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STRAIGHTENING OUT THE STRENGTH UNIT CURVE

(Burman & Hodgson)

June 1979

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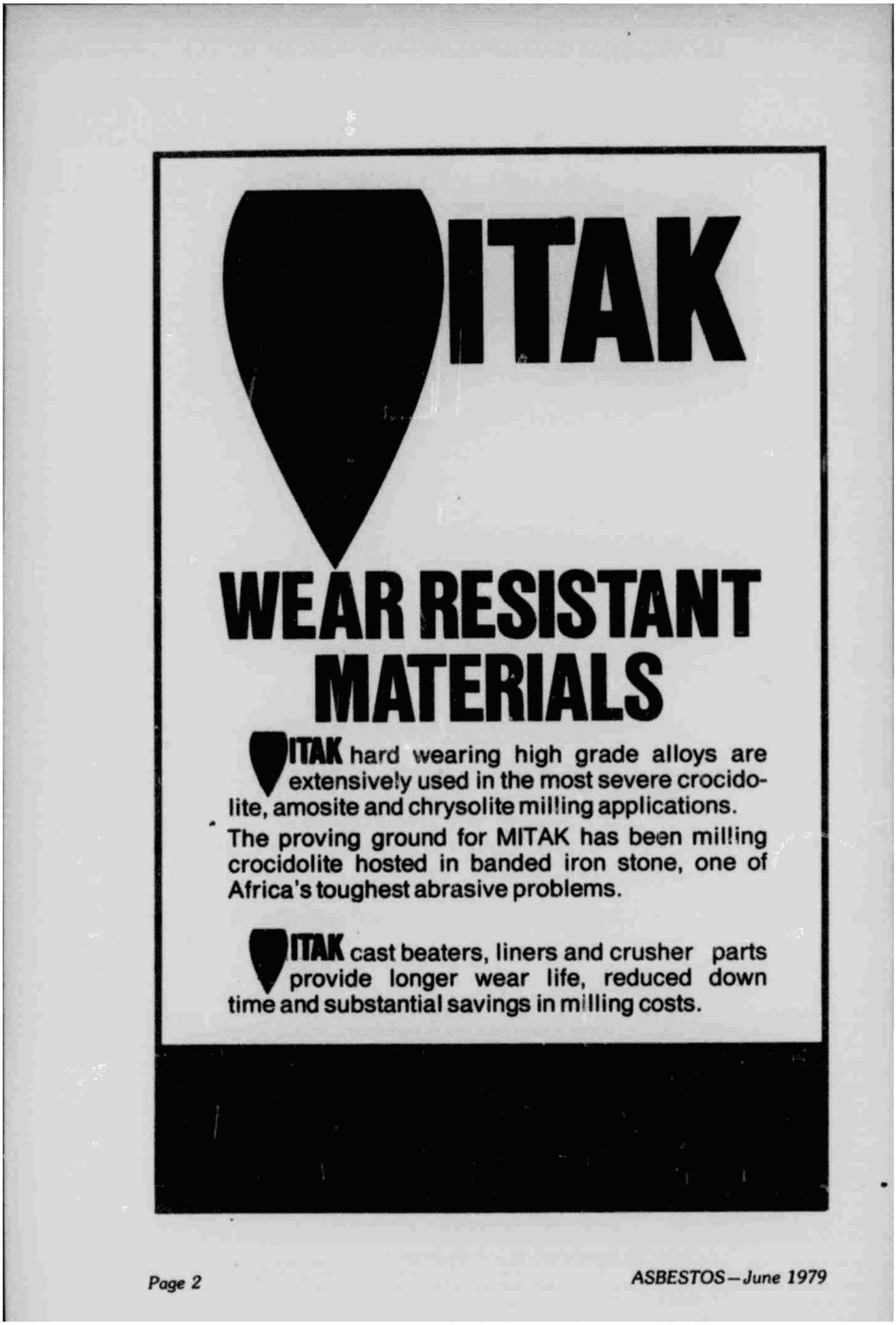
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STRAIGHTENING OUT THE STRENGTH UNIT CURVE

BY: D. R. BURMAN & A. A. HODGSON,
Cape Asbestos Fibres Ltd.

The Strength Unit Test Method (Ref. 1) is well known and widely used in the asbestos cement industry. While there are some practical problems in the techniques adopted within the method which, from time to time, surface in any critical discussion of reinforcing strength, it is not the present intention to deal with these. More importantly, from both an analytical and practical view, the Strength Unit concept itself is open to argument that it is fallacious and misleading; and it is the purpose here to examine these matters and present an alternative measure for reinforcing strength which is unequivocal and direct.

STRENGTH UNITS

Strength Units for asbestos fiber in asbestos-cement composites (Ref. 1) are defined in the following way: An asbestos fiber, giving a standard strength as modulus of rupture, MR, of 26.97 MN/m^2 (275 kg/cm^2) at a standard density of 1.6×10^3 kg/m^3, and when used as 10% of the furnish, is defined as having 100 strength units (SU). When the proportion of fiber (%F) required to give the standard strength is anything other than 10%, then SU = 1000/%F for that fiber; and all grades of asbestos are compared with the standard fiber in strength unit terms in this way.

There are several serious flaws in this concept:

(1) The expression SU = 1000/%F is artificial because it gives a number which relates only to fiber content and not to fiber reinforcing performance.

(2) The expression SU = 1000/%F is invalid because as %F $\longrightarrow$ 0, then SU $\longrightarrow$ 00, and at 100%F, SU has a residual value of 10—both of which extremes are mathematically absurd.

(3) The expression for SU is hyperbolic, gives an inverted concept of the real reinforcing strength of asbestos fibers and is contrary to the observed linear relationship between reinforcing strength and fiber content.

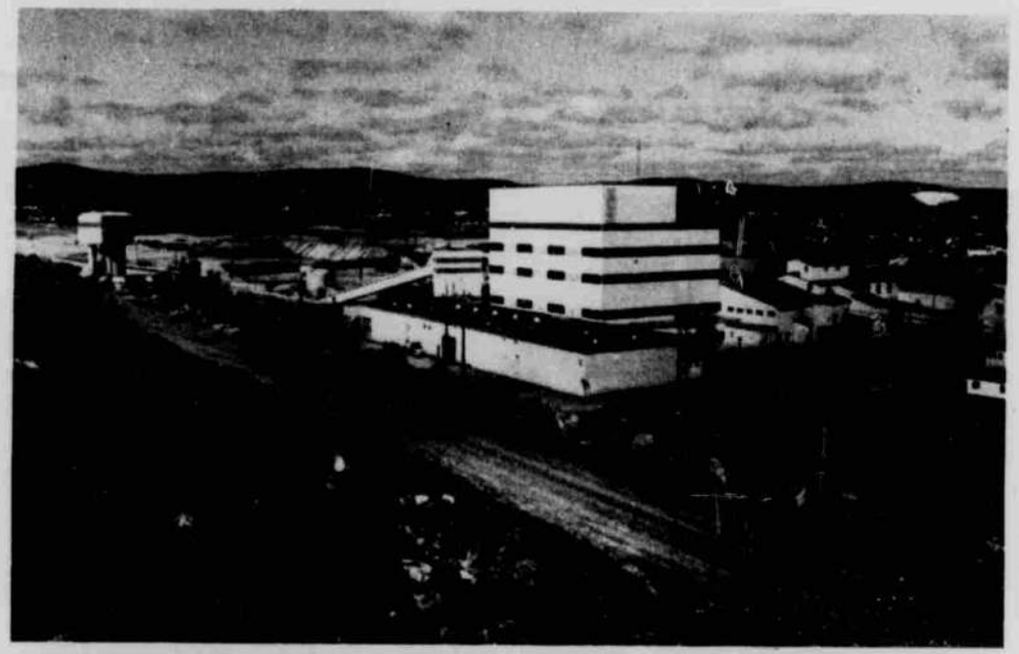
(4) Derivation of the SU expression implies that x% of fiber with SU = 100 has the same reinforcing strength as 2x% fiber with SU = 50. If this is correct, then the converse must hold that x% of fiber with SU = 50 has half the reinforcing strength of x% of fiber with SU = 100.

But this is not true in practice since the Strength Unit concept does not take into account the fact that observed reinforcing strength is the sum of fiber reinforcement and matrix strength.

