Asbestos

By Timothy C. May [1]

FOR the first time, domestic production of asbestos exceeded 100,000 short tons. California surpassed Vermont in production of chrysotile asbestos. Total U.S. sales were 52 percent higher in volume and 59 percent higher in value than in 1963. The Nation ranked sixth among world producers. Canada continued to be the leading producer with 40 percent of the total output.

TABLE 1.—Salient asbestos statistics

	1955–59 (average)	1960	1961	1962	1963	1964
United States:						
Production (sales)—short tons	43,794	45,223	52,814	53,190	r 66,396	101,092
Value—thousands	$4,733	$4,231	$4,347	$4,677	r $5,108	$8,143
Imports for consumption (unmanufactured)—short tons	694,088	669,496	616,529	675,953	667,860	739,361
Value—thousands	$61,264	$63,345	$58,942	$64,112	$61,739	$72,973
Exports (unmanufactured) [1] short tons	3,223	5,525	3,799	2,949	10,044	27,147
Value—thousands	$442	$857	$759	$598	$1,304	$3,199
Exports of asbestos products (value) [1]—thousands	$13,683	$13,703	$13,825	$14,274	r $16,267	$16,288
Consumption, apparent [2] short tons	734,659	709,194	665,544	726,194	r 724,212	813,306
World: Production—do	2,065,000	2,440,000	2,770,000	3,050,000	3,210,000	3,540,000

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

LEGISLATION AND GOVERNMENT PROGRAMS

The Office of Emergency Planning announced new stockpile objectives of 40,000 short tons for amosite and 13,700 tons for chrysotile.

Under the Agricultural Trade Development and Assistance Act of 1954 (Public Law 480, 83d Cong.), the Department of Agriculture, through the Commodity Credit Corporation (CCC), bartered surplus agricultural commodities for the various types of asbestos. A total of 24,434 tons was acquired under the program in 1964, consisting of 12,905 tons of crocidolite, 11,308 tons of amosite, and 211 tons of chrysotile.

Strategic stockpile inventories on December 31, 1964, were as follows: Amosite, 11,705 tons; chrysotile, 6,224 tons; crocidolite (soft), 1,567 tons. Supplemental and CCC stockpiles consisted of the follow-

[1] Commodity specialist.

Minerals Yearbook: Asbestos Chapters, 1964
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ing: Amosite, 39,918 tons; chrysotile, 3,063 tons; crocidolite (harsh), 40,342 tons. Also, 2,348 tons of nonstockpile grade chrysotile was held in the Defense Production Act stockpile and 40,342 tons of nonobjective crocidolite (harsh) in the Supplemental and CCC stockpiles.

DOMESTIC PRODUCTION

Asbestos production in the United States was 52 percent more than 1963. Most of the increased production was from California deposits.

Vermont Asbestos Mines Division of Ruberoid Co., Lowell mine, near Hyde Park, Vt., continued as the major producer of chrysotile asbestos.

Three companies reported shipments of chrysotile from Gila County, Ariz.: Asbestos Manufacturing Co. from the Asbestos Peak and Ash Creek mines; Jaquays Mining Corp. from the Regal and Chrysotile mines; and Metate Asbestos Corp. from the Lucky Seven mine. It was reported that Johns-Manville Corp. set up bagging operations at the Metate Asbestos Corp. plant.

California production and shipments of chrysotile were reported by the following companies: Pacific Asbestos Corp. (formerly Jefferson Lake Asbestos Corp.), Calaveras County; Atlas Mineral Corp. and Coalinga Asbestos Co., Fresno County; Asbestos Bonding Co., Napa County; and Union Carbide Corp., Nuclear Division, San Benito County. It was reported that a new mill was placed in operation by the United States Asbestos Co. (formerly a Todd Industries operation) in Coalinga. Plant capacity was rated to exceed 25,000 tons of fiber per year.

Powhatan Mining Co., Baltimore, Md., produced anthophyllite asbestos at the Burnsville mine, Yancey County, N.C.

CONSUMPTION AND USES

Over 96 percent of the chrysotile consumed was short fiber of less than spinning length and was used chiefly in the manufacture of products used in the building construction industry. Asbestos cement products such as pipes, flat or corrugated sheet, roofing or siding shingles, and wallboards utilized the larger quantity of asbestos. The longer and better grades were used in the manufacture of asbestos textiles for use in safety clothing, clutch facings, brake linings, and plastics. Much of the Arizona chrysotile was used for filtering purposes and that produced in California was used in the manufacture of floor tile.

Consumption of crocidolite and amosite represented by imports continued to increase. Imports of crocidolite and amosite in 1964 were 25,000 and 24,000 tons respectively, compared with 11,000 and 22,000 tons in 1963.

