 shipments were exported.[6] Employment at Canadian asbestos mines and mills in 1961 totaled 6,875 workers.

Canadian Johns-Manville Co., Ltd., operated the Jeffrey mine, Asbestos, Quebec, close to capacity during 1962. The return of the mine to open-pit operation was essentially completed. An inclined skipway was installed for removing waste from the pit. Explorations for asbestos were conducted by the company between Amos and Barraute in northwestern Quebec. The company managed development operations at the Advocate Mines, Ltd. property, Baie Verte, northern Newfoundland, where stripping of waste continued in preparation for production to start in mid-1963. Output was expected to exceed 40,000 tons of fiber annually, mainly group 4 for use in asbestos-cement products.

Asbestos Corporation Ltd. exchanged shares equivalent to a 10-percent interest with Eternit S.A. of Belgium. A long-term contract for purchase of asbestos from the Canadian company was included in the agreement. Ore reserves at the end of 1962 were, in million tons: King-Beaver, 12.4; British Canadian, 46.9; Normandie, 20.3; and others, 14.2. A total of 4.6 million tons of ore was milled, and 10.9 million tons of barren rock excavated. More than 1 million tons of overlying waste was stripped from the ore body at the Normandie mine. A pilot plant for producing finely ground asbestos filler was installed at the mine.

An option was taken by Asbestos Corporation Ltd. on the Murray Mining Corp. Ltd., Asbestos Hill property, south of Deception Bay in the Ungava area, northern Quebec. Exploration and plans for development continued.

Production by Lake Asbestos of Quebec Ltd., a subsidiary of American Smelting and Refining Company, totaled 100,612 tons, compared with 95,042 tons in 1961. Ore reserves were increased at the company's Black Lake, Quebec, mine by continued development work on the open pit.

Several exploration holes were drilled by Bornite Copper Corp. on its prospect in Cleveland Township, near Asbestos, Quebec. A deposit 1,000 feet or more long and 140 feet wide was indicated. Assays were from 6.4 to 9.7 percent fiber and floats, mainly classified as shorts. A magnetometer survey was completed over the northeast part of the deposit.

National Gypsum Co. initiated an expansion program to increase capacity at its Thetford Mines, Quebec, property.

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[5] Values in this section are U.S. dollars based on the average rate of exchange by the Federal Reserve Board unless otherwise specified.

[6] Dominion Bureau of Statistics, Industry and Merchandising Division (Ottawa, Canada). The Asbestos Industry, 1961. Annual Rept. No. 26–205, October 1962, 10 pp.

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TABLE 5.—World production of asbestos by countries [1] [2]

(Short tons)

Country [1]	1953–57 (average)	1958	1959	1960	1961	1962
North America:						
Canada (sales) [3]	991,896	925,331	1,050,429	1,118,456	1,173,695	1,223,509
United States (sold or used by producers)	46,322	43,979	45,459	45,223	52,814	53,190
Total	1,038,218	969,310	1,095.888	1,163,679	1,226.509	1,276,699
South America:						
Argentina	429	285	320	[4] 330	[4] 330	[4] 330
Bolivia (exports)	205	----------	168	66	57	56
Brazil	2,738	3,816	12,325	14,590	[4] 18,700	[4] 18,750
Venezuela	3,223	9,152	5,095	4,333	650	----------
Total	6,595	13,253	17,908	19,319	[4] 19,750	[4] 19,150
Europe:						
Austria	----------	----------	----------	215	564	503
Bulgaria	1,146	1,100	1,100	1,200	1,200	[4] 1,100
Finland [5]	11,567	7,932	9,579	10,534	10,339	10,869
France	13,641	20,742	23,360	28,662	30,746	27,558
Italy	33,059	42,500	49,778	56,672	62,816	61,233
Portugal	58	98	40	144	21	----------
Spain	35	----------	19	4	11	----------
U.S.S.R [4]	425,000	550,000	600,000	660,000	880,000	1,100,000
Yugoslavia	4,465	5,960	4,748	5,970	6,709	7,401
Total [4]	490,000	630,000	690,000	765,000	990,000	1,210,000
Asia:						
China [4]	22,000	65,000	90,000	90,000	90,000	90,000
Cyprus	15,379	16,494	14,424	23,316	16,207	19,993
India	1,221	1,302	1,464	1,886	1,618	1,705
Japan	8,290	11,187	13,633	17,042	18,799	15,550
Korea, Republic of	90	22	88	740	341	1,333
Philippines	----------	----------	56	36	83	1,037
Taiwan	190	47	150	485	44	525
Turkey	208	839	411	238	496	709
Total [4]	47,000	95,000	120.000	135.000	128,000	130,000
Africa:						
Bechuanaland	1,185	2,265	1,410	1,282	1,924	2,375
Kenya	164	120	43	117	151	[4] 150
Morocco	467	----------	----------	----------	----------	----------
Mozambique	170	198	37	22	162	110
Rhodesia and Nyasaland, Federation of: Southern Rhodesia	104,811	127,115	119,699	133,963	161,610	142,196
South Africa, Republic of	123,532	175,644	182.405	175,867	194,834	221,302
Swaziland	30,692	25,261	24,806	32,027	30,792	32,830
United Arab Republic (Egypt)	49	485	502	496	254	[4] 250
Total	261,070	331,088	328,902	343.774	389.727	399.213
Oceania:						
Australia	8,244	15.570	17,875	15,613	16,746	18,392
New Zealand	154	454	640	319	373	[4] 375
Total	8,398	16.024	18.515	15.932	17,119	18,767
World total (estimate) [1] [2]	1,850,000	2,055,000	2,270,000	2,440,000	2,770,000	3,055,000