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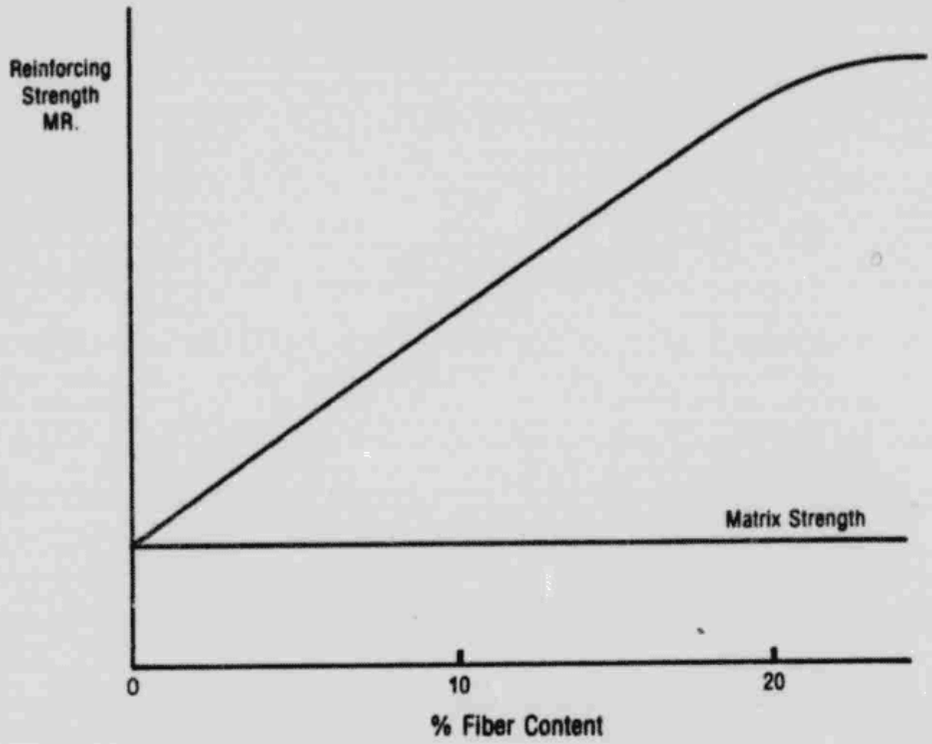
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REINFORCING STRENGTH AND FIBER CONTENT RELATIONSHIPS

It is an experimentally proven and accepted fact that the strength of a fiber-reinforced composite material increases linearly as the content of reinforcing fiber increases. At zero fiber content, the strength of the "composite" is that of the matrix only (Fig. I).

FIGURE I

RELATION BETWEEN REINFORCING STRENGTH (MR) AND FIBER CONTENT IN AN ASBESTOS-CEMENT COMPOSITE



The slopes of the lines relating composite strength and fiber content in asbestos cement differ for every grade of fiber; and the reinforcing strength of a blend of fibers at any chosen fiber content depends on the sum of the contributed strengths for those fibers.

Linearity between strength and fiber content in asbestos-cement composites is observed between the fiber content limits of zero and approximately 20% (Fig. I). In practical terms, there is little increase in strength at fiber loadings above 20% because the matrix becomes over-saturated with fiber. However, on theoretical grounds, linearity would be observed up to a fiber loading of 33% for asbestos fibers with specific diameter equal to that of cement particles.

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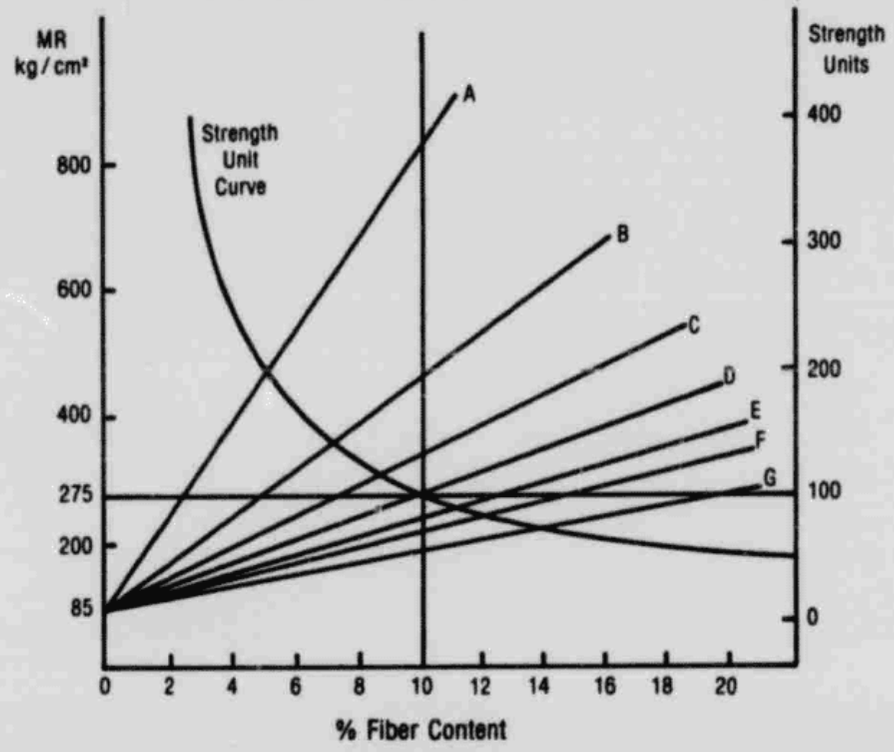
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STRENGTH UNIT CURVE—CONTINUED

Experimental Details—When the strengths (MR) of a-c composites at the standard density of 1.6 x 10^3 kg/m^3, containing successively increasing amounts of fiber, are measured, the results, when plotted against fiber content and extrapolated, cut the strength axis at approximately 85 kg/cm^2 for zero fiber content. This position is found for any type or grade of asbestos fiber regardless of its intrinsic reinforcing strength. The figure of 85 kg/cm^2 represents the strength of the cement matrix, as found for ordinary Portland cement used in the United Kingdom.

FIGURE II

MR/F LINES FOR SEVERAL IDEALIZED ASBESTOS GRADES AND THE CORRESPONDING STRENGTH UNIT CURVE FOR THE SAME GRADES



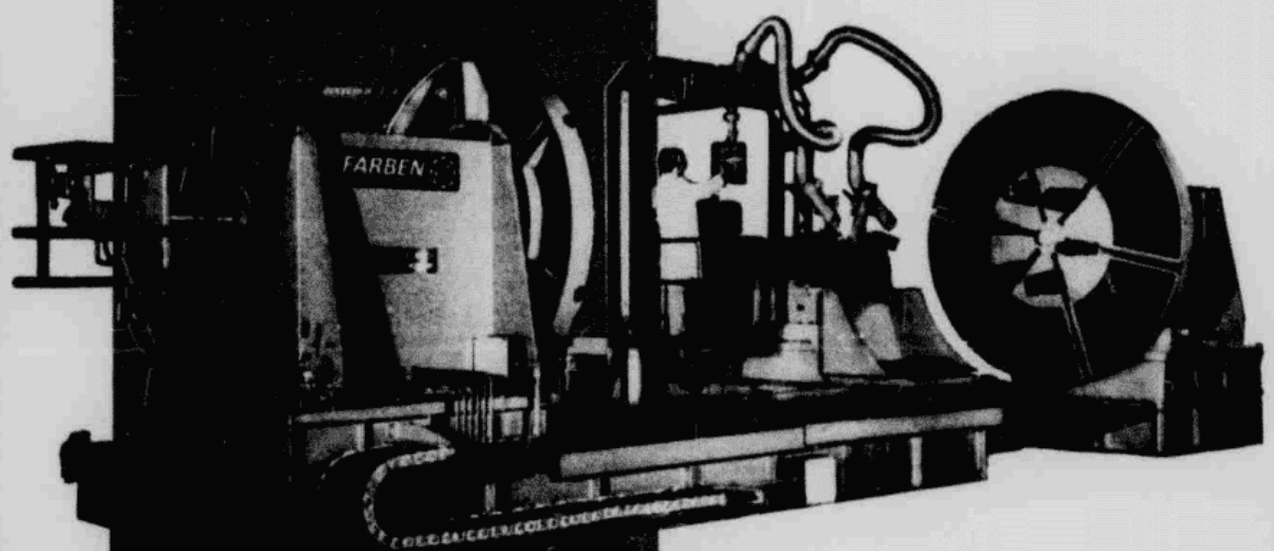
If now the reinforcing strengths for asbestos grades are determined at a standard 10% loading in the a-c composition, reinforcement lines referring strength to fiber content can be drawn up as shown in Fig. II. This diagram has two purposes:

(1) The reinforcing potential of a grade of fiber at any fiber loading other than 10% can be read off directly.

(2) These lines cut an axis of arbitrary standard strength of 275 kg/cm^2 at various fiber loadings, and the corresponding Strength Unit curve derived from SU = 1000/%F can be superimposed; the relations between Strength Unit and true strength at 10% fiber loading can then be observed.

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TABLE I

NUMERICAL ANALYSIS OF FIGURE II

"Grade"	A	B	C	D	E	F	G
1. %Fiber to give Standard MR of 275 kg/cm²	2.5	5	7.5	10	12.5	15	20
2. Strength Units from SU = 1000/%F	400	200	133	100	80	66	50
3. From 1, equivalent MR at 10% Fiber Content, by Graphical Derivation	845	465	340	275	237	211	180
4. From 3, MR Units Related to Standard at 275 kg/cm² = 100 units	307	169	124	100	85	76	65
5. From 4 and 2, Deviation of SU from Actual MR, as % of 4.	+29.5	+18.3	+7.3	0	−5.9	−13.2	−23.1

An analysis of the data in Fig. II is given in Table I:

(1) Grades A to G are hypothetical fiber types which produce the standard MR of 275 kg/cm² at various fiber loadings in the range 2.5 to 20%.

(2) Line 2 gives the calculated SU, related to fiber content.