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PRICES [2]

Quotations for Arizona asbestos, f.o.b. Globe, were listed as follows:

Grade:	Per short ton			
	1963		July 10, 1964	
No. 1 crude	$1,475	$1,650	$1,410	$1,650
No. 2 crude	800	1,000	610	900
AAA	------	------	------	800
Group No. 3 (nonferrous filtering and spinning)	425	500	425	750
Group No. 4 (nonferrous plastic and filtering)	385	420	385	500
Group No. 5 (plastic and filtering)	250	400	250	400
Group No. 7 (refuse and shorts)	58	90	58	90

Canadian (Quebec and British Columbia) chrysotile, f.o.b. mine, and United States (Vermont) chrysotile, f.o.b. mine, remained unchanged from prices quoted in 1962 and 1963. Cassiar (British Columbia) added a new grade, AY.

Canadian (Quebec) chrysotile asbestos prices, f.o.b. mine, were 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 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

Market quotations were not available for African and Australian asbestos because sales were negotiated separately. U.S. Department of Commerce reports show the following figures for imports per short ton:

[2] Asbestos. V. 46, No. 6, July 1964, p. 48.

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Imports:	1963	1964
Amosite: South Africa, Republic of	$158	$157
Crocidolite:		
Australia	190	197
South Africa, Republic of	212	198

FOREIGN TRADE

Imports of crocidolite were more than double those of 1963, and imports of chrysotile and amosite increased 9 percent each, resulting in a net increase of 11 percent in total imports.

Imports of low-iron spinning-length chrysotile from British Columbia, Canada, increased from 4,698 tons in 1963 to 4,948 tons, and imports of all grades of fiber increased from 14,088 tons to 18,640 tons in 1964.

Of all the chrysotile imported, fiber of less than spinning length accounted for 96 percent.

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

Year and country	Crude (including blue fiber)[1]		Textile fiber[1]		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1963:								
North America: Canada	470	$89,017	13,852	$5,216,206	604,420	$48,706,010	618,742	$54,011,233
Europe:								
Finland	55	2,000			398	22,246	453	24,246
Italy[1]	6	7,525					6	7,525
Portugal[1]					29	3,193	29	3,193
Yugoslavia	6,331	215,955			1,177	45,224	7,508	261,179
Africa:								
Portuguese Western Africa, n.e.c					20	2,601	20	2,601
Rhodesia and Malawi[1 2]	2,328	449,231	330	143,117	1,480	303,897	4,138	896,245
South Africa, Republic of[1]	33,172	5,830,022	136	27,845	3,646	673,044	36,954	6,530,911
Oceania: Australia	10	1,896					10	1,896
Total	42,372	6,595,646	14,318	5,387,168	611,170	49,756,215	667,860	61,739,029
1964:								
North America:								
Canada	4,466	795,546	13,881	5,380,633	648,626	54,404,684	666,973	60,580,863
Mexico					304	32,995	304	32,995
South America:								
Bolivia	3	4,800					3	4,800
Venezuela					624	26,996	624	26,996
Europe:								
Finland	117	4,400			934	42,522	1,051	46,922
Italy					6	7,395	6	7,395
Portugal					5	560	5	560
Spain					50	8,374	50	8,374
U.S.S.R.					20	732	20	732
Yugoslavia	2,785	107,148			2,081	74,977	4,866	182,125
Africa:								
Mozambique			90	37,273	239	41,921	329	79,194
Portuguese Western Africa, n.e.c					130	10,386	130	10,386
Rhodesia and Malawi[1 2]	7,633	1,518,126	90	35,719	6,271	1,330,350	13,994	2,884,195
South Africa, Republic of[1]	49,607	8,843,905			924	169,208	50,531	9,013,113
Oceania: Australia	475	94,022					475	94,022
Total	65,086	11,367,947	14,061	5,453,625	660,214	56,151,100	739,361	72,972,672

[1] Data reported by the Bureau of the Census have been adjusted by the Bureau of Mines.
[2] All believed to be from Southern Rhodesia.

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	1963			1964		
	Canada	Southern Rhodesia [1]	Republic of South Africa [2]	Canada	Southern Rhodesia [1]	Republic of South Africa [2]
Chrysotile:						
Crudes	470	2,188	452	4,466	7,633	817
Spinning and textile	13,852	330	136	13,881	90	----
All other	604,420	1,480	3,646	648,626	6,271	924
Crocidolite (blue)	----	140	10,776	----	----	24,858
Amosite	----	----	21,944	----	----	23,932
Total	618,742	4,138	36,954	666,973	13,994	50,531

[1] Reported by the Bureau of the Census as Rhodesia and Malawi.
[2] Includes data adjusted by the Bureau of Mines.