[1] Asbestos also is produced in Czechoslovakia, Eritrea, North Korea, and Rumania. No estimates for these countries are included in the total, as production is believed to be negligible.

[2] This table incorporates some revisions. Data do not add to totals shown because of rounding where estimated figures are included in the detail.

[3] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1953–57 (average) 27,042 tons; 1958, 18,449 tons; 1959, 29,532 tons; 1960, 51,624 tons; 1961, 41,696 tons; 1962, data not available.

[4] Estimate.

[5] Includes asbestos flour.

Compiled by Helen L. Hunt, Division of Foreign Activities.

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TABLE 6.—Canada: Sales of asbestos by grades

Grade	1961			1962		
	Short tons	Value		Short tons	Value	
		Total (thousands)	Average per ton		Total (thousands)	Average per ton
Crude No. 1, 2, and other	163	$132	$810			
Milled group:						
3	29,296	10,619	362			
4	339,082	56,874	168	[1] 1,223,509	(2)	(2)
5	179,852	20,359	113			
6	193,467	14,461	75			
7	423,116	15,916	38			
8	8,719	164	19			
Total, all grades	1,173,695	118,525	101	[1] 1,223,509	(2)	(2)
Waste rock	41,696	35	1	(2)	(2)	(2)

[1] Breakdown by grades not available.
[2] Data not available.

Source: Dominion Bureau of Statistics

At Roberge Lake, northwestern Quebec, McAdam Mining Corp. drilled a 500-foot hole to explore a magnetic anomaly northeast of the main asbestos zone. The main zone was reported to contain 15 million tons of ore averaging about $5 per ton in fiber value. A third zone was indicated by a magnetometer survey. Central Asbestos Mines conducted magnetometer surveys of claims in the Thetford Mines area and Coleraine Township, Quebec. Recoveries from bulk tests in the pilot plant at the Hedman Mines Ltd. property in Warden and Munro Townships, 25 miles northeast of Matheson, Ontario, averaged about $25.50 per ton in value. Reserves available through open-pit mining to a depth of 300 feet were estimated at 8.5 million tons. Design of a large mill was nearly completed.

The main shaft at the Munro mine of Canadian Johns-Manville Co., Ltd., was deepened 300 feet below the 637-foot level in preparation for a second production level. Work continued on the westward extension of the 637-foot level. Two grades of fiber were produced.

Operations at the Cassiar Asbestos Corp. Ltd. mine in British Columbia continued through the winter months. During 1962 720,000 tons of ore was mined and 2,358,000 tons of waste rock stripped. Ore milled totaled 535,000 tons, consisting of 295,000 tons of concentrate from the rock-rejection circuit and 240,000 tons of mine-run ore. Plans were made to move the crushing plant to a lower level and to install a larger crusher. Recovery of AK and AX grades was to be improved. Ore reserves were sufficient for 30 years of production at the current rate. The parent company, Conwest Exploration Co., Ltd., leased waterfront property in North Vancouver, British Columbia, and planned a $1 million improvement in dock facilities. An option on an asbestos prospect southeast of Atlin on the Taku River, British Columbia, was dropped.