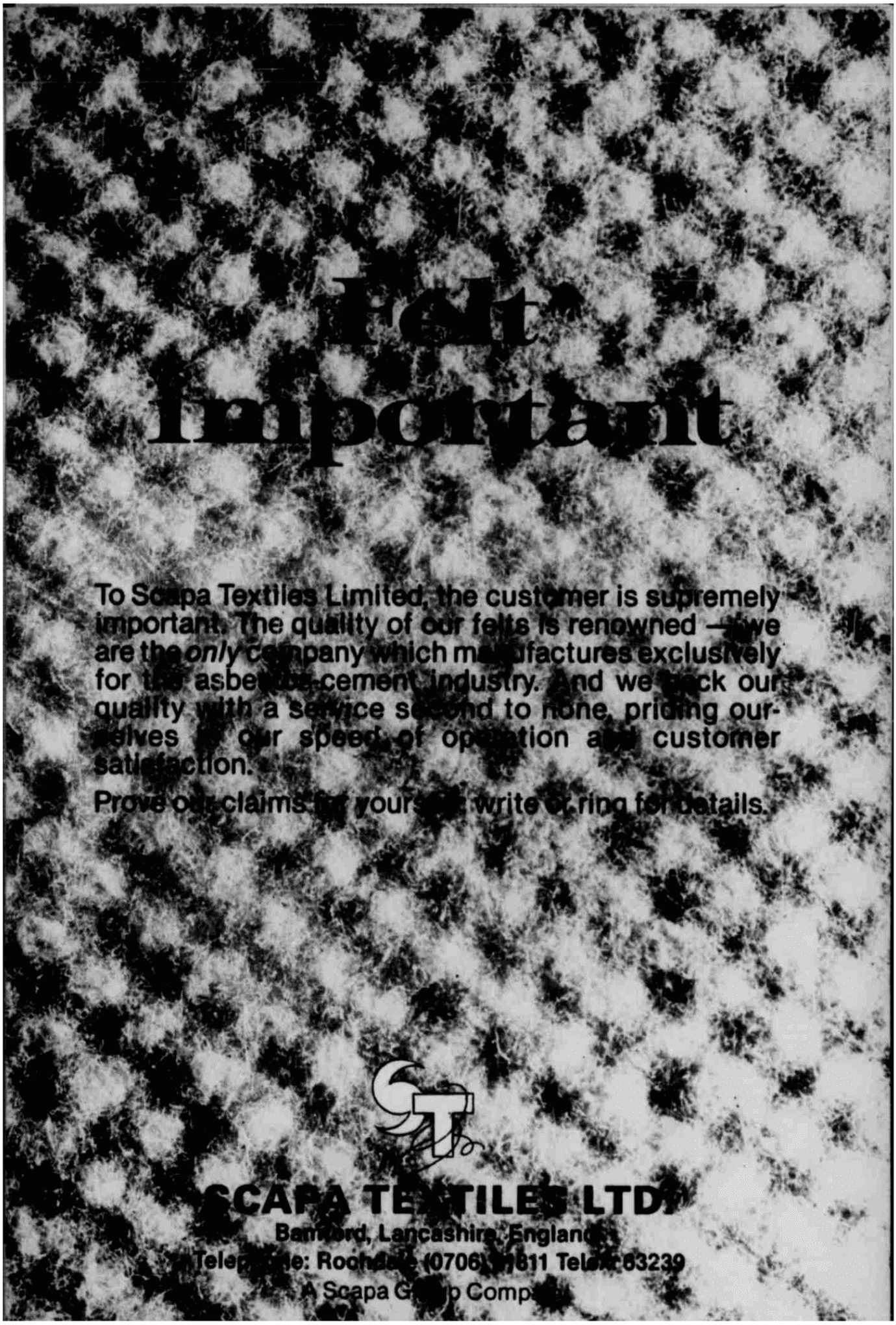
(3) Line 3 shows the equivalent MR expected at 10% fiber content for each of the grades A to G, derived from the MR/F slopes and line 4 transposes these figures to "MR units" based on 275 kg/cm² = 100 units.

(4) Comparing 4 and 2, the deviation of SU from true composite strength varies from +29.5% for low fiber contents to −23.1% for high fiber contents (line 5). The strength unit formula exaggerates the strength attributable to grades with MR above 275 kg/cm² and conversely diminishes the strength of those grades with MR below 275 kg/cm².

DERIVATION OF A STRENGTH RELATIONSHIP FOR FIBER IN THE ASBESTOS CEMENT SYSTEM

The lines 85 — MR_A — MR_C and 85 — MR_B — MR_D in Fig. III represent MR/F relationships for two different grades of asbestos fiber. At F = 0, residual MR = 85 kg/cm² representing the strength of the cement matrix only. The point MR_A does, in fact, represent the standard fiber in the strength unit context, which gives an MR of 275 kg/cm² at 10%F and has SU = 100 units. It is only at this point that MR/F and SU relationships coincide and a unitized formula to fit Fig. III cannot, therefore, be based on SU. If it were required to provide an alternative unit system, then this

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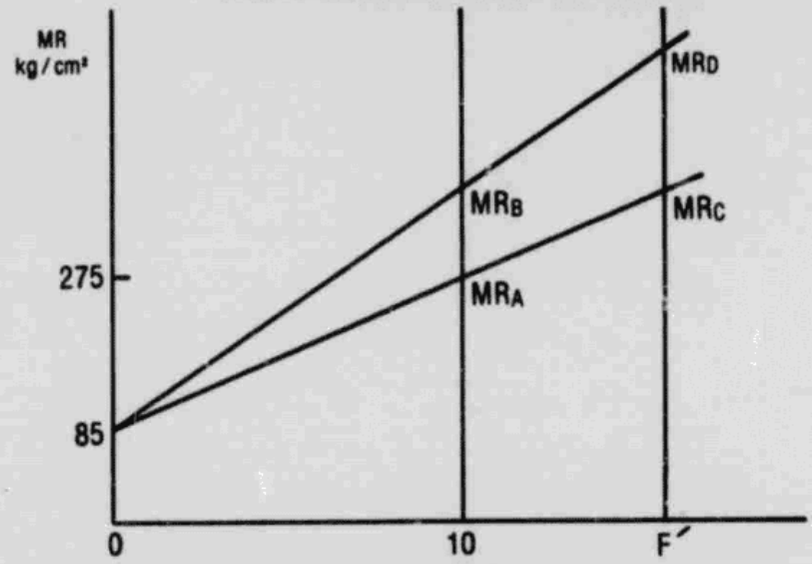


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must be based on MR units (MRU) to distinguish it entirely from the SU system.

FIGURE III

IDEALIZED MR/F RELATIONSHIPS IN ASBESTOS CEMENT—
F´ REPRESENTS ANY ARBITRARY FIBER CONTENT



An MRU system is derived in the following way. The concept of the standard fiber, as represented by the point MR_A, is retained but this standard fiber now has MRU = 100. Since (MR − 85) and F are directly related, all other points MR_B, MR_C, MR_D, etc., can be expressed in terms of MR_A by

$$MRU_F = \frac{(MR_x - 85) \times F}{19} \qquad \text{(Appendix I)}$$

where F indicates any % fiber content and MR_x is the measured MR at 10% fiber content of the particular grade of asbestos fiber under investigation. However, in practical terms, such an expression is unnecessary since it is merely a transposition from one set of units to another. Nor is it necessary to consider fiber strength values in terms of a standard fiber. In practice, what is required is knowledge of the potential reinforcing strength of a grade of fiber or of a blend of fibers to meet the required mechanical properties of an asbestos-cement sheet or pressure pipe. The points MR_A and MR_C, and MR_B and MR_D are connected by the direct and preferred general relationship

$$(MR_F - 85) = (MR_{10} - 85) \times \frac{F}{10}$$

where MR_{10} is reinforcing strength at a standard 10% fiber loading and MR_F is the reinforcing strength at any other fiber loading F.

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For practical purposes, MR_{10} has to be measured for all grades of fiber under consideration. MR_F can then be determined for individual grades of fiber or for blends of fiber.

To summarize then, the Strength Unit concept produces a curve relating reinforcing strength to fiber content in a way which cannot be substantiated by experimental evidence. Examined in the barest detail, this curve is in fact a geometrical device and the concept offers no possibility that, as the title to this paper suggests, an acceptable straight line relationship can by some means be derived from a restatement of the basic formula.

To achieve a totally unambiguous straight line solution to this problem, one must use the direct relationship between measured reinforcing strength and fiber content as observed in a-c composite materials. The essential part of a test method for determining the reinforcing strength of asbestos in asbestos cement lies in the measurement of reinforcing strength, MR_{10}, of the composite at a fixed 10% fiber content and at a composite density of 1.6×10^3 kg/m³. When MR_{10} is known for various grades of asbestos, then MR_{10} for a mix of these grades emerges by proportional calculation. The potential strength of an individual fiber grade or a mix of grades at any other fiber content F is derived from the general expression relating MR and F:

$$(MR_F - 85) = (MR_{10} - 85) \times \frac{F}{10}$$

Furthermore, the potential reinforcing strength of individual grades or mixes of grades under conditions of composite density other than the standard density can be calculated by the rules adopted for density relationships. The method, therefore, offers complete scope for direct evaluation of asbestos grades in practical situations.

This basic technique for the preparation of test specimens and the determination of MR for asbestos grades in asbestos cement is documented in two methods in the Chrysotile Asbestos Test Manual (Ref. I and II). There is, however, no mathematical justification for attempting to express a standard reinforcing strength in any other terms than MR_{10} in kg/cm² or N/m², whichever is preferred, from which all essential practical data, and, in the final analysis, cost-effectiveness values of asbestos grades and furnishes can be calculated.

REFERENCES:

1. Chrysotile Asbestos Te Manual, 3rd Edition, 1974 (ATI INC. and QAMA)—Section F-2: Method for Asbestos Fibre Strength Unit.
2. Chrysotile Asbestos Test Manual, 3rd Edition, 1974 (ATI INC. and QAMA)—Section F-3: Strength in Asbestos-Cement Products.