Source: Bureau of the Census.

TABLE 4.—U.S. exports and reexports of asbestos and asbestos products

Product	1963		1964	
	Quantity	Value	Quantity	Value
Exports:				
Unmanufactured:				
Crude and spinning fibers, short tons	847	$228,666	620	$168,137
Nonspinning fibers, do	3,169	506,725	12,887	1,881,195
Waste and refuse, do	5,962	553,272	13,312	1,112,664
Total unmanufactured, do	9,978	1,288,663	26,819	3,161,996
Products:				
Brake lining and blocks-molded, semimolded, and woven	[1]	4,888,141	[1]	4,808,497
Clutch facing and lining, number	2,519,467	1,760,767	2,046,247	1,840,560
Construction materials, n.e.c., short tons	r 13,163	r 3,307,031	12,988	3,204,223
Pipe covering and cement, do	4,100	1,607,754	3,951	1,599,039
Textiles, yarn, and packing, do	1,496	3,499,384	1,520	3,566,507
Manufactures, n.e.c.	[2]	1,183,752	[2]	1,235,055
Total products	----	r 16,246,829	----	16,253,881
Reexports:				
Unmanufactured:				
Crude and spinning fibers, short tons	66	14,651	108	17,725
Nonspinning fibers, do	----	----	2	660
Waste and refuse, do	----	----	218	18,861
Total unmanufactured, do	66	14,651	328	37,246
Products:				
Construction materials, n.e.c., short tons	28	10,637	114	22,496
Pipe covering and cement, do	[2]	5,670	----	----
Textiles and yarn, do	----	----	[3]	122
Manufactures, n.e.c.	[2]	3,800	[2]	11,870
Total products	----	20,107	----	34,488

r Revised.
[1] Values have been summarized; quantities not shown.
[2] Quantity not recorded.
[3] Less than ½ unit.

Source: Bureau of the Census.

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WORLD REVIEW

NORTH AMERICA

Canada.—Shipments of asbestos reached an alltime record high. Approximately 1.42 million tons was shipped showing an increase of 11 percent compared with 1963.

Both volume and sales for Cassiar Asbestos Corp., Ltd., were higher than in 1963. Cassiar accounted for approximately 5 percent of the quantity and 10 percent of value of total Canadian exports of asbestos in 1964. During the year the mine produced 705,000 tons of ore, of which 350,000 tons was treated in the rock rejection circuit to eliminate 118,000 tons of rock. Ore and concentrate milled totaled 588,000 tons. An addition to the mill completed in July 1964 provided for production of the new AY grade. Production of fiber was 66,897 tons, an increase of 7 percent over 1963. Diamond drilling was carried out on the Clinton Creek property, Yukon Territory. A preliminary estimate of the ore outlined to date was 12.3 million tons.[3]

Operations at the Canadian Johns-Manville Co., Ltd. Munro mine near Matheson, Ontario, were terminated in August. The Munro mine began commercial production of fiber for asbestos cement in 1950 and was the only producing mine in Ontario. Bulk sampling and drilling were being pursued at the Garrison Township property about 13 miles east of the Munro mine. Also, development and evalution was in progress by Canadian Johns-Manville on its Reeves Township property about 40 miles southwest of Timmins.[4]

The various steps necessary to make a producing mine out of a new discovery, as experienced by Advocate Mines Ltd., at its Baie Verte mine on the northeastern coast of Newfoundland, were described. It was reported that 10 years were required to bring the deposit into production after discovery.[5]

The McAdam Mining Corp. completed a 3-year drilling program on its Roberge Lake property in McCorkill Township, east of Chibougmau, Quebec. It was reported that 40 million tons of chrysotile asbestos ore that can be mined at a profit was found.[6]

Asbestos Corp., Ltd., and Johnson's Co., Ltd., including its subsidiary, Johnson's Asbestos Co., announced an agreement to integrate their operations in the Thetford-Black Lake region of the eastern townships. The Asbestos Corp., Ltd., early in the year, acquired the deposit of Murray Mining Corp., Ltd., in northern Ungava, Quebec. The asbestos deposit is located 40 miles south of Hudson Strait and 1,200 miles north of Montreal.[7]

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[3] Cassiar Asbestos Corp., Ltd., (Toronto). Thirteenth Annual Report, Dec. 31, 1964.
[4] Woodroffe, H. M., H. K. Conn, and S. J. Rice. Asbestos. Min. Eng., v. 17, No. 2, February 1965, p. 121.
[5] Mining in Canada (Winnepeg) Asbestos After a Decade. V. 37, No. 8, August 1964, pp. 12–15.
World Mining. Advocate Asbestos—Canada's New Producer. V. 17, No. 10, September 1964, pp. 49–51.
[6] Northern Miner (Toronto). McAdam Considering Production Plans for Asbestos Show. V. 50, No. 33, Nov. 5, 1964, pp. 1, 7.
[7] Engineering and Mining Journal. Asbestos Corp. Acquires Two Mining Companies. V. 165, No. 4, April 1964, p. 138.