SOUTH AMERICA

Brazil.—The mine of Mineracão de Amianto, S.A., at Djalma Dutra (Pocões), Bahia, continued production. Sales of chrysotile to Bra-

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zilian ports totaled 1,279 tons in 1962. A pilot plant reportedly was constructed for processing fiber from newly discovered deposits in Batalha, Alagoes.

EUROPE

Greece.—Developmental work was continued on an extensive deposit of asbestos at Kozani by Kenbestos Corp., a subsidiary of Kennecott Copper Corp. A plant to produce asbestos-cement products was planned.

Ireland.—Exploratory drilling of a deposit near Sligo on the northwest coast was planned by Northern Canada Mines, Ltd.

United Kingdom.—A $3 million asbestos-cement-products plant, the largest in Europe, was opened at Widnes in northwest England.

Yugoslavia.—An established plant, Antisa Vucicic Salonite, began producing large-diameter asbestos-cement pipe partly for export. An asbestos-yarn plant began operating at Poloce on the Adriatic. Means for improving the mining and processing of asbestos were studied by an American, Dr. Arthur B. Cummins, under an International Cooperative Administration contract.

ASIA

Cyprus.—All production was exported, except for a few hundred tons that was used annually for domestic manufacture of asbestos-cement sheeting. Reserves at the Cyprus Asbestos Mines, Ltd., deposit below the summit of Mount Olympus near Amiandos were large, but the fiber content was generally less than 1 percent.

India.—Imports of asbestos totaled 21,679 tons valued at $4,935,000 in 1961, compared with 24,315 tons valued at $5,670,000 in 1960. Domestic asbestos was a suitable substitute for imported fiber in the manufacture asbestos-cement pipe in a process developed by Central Fuel Research Institute.[7]

Viet-Nam.—Plans were announced by Eternit Vietnam for an asbestos-cement plant at Saigon having an annual capacity of 10,000 tons.

AFRICA

Bechuanaland.—Exports totaled 1,852 tons valued at $450,527 in 1961. An aerial magnetometer survey was conducted, mainly over southern portions of the territory, in search of asbestos and other minerals.

Mozambique.—Long-fiber tremolite was produced from the Mavita mine of Sociedade Mineira de Mavita, Lda., south of Vila Manica near the Rhodesian border, and exported to several countries including the United States for asbestos-cement manufacture.

Rhodesia and Nyasaland, Federation of.—Crude asbestos exports, mostly from Turner and Newall, Ltd., mines at Shabani and Mashaba, totaled 133,516 tons valued at $23,637,000 in 1961. The tonnages were distributed as follows, in percent: United Kingdom, 57; Czechoslovakia, 8; Poland, 2; United States, 1; and other countries, 32. As-

[7] Journal of Mines, Metals and Fuels (Calcutta, India). Asbestos Cement Pipes From Indian Asbestos. V. 10, No. 9, September 1962, pp. 29, 31.

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bestos contributed $24.5 million, or 32 percent of the total value of Southern Rhodesia's mineral production in 1961. Turner and Newall, Ltd., mines produced 67 percent of the tonnage and 78 percent of the value of the fiber.

TABLE 7.—Southern Rhodesia: Asbestos production

Year	Short tons	Value (thousands)	Year	Short tons	Value (thousands)
1958	127.115	$24,147	1961	161,610	$24,453
1959	119,699	20,735	1962	142,196	20,467
1960	133,963	20,888			

Expansion of the Pangani Asbestos Mines (Pvt.), Ltd., operations near Filabusi, Southern Rhodesia, was announced. Three ore bodies containing reserves estimated to total 5.5 million tons of fiber were being prepared for open-pit mining. An output of 30,000 tons of fiber per year was anticipated. The fiber was expected to be sold mainly to asbestos manufacturers in Europe, and some to users in South America, South Africa, and the Far East.[8]

The Honeybird mine, a small producer at Shabani owned by Mashaba Rhodesian Asbestos Co., Ltd., was closed. The sinking of an 1,100-foot inclined shaft at the Ethel mine in the northern Umvukwes region was described.[9]

South Africa, Republic of.—Breakdowns of the 1960 and 1961 exports by varieties and countries were published.[10] A vertical shaft 1,356 feet deep was placed in operation at the Penge mine (the world's only important producer of amosite asbestos) operated by subsidiaries of Cape Asbestos S.A. (Pty.), Ltd. Reserves at levels below 500 feet exceeded previous estimates, and plans were made to increase production from 70,000 to 85,000 tons of fiber per year by 1963.