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APPENDIX I

Derivation of the expression $MRU_F = \frac{(MR_x - 85) \times F}{19}$:

From Fig. III, the point MR_A represents the standard fiber giving an MR of 275 kg/cm² at the standard density of 1.6×10^3 kg/m³ and standard furnish of 10% fiber (F), and is represented by 100 MRU.

$$\text{Then } 100 \text{ MRU} = MR_A - 85 = 190 \text{ kg/cm}^2 \quad (1)$$

The point MR_B represents another grade of fiber, giving an MR of MR_B at 10%F, and

$$MRU_B = \frac{MR_B - 85}{MR_A - 85} \times 100 = \frac{MR_B - 85}{1.9} \quad (2)$$

The points MR_A and MR_C and the points MR_B and MR_D are connected by the general relationship:

$$(MR_F - 85) = (MR_{10} - 85) \times \frac{F}{10} \quad (3)$$

$$\text{Thus } (MR_D - 85) = (MR_B - 85) \times \frac{F}{10} \quad (4)$$

and following from (2)

$$MRU_D = \frac{(MR_D - 85)}{(MR_A - 85)} \times 100$$

$$= \frac{(MR_B - 85)}{190} \times \frac{F}{10} \times 100$$

$$= \frac{(MR_B - 85) \times F}{19}$$

The reinforcing value of any grade of fiber at any fiber content F, expressed as percentage, is given by

$$MRU_F = \frac{(MR_x - 85) F}{19}$$

where MR_x is the measured reinforcement as modulus of rupture under standard test conditions at 10% fiber content.

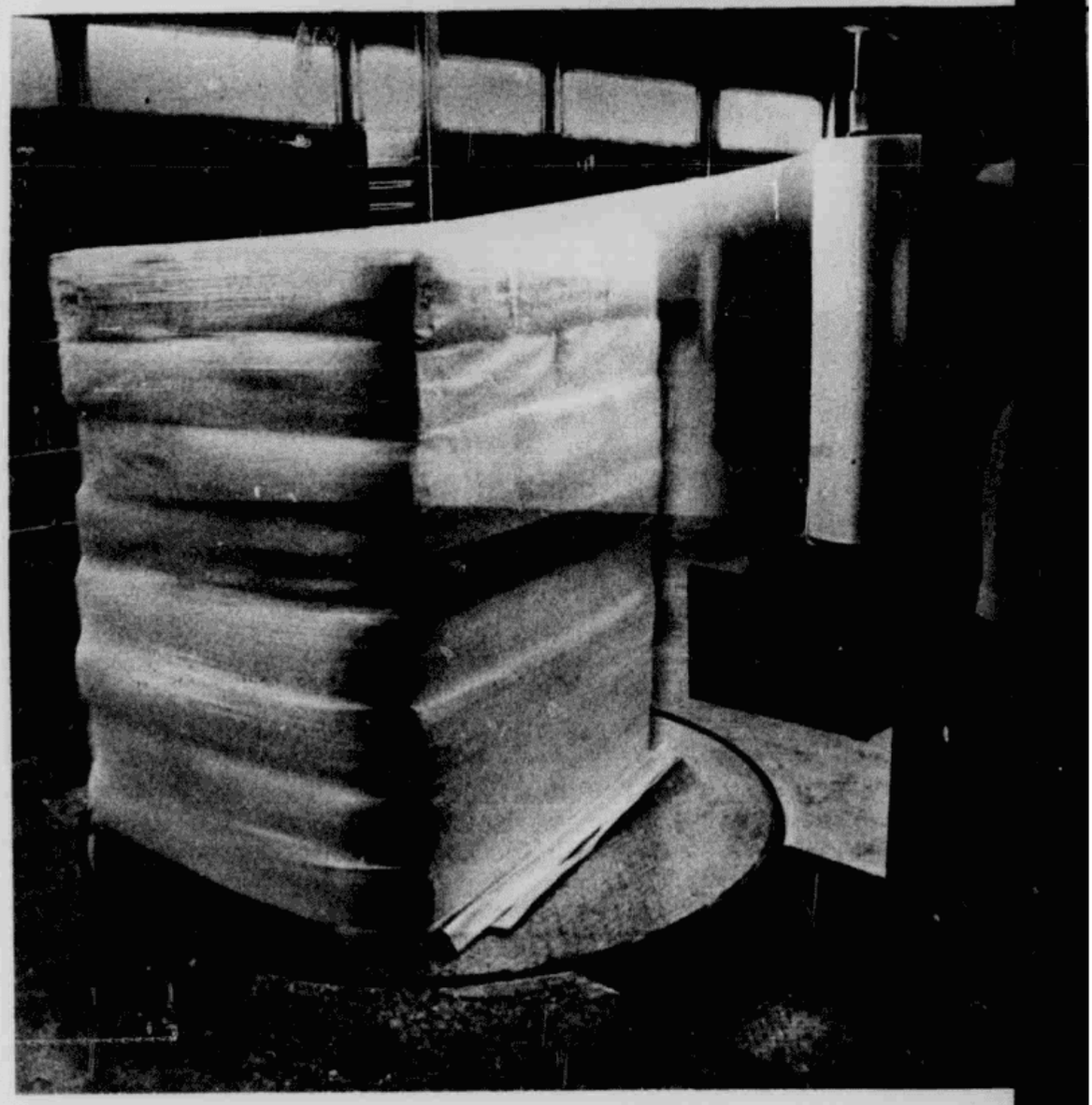
Alternatively, this can be expressed as

$$MRU_F = MRU_{10} \times \frac{F}{10}$$

where MRU_F is strength units at fiber content F and MRU_{10} is strength units at 10% fiber content.

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COMPANIES & PRODUCTS

QUEBEC OPENS PAPER PLANT

Lupel-Amiante, a new asbestos papermaking plant, was officially opened May 4, 1979, by the Quebec Minister of Natural Resources, Yves Berube. The factory, a division of the provincial government agency, Societe Nationale de l'Amiante (SNA), is situated at Cap-de-la-Madeleine, near Trois Rivieres, on the north shore of the St. Lawrence River. This is the first of several enterprises planned by the government in its campaign to increase the amount of Quebec asbestos used in the manufacturing industry of the Province. Over the next four years, SNA envisages projects requiring an investment of some $75-million, creating about 450 direct jobs and raising the amount of Quebec asbestos used in local product manufacture to 8%. The figure currently stands at 3%. The overall objective is to increase employment some 1,500 to 2,000 over the coming decade, raising the processing percentage to 12%, and ultimately to 20%.

The first material for the new plant is 12-foot-wide asbestos flooring felt, which, when combined with latex, serves as a backing for vinyl floor coverings. The manufacture of asbestos roofing paper is planned at a later date.

Lupel-Amiante is a three-way partnership between SNA; Papiers Cascades, Kingsey Falls; and Domco Industries Ltd., a maker of resilient floor coverings in Montreal. Papiers Cascades was responsible for converting the already-existing papermaking machine formerly operated at the site by Consolidated-Bathurst Ltd. Domco will handle worldwide marketing for the new operation.

When in full production, Lupel-Amiante will have the capacity to annually produce 40,000 tons of material, containing 85% asbestos. Domco, which currently imports its flooring felt from the United States and Canada, will purchase the first 10,000 tons of Lupel-Amiante's production.

Within the next three years, SNA hopes to add asbestos paper to the Lupel-Amiante line in widths to meet the metric needs of world markets. Cost to install the necessary additional equipment is placed at $8-million.

Dow Chemical of Canada Ltd., Sarnia, Ontario, supplier of latex used in asbestos papermaking, will begin production next year at its latex plant now under construction at Varennes, Quebec.

It is interesting to note that flooring felt was one of the products selected by Sores Inc. in its study for the Quebec Asbestos Mining Association, undertaken to determine what materials offered the best commercially-economic opportunities for increas-

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ing the asbestos products manufacturing industry in Quebec. Sores estimated the market potential for a new producer of flooring felt would be some 70,000 tons by 1985. If this proves accurate, Lupel-Amiante could well be on its way to becoming a major producer, with the capability of supplying over half of that projected by Sores.

Lupel-Amiante, plus a pilot plant in the offing to extract magnesium chemicals from asbestos tailings and an anticipated friction materials operation, represent an investment of about $11.5-million. The latter possibility, in line for early development, will probably be an automobile disc brake lining venture with Canadian Distex Ltd., a friction materials maker in St. Laurent, Quebec.

The magnesium products project, to be sited at Thetford Mines, Quebec, will be a prototype plant to extract, from asbestos tailings, such magnesium components as sulfate, carbonate, oxide and hydroxide. These substances are used by the chemical industry as neutralizers and additives in rubbers and polymers, and by the pharmaceutical industry, notably in antacids.

The pilot plant will be named MAGNAQ-1, meaning Magnesium-Asbestos-Quebec. It will have the capacity to produce 5,000 to 7,000 tons of material a year. An investment of some $6-million is expected and production start-up is scheduled for early 1980. If the process proves feasible, SNA will construct MAGNAQ-3, which will be a plant 5-10 times the size of the pilot plant. MAGNAQ-3 will involve an investment of some $35-million and will also be located at Thetford Mines.

SNA also is looking seriously at the possibility of putting into production, by 1982, a third plant at Thetford Mines; this to be called MAGNAQ-2 and to preliminarily cost some $20-million. It would be for the production of magnesium metal, for eventual export to the U.S., Japan, Australia and the Middle East.