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

(Short tons)

Country [1]	1955–59 (average)	1960	1961	1962	1963	» 1964
North America:						
Canada (sales)	1,019,983	1,118,456	1,173,695	1,215,814	1,276,609	1,416,650
United States (sold or used by producers)	43,794	45,223	52,814	53,190	66,396	101,092
Total	1,063,777	1,163,679	1,226,509	1,269,004	1,343,005	1,517,742
South America:						
Argentina	508				220	[3] 220
Bolivia (exports	73	66	57	56	10	
Brazil	3,420	• [4] 3,900	• [4] 3,400	• [4] 4,900	[5] 1,440	[3] [5] 1,440
Venezuela	5,891	4,333	650			
Total	9,892	8,299	• 4,100	• 5,000	1,670	1,660
Europe:						
Austria		66	564	503	638	
Bulgaria	1,152	1,200	1,200	• 1,100	• 1,100	• 1,100
Finland [6]	9,108	10,534	10,340	10,869	10,108	11,611
France	17,292	28,662	30,746	28,364	26,645	24,250
Italy	42,141	60,532	62,804	61,233	63,418	75,573
Portugal	63	144	21		29	
Spain	3	4	11			
U.S.S.R. •	519,000	660,000	880,000	1,100,000	1,200,000	1,300,000
Yugoslavia	5,060	5,970	6,709	7,400	9,074	9,280
Total •	595,000	770,000	990,000	1,210,000	1,310,000	1,420,000
Asia:						
China •	47,000	90,000	100,000	100,000	110,000	130,000
Cyprus	15,325	23,316	16,207	22,391	19,962	13,037
India	1,527	1,886	1,624	1,865	2,989	3,271
Japan	10,972	17,042	18,799	15,407	18,210	17,979
Korea, South	66	696	341	1,333	2,120	• 1,300
Philippines	[7] 56	36	83	1,037	421	586
Taiwan	197	485	44	525	604	526
Turkey	449	238	496	709	409	1,015
Total •	75,500	135,000	138,000	145,000	155,000	170,000
Africa:						
Bechuanaland	1,608	1,282	1,924	2,375	2,368	2,161
Kenya	119	117	151	212	78	204
Morocco	228					
Mozambique	179	22	162	370		
South Africa, Republic of	154,348	175,867	194,834	221,302	205,744	215,592
Southern Rhodesia	120,634	133,963	161,610	142,196	142,255	153,451
Swaziland	28,657	32,027	30,792	32,830	33,350	39,862
United Arab Republic (Egypt)	202	496	254	606	192	[3] 192
Total	305,975	343,774	389,727	399,891	383,987	411,462
Oceania:						
Australia	12,764	15,613	16,746	18,416	13,374	• 16,200
New Zealand	373	319	373	457	439	[3] 439
Total	13,137	15,932	17,119	18,873	13,813	• 16,650
World total (estimate) [1] [2]	2,065,000	2,440,000	2,770,000	3,050,000	3,210,000	3,540,000

• Estimate. » Preliminary.

[1] Asbestos is also 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] 1963 data.

[4] Data represents fiber.

[5] Bahia only.

[6] Includes asbestos flour.

[7] Data for year 1959 only.

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TABLE 6.—Canada: Shipments of asbestos, by grades

(Short tons)

Grade	1960	1961	1962	1963	1964
Quebec:					
Crude No. 1, 2, and other	330	163	205	218	218
Milled group:					
3 (spinning)	32,190	29,296	30,374	23,160	31,376
4 (shingle)	294,092	339,082	355,121	292,080	319,629
5 (paper)	156,901	179,852	161,952	154,456	188,672
6 (stucco)	179,361	193,467	209,572	224,209	232,382
7 (refuse)	445,509	423,116	451,521	456,209	507,003
8 (sand)	10,073	8,719	7,069	7,986	5,602
Newfoundland, Ontario, and British Columbia	(1)	(1)	(1)	118,291	131,768
Total all grades	1,118,456	1,173,695	1,215,814	1,276,609	1,416,650

[1] Included with Quebec.

Source: Dominion Bureau of Statistics.