Cape Blue Mines (Pty.), Ltd., a subsidiary of Cape Asbestos S.A. (Pty.), Ltd., with the Koegas and Pomfret mines, was the world's largest producer of crocidolite. Griqualand Exploration and Finance Co., Ltd., was the second largest producer, with 30 percent of the total output coming from six small mines near Kuruman. The company developed several deposits in the same area in a joint venture with Federale Mynbou Beperk, and also acquired the Sterkspruit chrysotile mine in the eastern Transvaal. Kuruman Cape Blue Asbestos (Pty.), Ltd. was the third largest crocidolite producer; it operated three mines in the Kuruman area and was developing a fourth. The Msauli mine of Msauli Asbestos Mining and Exploration Co., Ltd., in the Barberton district, produced nearly half of the domestic chrysotile. Barberton Chrysotile Asbestos Ltd. and African Asbestos-Cement Corp., Ltd., were other important producers. The latter company recovered 4,003 tons of fiber from 81,106 tons of ore milled during the year ending June 30, 1962.

Swaziland.—Mineral Holdings Ltd. explored a chrysotile deposit near the Transvaal border.

[8] Rhodesian Mining and Engineering (Salisbury, Southern Rhodesia). Top-Class Equipment for Use in Pangani Development. V. 27, No. 13, December 1962, pp. 34–35.
[9] Chambers, D. W. New Layout at Ethel Asbestos No. 3 Shaft. Rhodesian Min. and Eng. (Salisbury, Southern Rhodesia), v. 27, No. 1, January 1962, pp. 20–22.
[10] Bureau of Mines. Mineral Trade Notes. V. 55, No. 2, August 1962, pp. 7–9.

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TABLE 8.—Republic of South Africa: Asbestos production, by varieties and sources

(Short tons)

Variety and source	1958	1959	1960	1961	1962
Amosite (Transvaal)	69,773	71,720	68,630	69,234	74,883
Chrysotile (Transvaal)	27,403	29,326	29,471	31,726	29,993
Blue (Transvaal)	16,670	13,113	11,185	11,176	14,296
Blue (Cape)	61,520	68,024	66,567	82,624	102,034
Tremolite (Transvaal)	278	222	14	74	96
Total	175,644	182,405	175,867	194,834	221,302

TABLE 9.—Republic of South Africa: Production and exports of asbestos

Year	Production (short tons)			Exports	
	Transvaal	Cape Province	Total	Short tons	Value (thousands)
1958	114,124	61,520	175,644	145,796	$25,420
1959	114,381	68,024	182,405	151,515	25,971
1960	109,300	66,567	175,867	174,810	28,965
1961	112,210	82,624	194,834	180,684	29,830
1962	119,268	102,034	221,302	184,170	30,787

OCEANIA

Australia.—The 1961 production consisted of 969 tons of chrysotile valued at $88,939 and 15,777 tons of crocidolite valued at $1,404,153.

TECHNOLOGY

Research on asbestos synthesis resulted in the description of properties of palygorskite, a potentially useful asbestiform mineral,[11] and of a synthetic magnesio-fluor-richterite that had some flexibility.[12]

The Jeffrey mine, Quebec Province, Canada, resumed open-pit operations using new skipways[13] and improved fragmentation with inclined drill holes.[14]

Papers given at the Industrial Minerals Division Joint Meeting of the Canadian Institute of Mining and Metallurgy and the American Institute of Mining, Metallurgical and Petroleum Engineers at Ottawa, Canada, in October 1961 covered geology of the asbestos belt in Southeastern Quebec,[15] mining and milling practices,[16] and testing and quality-control methods.[17] A short historical review of the development of the asbestos industry in Canada was published.[18]

[11] Huggins, Charles W., M. V. Denny, and H. R. Shell. Properties of Palygorskite, an Asbestiform Mineral. BuMines Rept. of Inv. 6071, 1962, 17 pp.

[12] Huggins, Charles W. Electron Micrographs of Some Unusual Inorganic Fibers. BuMines Rept. of Inv. 6020, 1962, 27 pp.

[13] Brigham, S. K. Conversion to Open Pit Skipway Operation at Jeffrey Mines. Canadian Min. and Met. Bull. (Montreal), v. 55, No. 599, March 1962, pp. 146–149.

[14] Milosevic, M. I. Inclined Drilling Proves Best. Eng. and Min. J., v. 163, No. 3, March 1962, pp. 86–90.