ASBESTOS PRODUCTS/U.S. CENSUS REPORT

Operators of the asbestos products manufacturing plants in the United States (SIC 3292) reported value-of-shipments for the industry at $881.6-million and employment at 13,900 workers in 1977, according to a preliminary report of the 1977 Census of Manufactures, just issued by the Bureau of the Census, U.S. Department of Commerce. The value-of-shipments figure, unadjusted for price change, rose 16% over 1972 but fell 11% from 1976. Employment declined 34% below 1972 and 16% below 1976. Pennsylvania, California, New York and Illinois accounted for about 45% of the industry's 1977 employment. . . . Value-added-by-manufacture amounted to $439.7-million in 1977, some 3% over 1972. Value-added-by-manufacture approximates the

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value of shipments, less the cost of materials used to make the products. . . . Shipments of asbestos products by all manufacturing establishments, including those not classified in this industry, were valued at $958.1-million, an increase of 29% over 1972 ($742.6). Product shipments, by category, were: asbestos friction materials—$271.8-million in 1977 vs. $209.5-million in 1972; asphalt and vinyl asbestos floor tile—$232-million in 1977 vs. $208.4-million in 1972; asbestos textiles, insulation and other asbestos and asbestos-cement products—$429.5-million in 1977 vs. $319.4-million in 1972; other asbestos products—$24.8-million in 1977 vs. $5.3-million in 1972. . . . There were 122 establishments in this industry in 1977, 75 of which had 20 or more employees. The figures for 1972 were 142 establishments, 97 with 20 or more employees. Payroll totaled $179.2-million in 1977 compared with $171-million five years prior. End-of-year inventories were valued at $167.5-million in 1977 against $136.3-million in 1972. Delivered cost of materials, containers and supplies was $390.2-million in 1977 ($288.9-million in 1972), including $104.2-million of asbestos crude and fiber ($78.7-million in 1972).

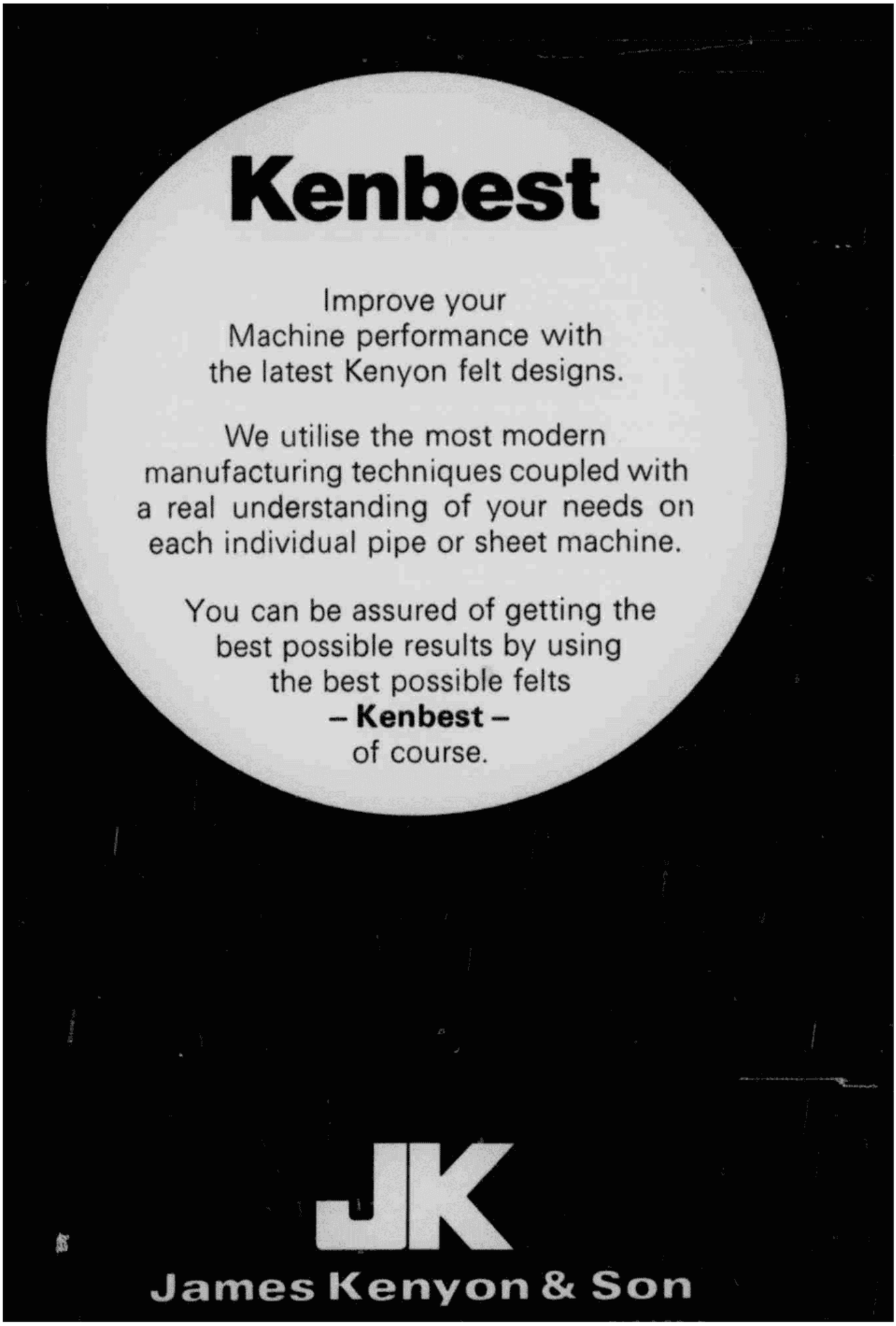
ATLAS TURNER EXPORTS ON THE RISE

Atlas Turner Inc., Montreal, Quebec, (formerly Atlas Asbestos Co. Ltd.), has been awarded a five-year, $23-million contract to supply asbestos-cement panels for large cooling towers to be built at various locations in the United States. First delivery is due August 1979 to Research Cottrell, Inc., at Bound Brook, New Jersey. A total of 22 jobs have been added at the Atlas plant in Montreal because of the contract. Atlas plans to invest $2-million to adapt equipment to accommodate the contract and further business being promoted in the U.S. This export drive could give the company additional sales of $7-million a year and could increase the firm's asbestos fiber usage some $3-million worth. . . . John Zacharias, President of Atlas Turner, along with local government officials, officiated March 30, 1979, at the ribbon-cutting ceremony commemorating the opening of the manufacturer's new Distribution Center at Surrey, British Columbia. Atlas has spent some $675,000 on the facility. The Center will allow Atlas and its affiliated Turners Building Products Ltd., Mission, B.C., to better supply distributors and applicators in Western Canada and the United States.

THE DYNATECH PIPE TESTER

An instrument for evaluating the thermal performance of pipe insulation samples is available from Dynatech R/D Company, Cambridge, Massachusetts. Simulating a 3″ IPS pipe, the instru-

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ment's cylindrical, heated test fixture accommodates 36″-long insulation specimens with a 3.5″ inner diameter and up to a 6″-thick wall. Tests are conducted over a 40° to 800°C temperature range with a ±3% accuracy. The Model TCP-R16 Pipe Tester is designed specifically for determining the thermal conductivity of homogeneous pipe insulations, or the thermal conductance and thermal transference of homogeneous as well as non-homogeneous pipe insulations, in accordance with ASTM Specifications C-335 and C-691.

KUWAIT USES FARBEN TECHNOLOGY

Farben Industrial Development, Torino, Italy, announced that a final contract for a second asbestos-cement pressure pipe plant for Kuwait Asbestos Industries was signed by Dr. L. Bianco, General Manager of Farben, and H. Al-Atiqi, Chairman of National Industries Company. The first such Farben plant was received by Kuwait between 1962 and 1978 and included four lines. This second plant includes two lines for the production, according to ISO standards of a-c pipes with nominal diameters from 100 mm to 2,000 mm. Each line can produce up to 120 tons per day. The finishing department has 12 machines, including a lathe for large pipes and a-c mandrels. Other Farben plants in the Middle East are at Aleppo, Syria; Mashad, Douroud and Ahwaz, Iran; and the nearly-completed plant of Umm-Al-Qaiwain, in the Arab Emirates.

ASTM C-16 THERMAL RESISTANCE STATEMENT

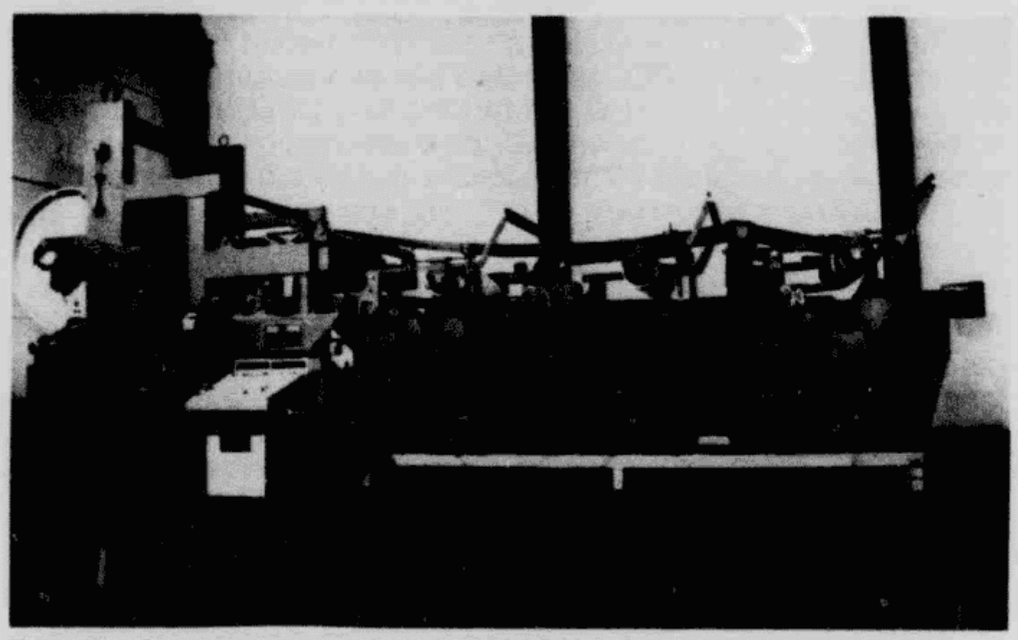
In recent years, the use of thick, low-density thermal insulation to conserve energy has become a widespread practice. However, a number of practical problems exist which impede accurate measurements of the thermal resistance of such materials. In light of this, Committee C-16 on Thermal and Cryogenic Insulating Materials, American Society for Testing and Materials, prepared a position statement that delineates the problem and some pending solutions and cautions against inaccurate testing practices. The text of the statement appears in the March 1979 issue of ASTM Standardization News.