A description of the history of mining methods at the Jeffrey mine of the Canadian Johns-Manville Co., Ltd., at Asbestos, Quebec, was published. The Jeffrey deposit has been in operation since 1881. Reasons for the conversion of mining operations from open pit to underground followed by the reversal to open pit are noted.[8]

It was reported that mine production and sales at the Black Lake property operated by Lake Asbestos of Quebec, Ltd., during the first months of 1964 were at an alltime high. Asbestos fiber produced and shipped for the 6-month period was 11 percent and 14 percent above that of the corresponding period in 1963.[9]

SOUTH AMERICA

Brazil.—Asbestos was mined in the southeastern part of the Macacos quadrangle and occurs in serpentinite as cross fiber veinlets and as slip fiber.[10]

EUROPE

Greece.—Kennecott Copper Corp. sold the concession rights on the Kozani asbestos mine to the Greek state-owned Industrial Development Corporation for $20,000. A pilot plant was built at the deposit, but it was never placed in commercial production.[11]

Yugoslavia.—Asbestos was discovered in the Ibar Massive area between Kraljevo, Servia, and Skopje, Macedonia. It is reported that the deposit contains about 40 million tons of ore containing about 1.13 percent fiber. The only working mine in Yugoslavia is at Korlaca in the same area.[12]

[8] Brigham, S. K., and G. A. Piché. Mining Methods at Jeffrey Mine. Mining in Canada (Winnipeg), v. 37, No. 12, December 1964, pp. 7–13.
Skillings' Mining Review. History of Mining Methods Employed at Jeffrey Asbestos Mine, Quebec. V. 53, No. 15, Apr. 11, 1964, pp. 4, 18–19.

[9] Northern Miner (Toronto). United Asbestos Net Higher—Sales at Record. V. 50, No. 20, Aug. 6, 1964, p. 12.

[10] Pomerene, J. B. Geology and Ore Deposits of the Belo Horizonte, Ibirite, and Macacos Quadrangles, Minas Gerais, Brazil. U.S. Geological Survey Professional Paper 341–D, 1964, p. 74.

[11] Mining Journal (London). Kennecott Sells Greek Asbestos Rights. V. 263, No. 6729, August 1964, p. 98.

[12] Engineering and Mining Journal. V. 165, No. 8, August 1964, p. 158.

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ASIA

China.—The expansion of one of China's largest asbestos mines in Szechwan Province was reported. When completed, mining, transportation, and ore dressing will be mechanized.[13]

Japan.—In April 1964 a 5 percent duty was imposed on shipments valued at less than $917 per metric ton. Asbestos was produced almost exclusively in Hokkaido by Nozawa Asbestos Cement Co. and Yamabe Asbestos Co.

AFRICA

South Africa, Republic of.—During 1964, 215,592 tons of asbestos was produced consisting of 77,276 tons of amosite, 35,921 tons of chrysotile, and 102,395 tons of crocidolite. Total exports amounted to 207,470 tons.

Cape Asbestos South Africa (Pty.), Ltd., completed a dust-free milling plant at the Penge mine, the largest producer of amosite asbestos.

The major producers of Cape Blue asbestos (crocidolite), Cape Blue Mines (Pty.), Ltd., Griqualand Exploration & Finance, Ltd., and Wandrag Asbestos (Pty.) formed an association so that there will be one fully representative body for the whole industry. Standardization of grades and nomenclature of Cape Blue asbestos will be developed.[14]

TABLE 7.—Republic of South Africa: Asbestos production, by varieties and sources

(Short tons)

Variety and source	1960	1961	1962	1963	1964
Amosite (Transvaal)	68,630	69.234	74,883	77,618	77,276
Chrysotile (Transvaal)	29,471	31,726	29,993	28,928	35,921
Blue (Transvaal)	11,185	11,176	14,296	11,205	10,304
Blue (Cape)	66,567	82,624	102,034	87,965	92,091
Tremolite (Transvaal)	14	74	96	28	----
Total	175,867	194,834	221,302	205,744	215,592

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

(Short tons)

Variety and source	1960	1961	1962	1963	1964
Amosite (Transvaal)	68,187	67,863	69,659	72,899	81,763
Chrysotile (Transvaal)	25,338	25,094	27,538	16,109	28,573
Blue (Transvaal)	9,122	12,025	11,867	9,309	10,709
Blue (Cape)	72,152	75,702	75,106	85,535	97,135
Tremolite (Transvaal)	11	4	----	9	----
Total	174,810	180,688	184,170	183,861	218,180

[13] Engineering and Mining Journal. China Mechanizes Mine, Increases Asbestos Output. V. 165, No. 6, June 1964, p. 255.