[15] Riordon, P. H. Geology of the Asbestos Belt in Southeastern Quebec. Canadian Min. and Met. Bull. (Montreal), v. 55, No. 601, May 1962, pp. 311–313; v. 55, No. 603, July 1962, p. 500.

[16] Gartshore, J. L. The Quebec Asbestos Industry: Mining and Milling. Canadian Min. and Met. Bull. (Montreal), v. 55, No. 602, June 1962, pp. 400–402.

[17] Wiser, J. P. The Quebec Asbestos Industry: Testing and Quality Control. Canadian Min. and Met. Bull. (Montreal), v. 55, No. 602, June 1962, pp. 403–405.

[18] Woodrooffe, H. M. One Hundred Years of Asbestos in Canada. Eng. J. (Montreal), v. 45, No. 6, June 1962, pp. 49–50.

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Theories of the origin of serpentine and chrysotile in the Matheson area of northern Ontario were discussed. The host rocks resulted from local differential fusion of the peridotite substratum followed by multiple injection. Evidence indicated deposition of chrysotile in fissure veins from aqueous solutions, as replacements after picrolite, and as replacement veins in dunite and peridotite.[19]

Anthophyllite asbestos was found in Precambrian metasediments in Fremont County, Colo. Anthophyllite content ranged from trace amounts to 41 percent in some specimens. Dark silky green rocks having the highest content were characterized by radiating and sheaf-like clusters of anthophyllite.[20]

Open-pit mining and milling practices at the Vermont Asbestos Mines in Lamoille and New Orleans Counties, Vt., were described. Methods of exploration, sampling, and evaluation were outlined, and cost data were given for a recent year.[21]

Long-hole drilling was employed to advantage in an Eastern Transvaal asbestos mine. Exploration by percussion drill to depths of 80 feet and more revealed ore bodies that were missed in previous mining.[22]

Aromatic hydrocarbons and amino acids were detected in trace amounts of oil extracted from South African crocidolite and amosite samples and from the ironstone country rocks as well.[23]

Grading requirements were reported for anthophyllite from Finland; both descriptive and test data were supplied.[24]

Organic substances were extracted from asbestos products by a newly patented process using a heated aqueous solution containing acid salts of alkali silicates and phosphates.[25]

An improvement in the conventional fiber opening and cleaning apparatus was patented. Unopened fiber was retained by spikes spaced along the inner surface of a tube and beaten by fan blades or other means.[26]

In another design for fiberization, a pair of contrarotating beaters broke clumps of fiber by throwing them against a rotating cylindrical screen.[27] A Soviet patent was issued for a fiber-opening technique in which crude asbestos fiber bundles were saturated with heated acidulated water, pressurized at 30 to 32 atmospheres, and exploded into a chamber heated to 250° C.[28] To eliminate such impurities as magnetite and picrolite, especially from shingle and paper grades of fiber,

[19] Grubb, P. L. C. Serpentinization and Chrysotile Formation in the Matheson Ultrabasic Belt, Northern Ontario. Econ. Geol., v. 57, No. 8, December 1962. pp. 1228–1246.
[20] Salotti, Charles A. Anthophyllite Within the Albite-Epidote Hornfels Facies, Fremont County, Colo. Am. Miner., v. 47, No. 9–10, September–October 1962, pp. 1055–1066.
[21] Burmiester, H. L., and I. E. Matthews. Mining and Milling Methods and Costs, Vermont Asbestos Mines, The Ruberoid Co., Hyde Park, Vt. BuMines Inf. Circ. 8068, 1962, 43 pp.
[22] Mining Magazine (London). Prospecting by Long-Hole Drilling. V. 106, No. 5, May 1962, pp. 285–286.
[23] Harington, J. S. Natural Occurrence of Amino Acids in Virgin Crocidolite Asbestos and Banded Ironstone. Science, v. 138, No. 3539, Oct. 26, 1962, pp. 521–522.
[24] Asbestos. Quality Descriptions for Finnish Anthophyllite Asbestos Fibers. V. 44, No. 2, August 1962, pp. 12. 14, 16.
[25] Burger, Walter, and Helmut Lübbe (assigned to Flammer Seifenwerke K.G., Germany). Process for the Treatment of Asbestos. U.S. Pat. 3,065,114, Nov. 20, 1962.
[26] Barett, I. (assigned to Johns-Manville Corp.). Fiber Opening and Cleaning. U.S. Pat. 3,042,976, July 10, 1962.
[27] Christian, J. D. (assigned to Cassiar Asbestos Corp., Ltd., Toronto, Canada). Apparatus for Cleaning and Grading Asbestos. U.S. Pat. 3,021,008, Feb. 13, 1962.
[28] Kruglov, S. Ya., and D. M. Mnushkin. U.S.S.R. Pat. 144,008, Jan. 27, 1962.