GERMAN PLANT TO CLOSE

Deutsche Kap-Asbestwerke, A.G., Germany, a subsidiary of Saint-Gobain-Pont-A-Mousson, will close the middle of this year. It is claimed that the textile processing of asbestos, as carried out by the company, was no longer competitive due to cheaper imports from Spain, Yugoslavia and South Korea. [Industrial Minerals]

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MARKET CONDITIONS

GENERAL BUSINESS

While many manufacturing businesses continue to operate at near-peak capacity, statistics indicate that a slowdown in the general economy is underway. Sales of large chain retailers leveled off in April and actually decreased when corrected for inflation. There appears to be a shift of consumer purchases from soft goods to durables despite which sales of domestic automobiles slumped in April. Sales of compact models and of small imported cars were strong, prompted by fears of gasoline shortages to come.

The brightest spot in the overall picture is the indication that capital spending plans are being revised upward as a result of the high level of current operations. If such plans materialize promptly, capital goods activity could pick up much of the slack resulting from a contraction in consumer spending.

Inflation continues at a double-digit rate as food prices have not come down sufficiently to offset rising fuel costs. Many oil-producing countries are selling on the spot-market at prices well above the "official" OPEC price and it is almost certain the base price will again be raised at the forthcoming OPEC meeting. The administration's voluntary wage-price guidelines have shown little success in moderating inflation and it is now officially admitted that the overall inflation rate of 1979 will certainly exceed 8%. An indication of feelings about our inability to contain inflation can be found in the price of gold which rose to a new all-time high in May.

On the energy front, the U.S. situation shows signs of further deterioration. In California, a shortage of gasoline has resulted in long lines of cars waiting to top off their tanks and spot shortages of gasoline and diesel fuel are occurring elsewhere. Congress, in its infinite wisdom, has rejected several plans presented by the President for standby powers to ration gasoline and, with no apparent recognition of the fact that government intervention lies at the root of many of our present energy problems, a group of "liberals" is trying to prevent the President from decontrolling the price of oil. Should these people be successful, they may be hailed as friends and saviours of the consumer today, but it would be interesting to see the consequences of their actions five years or so down the road. It is no mere coincidence that many of these are the same people who, in the face of a slight recession, would advocate throwing money at it regardless of the effects of such acts on inflation.

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We do not pretend to be philosophers but it concerns and hurts us deeply when we see the greatest country on earth foundering on the shoals of indecision-impotent in the face of problems which once would have been considered mere challenges to demonstrate the strength and resourcefulness of its people—and all because, somewhere along the line, we have fallen for the historically-discredited idea that government can solve all problems for all its people.

MOTOR VEHICLE FACTORY SALES

FIRST QUARTER 1979—Motor vehicle factory sales from plants in the *United States* totaled 3,257,121 during the first three months of 1979 compared with 3,090,297 in the first quarter of 1978. Breakdown for the latest period is: 2,292,855 passenger cars (up 52,002) and 964,266 trucks and buses (up 114,822).

Factory sales from plants in *Canada* reached 485,127 motor vehicles to March 1979 compared with 448,197 in the comparable, year-earlier quarter. [Motor Vehicle Manufacturers Association of the United States, Inc.]

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PRODUCTION—IMPORTS—EXPORTS

AUSTRALIAN IMPORTS & EXPORTS—For the *Nine Months Ended March 1979*, Australia *imported* 24,699 metric tonnes of asbestos, valued at A$10,574,702; behind the same period a year earlier 44% in quantity and 48% in value. The breakdown by variety of asbestos for the latest nine months is: Chrysotile, 14,047 tonnes (down 23.1%); Amosite, 7,489 tonnes (down 41.5%); Other, 3,163 tonnes (down 75.6%). Import quantities and values for prior nine-month periods were: 44,042 tonnes, valued at $20.3-million to March 1978; 50,558 tonnes, valued at $20.7-million to March 1977; 38,116 tonnes, valued at $12.8-million to March 1976; 38,116 tonnes, valued at $7.4-million to March 1975. . . . *Exports* of all types of asbestos for the *Nine Months Ended March 1979* totaled 26,313 tonnes, valued at $10,114,315; ahead 1% in quantity, but behind 42.2% in value. Export quantities and values for prior nine-month periods were: 26,059 tonnes, valued at $17.5-million to March 1978; 21,949 tonnes, valued at $6.9-million to March 1977; 26,967 tonnes, valued at $8.3-million to March 1976; 11,892 tonnes, valued at $19.1-million to March 1975. [Australian Bureau of Statistics]

CANADIAN FIBER SHIPMENTS—Primary Canadian producers' *shipments* of asbestos (including tonnage for own use and concentrate shipped from Asbestos Hill) amounted to 108,442 tonnes in *January 1979*, 109,331 tonnes in *February 1979* and 123,242 tonnes in *March 1979*. The cumulative total for *January-March 1979* was 341,016 tonnes: 302,038 tonnes from plants in Quebec and 38,978 tonnes from plants in Newfoundland, Ontario, British Columbia and the Yukon. The total for the First Quarter of 1978 was 306,983 tonnes: 261,511 tonnes from Quebec plants and 45,472 tonnes from plants in the other four Provinces. [Statistics Canada, Ottawa]

SOUTH AFRICAN OUTPUT & EXPORTS—Asbestos *production* for the *First Nine Months of 1978* totaled 192,255 tonnes, 33.4% less than in the same period in 1977. Breakdown for January-September 1978 is: 104,917 tonnes of Cape Crocidolite (down 48,323 tonnes), 57,846 tonnes of Chrysotile (down 57,846 tonnes), 29,375 tonnes of Amosite (down 21,615 tonnes), 117 tonnes of Transvaal Crocidolite (up 97 tonnes). No Anthophyllite was produced, compared with 550 tonnes to September 1977. . . . *Exports* for the *First Nine Months of 1978* were valued at R82,937,151, down 16.3% from the same 1977 period. By variety of asbestos, the values for the latest period are: Cape Crocidolite—R56,593,676 (down R8.5-million); Chrysotile—R10,784,810 (down R5-million), Amosite—R15,558,665 (down R2.6-million), Anthophyllite—none exported in 1978 vs. R24,094 worth the prior year. [Department of Mines, Braamfontein]

TAIWAN PRODUCTION & IMPORTS—Taiwan *produced* 2,031 tonnes of asbestos in the *Year 1978* compared with 2,453 tonnes in 1977, 2,491 tonnes in 1976, 1,737 tonnes in 1975, 2,957 tonnes in 1974 and 5,308 tonnes in 1973. The asbestos produced in Taiwan is a brittle fiber, mostly Tremolite and Actinolite ranging from ¼" to 20". The product is primarily crushed into powder for the manufacture of heatproof plastic tiles. . . . *Imports* into Taiwan totaled 24,892 tonnes in *1978*, valued at US$12-million—12,110 tonnes from Canada, 11,325 tonnes from the Republic of South Africa and 1,457 tonnes from Other Countries. Imports in the prior year amounted to 25,343 tonnes. The imported asbestos is used in the making of such fireproof materials as asbestos-cement sheets, roofing tiles and tubings. [Ministry of Economic Affairs, Taipei]

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CURRENT ASBESTOS PRICES

QUEBEC

As of July 1, 1979

Per Ton of 2000 Lbs., F.O.B. Mine
Canadian Dollars

No. 2 Crude	$2295
No. 3 Spinning Fiber	$1023—$1606
No. 4 Asbestos Cement Fiber	687— 1011
No. 5 Paper Fiber	388— 580
No. 6 Paper and Shingle Fiber	330— 352
No. 7 Shorts	113— 218

CASSIAR

As of January 1, 1979

Per Ton of 2000 Lbs., F.O.B. North Vancouver, B.C.
Canadian Dollars

Cassiar Mine

C-1	—No. 1 Crude	$3621
AAA	—Nonferrous Spinning Fiber; Canadian Group 3	2000
AA	—Nonferrous Spinning Fiber; Canadian Group 3	1600
A	—Nonferrous Spinning Fiber; Canadian Group 3	1050
AC	—Nonferrous Spinning Fiber; Canadian Group 3	960
AK	—Asbestos Cement Fiber; Canadian Group 4	850
AS	—Asbestos Cement Fiber; Canadian Group 4	740
AX	—Asbestos Cement Fiber; Canadian Group 4	670
AY	—Asbestos Cement Fiber; Canadian Group 5	470
AZ	—Asbestos Cement Fiber; Canadian Group 6	340

Clinton Mine

CT	—Asbestos Cement Fiber; Canadian Group 4	$ 680
CY	—Asbestos Cement Fiber; Canadian Group 5	470
CZ	—Asbestos Cement Fiber; Canadian Group 6	340