[14] South African Mining and Engineering Geology (Johannesburg). Cape Blue Asbestos Association. V. 75, pt. 1, No. 3711, Mar. 20, 1964, p. 627.

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Southern Rhodesia.—Rhodesian & General Asbestos Corp. (Pvt.), Ltd., of Bulawayo announced that the Cementation Co. (Rhodesia) would sink the new King Section shaft at Gath's mine. The concrete-lined shaft will be 20 feet in diameter and 1,458 feet deep.[15]

As part of the first stage of the development of the new Pangani mine near Filabusi, more than 1 million tons of overburden was removed. Asbestos Investments (Pty.), Ltd., plans to remove 5 million tons of overburden, uncovering about 4 million tons of asbestos ore.[16]

TABLE 9.—Southern Rhodesia: Chrysotile asbestos production

Year	Short tons	Value (thousands)	Year	Short tons	Value (thousands)
1960	133,963	$20,888	1963	142,255	$16,791
1961	161,610	24,453	1964	153,451	19,174
1962	142,196	20,467			

OCEANIA

Australia.—Numerous outcrops of asbestos were reported at Baryulgel, 40 miles northwest of Grafton, New South Wales. Asbestos Mines (Pty.), Ltd., has been working in the area.[17]

TECHNOLOGY

A Conference on the Biological Effects of Asbestos sponsored by the New York Academy of Sciences was held in New York City in October. Papers were presented in the biological and physical sciences by leading investigators from many countries concerned with the effects of asbestos inhalation on health. Panel discussions covered asbestos materials in modern technology, living tissue and mineral matter, experimental asbestosis, asbestosis in industrial populations, dust controls and standards, asbestos and neoplasia, and pulmonary function in asbestosis.[18]

Chrysotile fibers were dehydrated hydrothermally, and the resulting pseudomorphs studied by x-ray rotation photographs. Initial products were forsterite and distorted material.[19]

Electron micrographs of individual fibers of chrysotile have shown it to have a tubular morphology. Chrysotile crudes from Lake Asbestos of Quebec, Ltd., Black Lake, Quebec; Johns-Manville, Asbestos, Quebec; Bell Asbestos Mines, Ltd., Thetford mine, Quebec; Asbestos Corp., Ltd., Vimy Ridge, Quebec; and Cassiar Asbestos Corp., Ltd., McDame Lake, British Columbia, were subjected to ultrasonic cleaning treatment. All samples liberated an ultrafine material when sub-

[15] Mining Journal (London). Asbestos Mine Contract in S. Rhodesia. V. 263, No. 6744, Nov. 20, 1964, p. 377.
[16] South African Mining and Engineering Journal. Stripping Overburden at Pangani Asbestos Mine, v. 75, pt. 1, No. 3, No. 3718, May 8, 1964, p. 1001.
[17] Mining Journal (London). Barryulgel Asbestos. V. 262, No. 6720, June 5, 1964, p. 449.
[18] New York Academy of Sciences, Section of Biological and Medical Sciences. Conference on Biological Effects of Asbestos. New York, Oct. 19–21, 1964.
[19] Ball, M. C., and H. F. W. Taylor. The Dehydration of Chrysotile in the Air and Under Hydrothermal Conditions. Mineralogical Magazine (London), v. 33, No. 261, June 1963, pp. 467–483.

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jected to ultrasonic irradiation. The fine material fills the interstices between fibers.[20]

A lenticular mineralization of asbestos was found along an outcrop 15 miles long in Chamoli, India. Chemical analysis indicates the material to belong to either the type actinolite or cummingtonite.[21]

Production and milling of amosite asbestos from the Penge mine in Transvaal, Republic of South Africa, was discussed. Dry milling of asbestos rock gave rise to problems of dust extraction and disposal of mill tailings. The mill has been arranged for almost totally enclosed conveying and handling. Hammer and fiberizing mills are enclosed, leakproof, and completely air swept.[22]

Research was conducted on the synthesis of fibrous materials that may be suitable for use as natural asbestos substitutes.[23]

The sterilization of liquids by filtration through an asbestos pad was discussed. The most important factor in this type of cold sterilization is the asbestos filter sheet, which should be acid treated and constantly checked to meet high standards of low leachable Ca and Fe content. Finest grades of asbestos filter sheet are used for the retention of bacteria or pyrogens.[24]

Friction matting of asbestos yarns and copper wire was developed for clutch and brake applications for construction machinery and other heavy automotive equipment. The matting offers high spin strength at low wear rates.[25]

The effect of sodium silicate on the filtration rate of a 4K chrysotile fiber that was ball milled and passed through a disintegrator was investigated.[26]