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an aqueous suspension containing a colloidizing agent was strained through a screen.[29]

Asbestos in the form of a mat, woven fabric, or rovings was embedded in metal castings as reinforcement.[30] A method was patented for spraying roofs and walls of coal mines with a mixture of asbestos fibers or floats and limestone to reduce the danger of explosion and provide better illumination.[31]

Patents were also issued for the following: Filter paper capable of filtering particles 0.3 micron or less made from a mixture of ultra-refined- and intermediate-grade asbestos;[32] a process in which asbestos was ball-milled with an alkali-stabilized silica sol, and the resulting colloidally dispersed fiber used for a semitransparent, shiny, hard, and flameproof coating on paper,[33] a method of forming a brine-impervious asbestos diaphragm for electrolytic cells used in the production of alkali metals;[34] a plastic paving and surfacing mixture containing asbestos fibers and fines;[35] and fertilizer sticks with asbestos filler.[36]

New and improved products included fire-retardant plywood containing a lightweight asbestos foam core,[37] gasket material designed to swell without disintegrating,[38] asbestos-Teflon gasketing for cryogenic temperatures,[39] epoxy-lined asbestos-cement pipe,[40] and a polyester laminate for electrical insulation that was reported to be superior to glass-polyesters.[41]

Clotting during the blending of asbestos for paper-making was reduced when 7R fiber grade was used instead of 5R. The view was expressed that fiber longer than a few millimeters contributed nothing to paper strength.[42]

Asbestos-cement pipe was tested for sulfate resistance and found to be adversely affected by free lime. Autoclave formulation and curing using regular type I cement resulted in pipe with sulfate resistance about equal to that normally obtained with special type V cement.[43]

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[29] Novak, I. J. (assigned to Raybestos-Manhattan, Inc.). Refinement of Asbestos. U.S. Pat. 3,035,698, May 22, 1962.
[30] Kremer, H. Strengthening of Metal. U.S. Pat. 3,038,248, June 12, 1962.
[31] Streib, W. C., and J. G. Rowe III (assigned to Johns-Manville Corp.). Asbestos Fibers-in Mine Roof Coatings. U.S. Pat. 3,055,434, Sept. 25, 1962.
[32] Poelman, A. J. J., and M. A. Germain (assigned to Etablissements R. Schneider and Bernard Dumas & Cie., France). Filter Papers. U.S. Pat. 3,034,981, May 15, 1962.
[33] Barbaras, G. D. (assigned to E. I. du Pont de Nemours & Co., Inc.). Film Forming Composition. U.S. Pat. 3,057,744, Oct. 9, 1962.
[34] Carling, W. W. (assigned to Pittsburgh Plate Glass Co.). Electrolytic Cell Diaphragm. U.S. Pat 3,057,794, Oct. 9, 1962.
[35] Sucetti, G. Paving and Surfacing Composition. U.S. Pat. 3,063,853, Nov. 13, 1962.
[36] Gessler, A. A. Fertilizer Sticks. U.S. Pat. 3,057,713, Oct. 9, 1962.
[37] Business Week. Asbestos-Based Plywood Panels Meet Fire Code Specifications. No. 1752, Dec. 29, 1962, p. 86.
[38] Materials in Design Engineering. Asbestos Gaskets Have High Positive Swell. V. 56, No. 6, November 1962, pp. 180, 184.
[39] Materials in Design Engineering. Cryogenic Gaskets Resist Acids, Solvents. V. 55, No. 3, March 1962, p. 189.
[40] Chemical Engineering. Epoxy-Lining Provides Good Corrosion Resistance, Glasslike Surface. V. 69, No. 15, July 23, 1962, p. 88.
[41] Materials in Design Engineering. Electrical Insulation. V. 55, No. 4, April 1962, pp. 10–11.
[42] Keppel, Reuben A., and Robert D. Walker, Jr. Paper From Inorganic Fibers. Ind. and Eng. Chem., Prod. Res. and Dev., v. 1, No. 2, June 1962, pp. 132–140.
[43] Manson, P. W., and L. R. Blair. Sulfate Resistance of Asbestos-Cement Pipe. Mat. in Design Eng., v. 2, No. 10, October 1962, pp. 828–835.

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