VERMONT

As of January 1, 1979

Per Ton of 2000 Lbs., F.O.B. Morrisville, Vermont
U.S. Dollars

Grade 4T Fiber	$ 591
Grade 5K Fiber	457
Grade 5R Fiber	368
Grade 6D Waste	284
Grade 7D Shorts	188
Grade 7M Shorts	108
Grade 7R Shorts	100
Hooker No. 1	1250
Hooker No. 2	700

ARIZONA

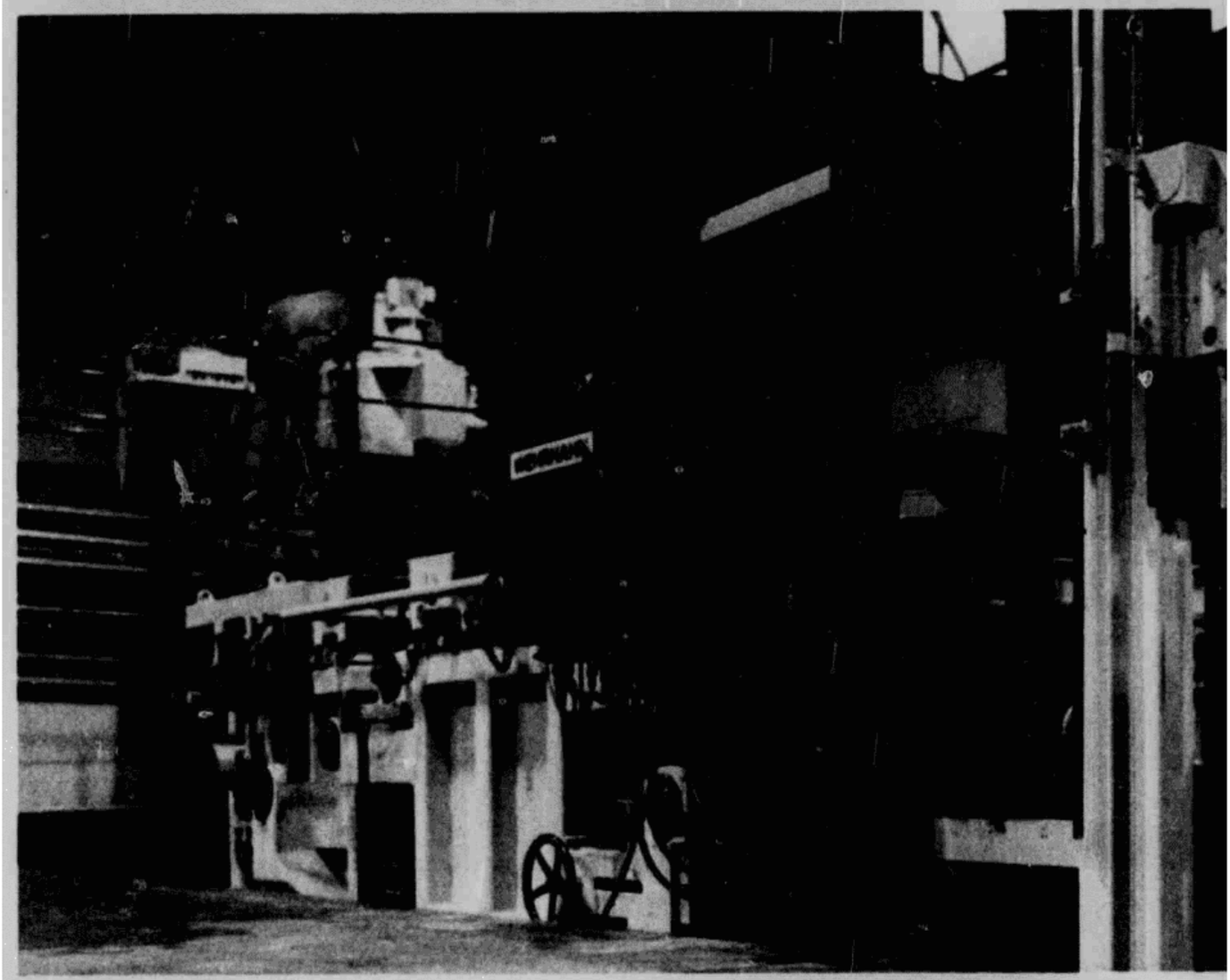
As of July 1, 1976

Per Ton of 2000 Lbs., F.O.B. Globe, Arizona
U.S. Dollars

No. 1 Crude (Soft)	$3000
No. 2 Crude (Soft)	1800
AAA	1300
Group No. 3 Nonferrous Filtering—Plastic	$ 750— 840
Group No. 4 Nonferrous Filtering—Plastic	750— 840
Group No. 7 White Shorts	100— 200

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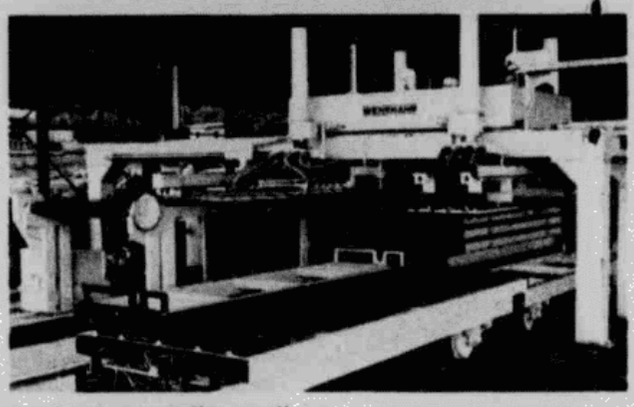
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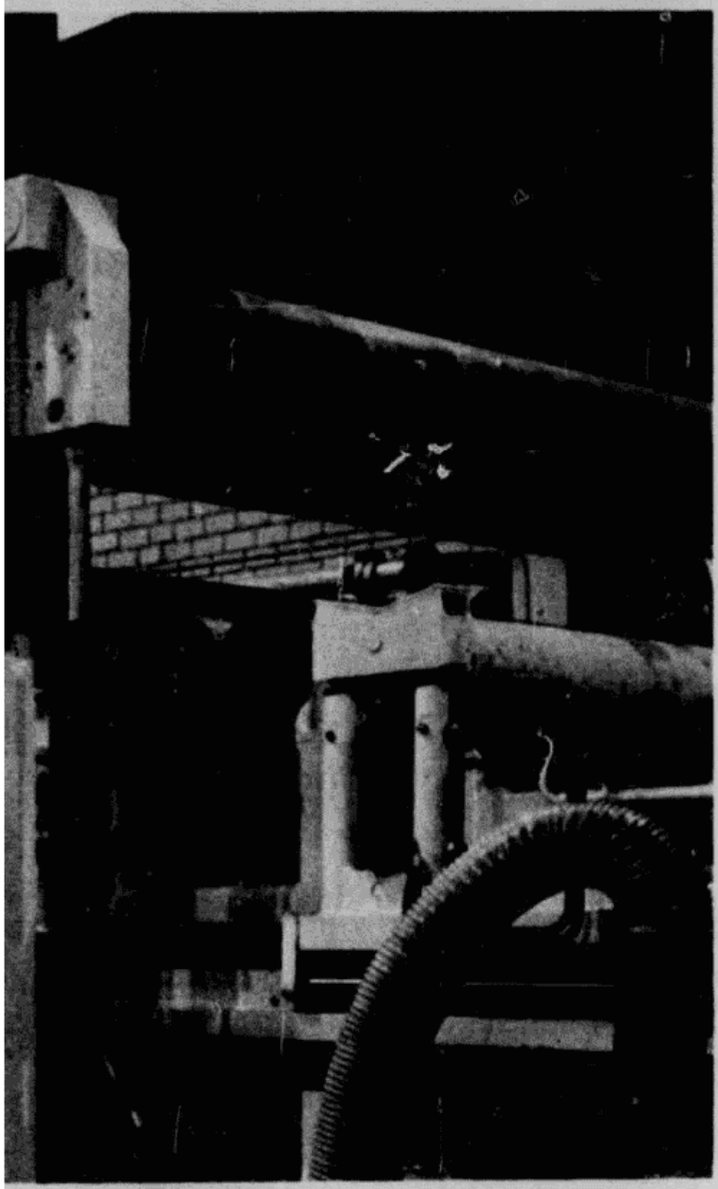
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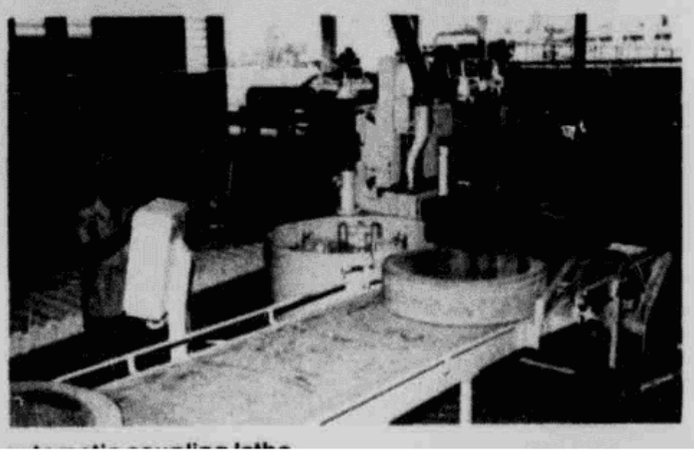
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EXPORTS FROM CANADA

From: Statistics Canada

JANUARY 1979

Short Tons

UNMANUFACTURED ASBESTOS:	Crude	Milled Gp 3	Milled Gp 4&5	Shorts Gp 6-9
Western Europe	..	533	17,621	17,727
Eastern Europe	..	220	2,620	115
Middle East	..	..	1,920	119
Africa	..	..	300	300
Asia	..	256	7,027	11,207
Oceania	..	..	971	177
So. & Cen. America & Antilles	..	265	5,200	8,083
United States	..	575	11,560	43,743
Short Tons	..	1,849	47,219	81,471
Metric Tonnes	..	1,678	42,836	73,910

The total amount of unmanufactured asbestos exported in *January 1979* was 130,539 short tons (118,424 tonnes), valued at C$43,963,000.