Procedures in the testing of asbestos at the Quebec Asbestos Mining Association Research Testing Laboratory at the University of Sherbrooke were discussed. The review of actual test procedures and apparatus, and the development of new testing techniques for a thorough evaluation of the physical properties and strength-imparting characteristics of asbestos fibers constitutes the main work load of the laboratory.[27]

Major operating and maintenance problems encountered since the start-up in 1962 of a 30,000-ton-per-day skipway, at the Jeffrey mine, Asbestos, Quebec, and the steps taken to overcome them were discussed.[28]

Chemical and physical properties of crocidolite asbestos were described and the manner in which these properties may be used to pro-

[20] Martinez, E., and J. Comer. The Concentration and Study of the Interstitial Material in Chrysotile Asbestos. Am. Mineralogist, v. 49, Nos. 1 and 2, 1964, pp. 153–157.
[21] Prakash, D. and I. K. Dalela. On the Occurrence of Asbestos in Chamoli, U.P. India. Am. Mineralogist, v. 49, Nos. 3 and 4, March–April 1964, pp. 424–427.
[22] South African Mining & Engineering Journal (Johannesburg). Penge Solves Asbestos Dust Problem. V. 75, No. 3709, Mar. 6, 1964, pp. 487–488, 490.
[23] Johnson, R. C., W. H. Warwick, H. R. Shell. Synthesis and Some Properties of Fibrous Silicon Nitride. BuMines Rept. of Inv. 6467, 1964, 25 pp.
[24] Vogel, G. P., Sterile Filtration. American Perfumer Cosmetology, v. 79, No. 6, 1964, pp. 65–66; Chem. Abs., v. 61, No. 6, Sept. 14, 1964, col. 6871.
[25] Materials in Design Engineering. V. 59, No. 2 February 1964, p. 154.
[26] Martinez Edward. The Effect of Sodium Silicate on the Filtration Rate of Asbestos Fiber. Canadian Min. and Met. Bull. (Montreal), v. 57, No. 630, October 1964, pp. 1042–1044.
[27] Paré, J. J. The O.A.M.A. Research Testing Laboratory and Its Relation to the Asbestos Mining Industry. Canadian Min. and Met. Bull. (Montreal), v. 57, No. 630, October 1964, pp. 1045–1049.
[28] Fletcher, J. M. Jeffrey Skipway-Operation and Maintenance. Canadian Min. and Met. Bull. (Montreal), v. 57, No. 628, August 1964, pp. 842–848.

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duce a wide range of reinforced plastic moldings and laminates was illustrated.[29]

The properties imparted by using asbestos in the manufacture of a new reinforced thermoplastic laminating material were described. The inorganic fiber content imparts heat and chemical resistance, impact strength, dimensional stability, low coefficient of expansion, and resistance to creep.[30]

The effect of ultrasonic energy transmitted through a liquid on chrysotile asbestos was investigated. Ultrasonic energy was effective in fiberization of chrysotile crudes as well as standard grades of milled asbestos fibers. It was found that ultrasonic energy greatly increased the rate of precipitation of latex on asbestos.[31]

A patent was granted on the use of a mixture of acrylic fiber and long chrysotile asbestos in the manufacture of a fireproof cloth.[32]

A process was patented for forming friction sheet material composed of crocidolite asbestos cotton linters, diatomite, and latex.[33]

A method was patented for preparing insulating boards or sheets from a mixture of 4T to 7K asbestos fiber with other materials.[34]

The use of amosite asbestos fiber in a sag-resistant felted mineral fiberboard containing mainly slag wool was patented.[35]

A method was patented for forming a high quality inert fabric for use in the filtration of hot or cold industrial gases. The fabric is strong, fireproof, chemically inert, and will filter fine solid particles out of gases.[36]

A patent was issued for the use of asbestos as a friction material in the manufacture of railroad composition brake blocks.[37]

A process for protecting metal surfaces was patented. Short fiber asbestos is sprayed into molten zinc coating, and the composite fiber-metal coating is dried.[38]

A method was patented for the use of asbestos in the preparation of felted asbestos paper or sheeting.[39]

A patent was issued on the use of asbestos fiber and a solid lubricant in the manufacture of stuffing box packings.[40]

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[29] Barrable, V. E., A. Bennett, and A. F. Jerome. Use of Crocidolite Asbestos in Reinforced Plastics. Industrial & Engineering Chemistry, v. 2, September 1963, pp. 186–189.
[30] Chemical Age (London). First Asbestos Reinforced Thermoplastic Laminate. V. 91, No. 2346, June 1964, p. 1014.
[31] Martinez, E. Effect of Ultrasonic Energy on Chrysotile Asbestos. Transactions of the Society of Engineers, v. 226, No. 4, December 1963, pp. 388–390.
[32] Crawley, W. P. (assigned to The Carborundum Co.). Heat Resistant Fibrous Products and Method of Making the Same. U.S. Pat. 3,125,404, Mar. 17, 1964.
[33] Schultz, H. W. (assigned to General Motors Corp.). Clutch Plate Facing. U.S. Pat. 3,141,814, July 21, 1964.
[34] Owens, W. G., and C. Haines, Jr. (assigned to Armstrong Cork Co.). Low-Density, Heat-Insulating Material. U.S. Pat. 3,147,177, Sept. 1, 1964.
[35] Cadotta, J. E. (assigned to Wood Conversion Co.). Production of Sag-Resistant Mineral Fiberboard. U.S. Pat. 3,146,156, Aug. 25, 1964.
[36] Gouzene, P. (assigned to Compagnie de Saint-Gobain, France). Filter Fabric and Method of Making It. U.S. Pat. 3,150,033, Sept. 22, 1964.
[37] de Gaugues, C. L. E., Jr. (assigned to Johns-Manville Corp.). U.S. Pat. 3,152,099, Oct. 6, 1964.
[38] Schendler, P. B. (assigned to Armco Steep Corp.). Process for Producing Protected Metal Surfaces. U.S. Pat. 3,155,530, Nov. 3, 1964.
[39] Morgan, R. W. (assigned to The Dow Chemical Co., Midland, Mich.). Method for Preparation of Asbestos Papers and Sheeting. U.S. Pat. 3,153,610, Nov. 20, 1964.
[40] Radke, R. Method for the Manufacture of Stuffing Box Packing. U.S. Pat. 3,157,983, Nov. 24, 1964.

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A method was patented for weaving an improved filter bag fabric from spinning grade asbestos fiber and dacron or other polyester fiber.[41]

An air washer for removing dirt and grit from newly opened asbestos fiber was patented. The fiber is advanced by means of a screw conveyor through slots in the conveyor housing, with a series of sharp blasts of high-velocity air. Dust and fine fiber is carried to a separating chamber, and the main fiber product is discharged at the end of the conveyor.[42]

A method was patented for the production of pipes, paper, and sheets from an aqueous suspension of asbestos fiber and portland cement.[43]

A design for an improved apparatus was patented for producing sheets which show uniform high strength in all directions from an aqueous suspension of asbestos and portland cement.[44]

British patents covered a method for lining the heads of foundry molds with a composition of asbestos fiber and other materials,[45] for defiberizing asbestos fiber bundles which are to be used in the manufacture of asbestos-cement products,[46] for the use of asbestos in making preformed insulation shapes for insulating pipes, [47] and preventing brittleness in sheets made from an aqueous slurry of asbestos fiber and portland cement.[48]

An improved method was patented for forming and curing friction materials comprising 7D to 4T chrysotile asbestos fibers.[49]

A method was patented for the use of asbestos floats in the production of a gasket forming material.[50]

[41] Barnet, I. (assigned to Johns-Manville Corp., New York). Filter Bag Fabric. U.S. Pat. 3,159,187, Dec. 1, 1964.
[42] Donovan, R. A. Air Washer for Asbestos Fiber. U.S. Pat. 3,163,595, Dec. 29, 1964.
[43] Schneider, R. A. (assigned to Certain-teed Products Corp.). Asbestos Cement Water-Laid Products Characterized by Equal Longitudinal to Transverse Strength Ratio. U.S. Pat. 3,120,465, Feb. 4, 1964.
[44] Amanzio, A. Apparatus for Producing Fiber Reinforced Cementitious Structure. U.S. Pat. 3,121,659, Feb. 18, 1964.
[45] Cherry, G. J. N. (assigned to Foseco Trading A. G.). British Pat. 952,786, Mar. 18, 1964.
[46] Bacher, J. P. (assigned to F. L. Smidth & Co., A/S.). British Pat. 953,596, Mar. 25, 1964.
[47] Jensen, H. (assigned to Park Sectional Insulating Co. Lt.). British Pat. 956,511, Apr. 29, 1964.
[48] Patterson, N. F. (assigned to Monsanto Chemicals Ltd.). British Pat. 958,286, May 21, 1964.
[49] Cofek, H. J. (assigned to Raybestos-Manhattan, Inc.). Canadian Pat. 693,430, Sept. 1, 1964.
[50] Rucker, H. L. (assigned to Johns-Manville Corp.). Canadian Pat. 694,291, Sept. 15, 1964.

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