MANUFACTURED ASBESTOS PRODUCTS:

Asbestos cloth, dryer felts & sheets	C$	521,000
Asbestos brake linings & facings		261,000
Asbestos-Cement building materials		1,138,000
Other basic asbestos products		611,000
	C$	2,531,000

FEBRUARY 1979

UNMANUFACTURED ASBESTOS:	Crude	Milled Gp 3	Milled Gp 4&5	Shorts Gp 6-9
Western Europe	..	421	12,438	11,002
Eastern Europe	..	..	2,262	..
Middle East	..	88	60	91
Africa	..	..	1,200	239
Asia	..	635	8,793	7,165
Oceania	..	..	1,694	99
So. & Central America & Antilles	..	134	4,213	4,040
United States	..	367	13,567	40,745
Short Tons	..	1,645	44,227	63,381
Metric Tonnes	..	1,493	40,125	57,499

The total amount of unmanufactured asbestos exported in *February 1979* was 109,253 tons (99,117 tonnes), valued at C$39,218,000.

MANUFACTURED ASBESTOS PRODUCTS:

Asbestos cloth, dryer felts & sheets	C$	414,000
Asbestos brake linings & facings		407,000
Asbestos-Cement building materials		969,000
Other basic asbestos products		460,000
	C$	2,250,000

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EXPORTS FROM CANADA—CONTINUED

JANUARY-FEBRUARY 1979

UNMANUFACTURED ASBESTOS:	Crude	Milled Gp 3	Milled Gp 4&5	Shorts Gp 6-9
Western Europe	..	954	30,059	28,729
Eastern Europe	..	220	4,882	115
Middle East	..	88	1,980	210
Africa	..	..	1,500	539
Asia	..	891	15,820	18,372
Oceania	..	..	2,665	276
So. & Cen. America & Antilles	..	399	9,413	12,123
United States	..	942	25,127	84,488
Short Tons	..	3,494	91,446	144,852
Metric Tonnes	..	3,171	82,961	131,409

The total amount of unmanufactured asbestos exported in *January-February 1979* was 239,792 short tons (217,541 tonnes), valued at C$83,181,000.

MANUFACTURED ASBESTOS PRODUCTS:

Asbestos cloth, dryer felts & sheets	C$ 935,000
Asbestos brake linings & facings	668,000
Asbestos-Cement building materials	2,107,000
Other basic asbestos products	1,071,000
	C$4,781,000

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THE ASBESTOS MINING SCENE

WILL QUEBEC EXPROPRIATE?

Following are some of the remarks made by Guy W. Fiske, Chairman, and M. E. Taschereau, President, at the recent Annual General Meeting of Shareholders of *Asbestos Corporation Ltd.* The comments concern the announced intention of the *Provincial Government of Quebec* to take over the mining company.

Mr. Fiske said the serious situation began in October 1977 when the Premier of Quebec formally announced the government's desire to acquire the 54.6% interest in Asbestos Corporation (ACL) held by *General Dynamics Corporation.* General Dynamics (GD) had absolutely no desire to dispose of its holdings in the company. However, in an effort to protect the interests of all the shareholders of ACL, GD retained the respected investment banking firm of Lazard Freres & Co. to conduct an independent valuation of the assets, markets and future business prospects of the company. Once the team was assembled, Quebec recognized its need for such information, so it, too, asked its hired consultants to conduct a similar study. No negotiations had been conducted between GD and the government up to that point, but ACL was certain that discussions would begin once the studies were completed. After many months, the studies were completed—and a comparison of the two lead one to believe they were dealing with two different companies.

In December 1978, Bill 121 was tabled in the Quebec Assembly. If passed, it would pave the way for expropriation of the assets of Asbestos Corporation. Bill 121 was reintroduced when the current session of the Assembly convened in March 1979. [Editor's Note: The second of three required readings of the bill took place early this month, after which the Quebec legislature approved in-principle legislation which would empower the provincial government to expropriate all of ACL's operations in Quebec. The approval-in-principle is to be followed by a legislative committee study before a final reading of and vote on the bill. The government may seek to close off debate if necessary to assure a final vote before a summer recess June 22. A spokesman for the Quebec Minister of Natural Resources said that while the legislation would enable the province to expropriate, it would prefer to arrive at a negotiated settlement with General Dynamics over its holding. A valuation of GD's holding undertaken for the province puts the price at about C$42.00 per share, or some $62-million. The study for General Dynamics suggests US$99.75 a share, or a total of $154.5-million.]

Mr. Fiske went on to say, "It is now apparent to virtually everyone that this ill-advised, politically motivated action does no good for anyone. The takeover of Asbestos Corporation would not be in the best interests of the company, would not result in greater product fabrication or more employment, and would not be in the best interest of either Quebec or Canada as a whole, both of which require and seek large U.S. investments in local industry and for development of energy resources. . . . Is this the beginning of the end of private enterprise in Quebec in several major sectors? Is investing in Quebec worth the risk? It is not too late for the government to turn back, now that the public is fully aware of the facts. I am sure that everyone would accept and respect a graceful withdrawal from the

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government's position of confrontation and expropriation." Mr. Fiske further stated ACL management stands ready to cooperate with the government in every other way possible to help achieve its worthy goals, and the door is still open for discussion on the wide range of alternatives available in the area of joint ventures.

Related remarks by Mr. Taschereau are as follows. "However pointless the government's proposed action may be, we nevertheless have had to deal in the marketplace with the impact of threatened expropriation. Our customers have been bombarded with so much Quebec government propaganda that several have found it prudent to secure alternate sources of supply. Most of our regular clients continue to purchase fiber from Asbestos Corporation, though some at reduced levels." Mr. Taschereau also said the objectives "as we understand them" are laudable; that is, increasing the manufacture of finished asbestos products in Quebec and increasing employment. However, none of these objectives will be accomplished by the government acquiring control of Asbestos Corporation.

Speaking at the Annual Meeting of the *Quebec Asbestos Mining Association,* Immediate-Past-President M. J. Messel (President of Lac d'Amiante du Quebec Ltee) said that a satisfactory working relationship can be achieved between the Quebec government and the primary asbestos industry in the province, so long as the government does not alter the ground rules on which the industry operates. The industry has shown a great deal of goodwill in its relations with the Quebec government and has amply demonstrated that it is determined to continue to do its utmost towards promoting the economic interests of Quebec.

ASARCO TO DRILL REX PROPERTY

Via an agreement entered into in April 1979, *Asarco Inc.* is committed to spend a minimum of $50,000 for additional drilling on the Rex asbestos property at Haines Junction, in the Yukon. The property is held by *Golden Gate Explorations Ltd. and its President, William J. Abraham.* Included in the program is at least six diamond drill holes to confirm results obtained during rotary drilling carried out in 1978, which was done at a previously undrilled section and which opened an entirely new area with large potential. In addition to the minimum commitment, the terms of the pact call for a further $200,000 worth of work in 1980 and $250,000 in 1981, plus a minimum of $75,000 per year thereafter and annual cash payments to Golden Gate Explorations. If Asarco meets all the criteria and takes the property into production, it is entitled to a 75% property interest, with Golden Gate retaining 25% carried interest. Asarco had explored the main asbestos zone when it held the property, under option, several years ago. Also, *Placer Development Ltd.* and *Cominco Ltd.* had each had an option at various times in the past.

ASBESTOS ON EXHIBIT IN THETFORD

The *Mining and Mineralogical Museum of the Asbestos Region* is now in operation at its new quarters in Thetford Mines, Quebec, having outgrown its former premises at the Black Lake Cultural Center. Exhibits at the museum display all categories of asbestos samples found in the province as well as in various other countries where asbestos is mined. Other

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types of rock and mineral samples are also on show. Ancient photographs, books, documents, paintings and mining equipment bear witness to the evolution of the asbestos mining industry. Also on display is a model of the open-pit and underground facilities of Bell Asbestos Mines Ltd. at Thetford Mines, as they were in the 1950's. The manufacturing sector is represented by a collection of asbestos-based finished products. Visitors are afforded the opportunity to examine various rock, ore and mineral samples via a microscope and an ultraviolet lamp. [QAMA Bulletin]

THE SOUTH AFRICAN SITUATION

A major capital expenditure program to improve recovery efficiencies has been undertaken in the Republic of South Africa by *Griqualand Exploration and Finance Co. Ltd.* Fiber recovery totaled 64,338 tonnes in 1978 compared with 76,103 tonnes in 1977. Owing to an oversupply of low-grade asbestos, the Bretby Mine in the Northern Cape was closed late last year. The closure will initially reduce Crocidolite output some 10%. . . . Although sales increased for the higher-priced, longer fibers, *Msauli Asbes Ltd.*, producer of Chrysotile, was faced with increased competition and Russian dumping in Far Eastern markets. As a result, fiber production was reduced from 100,700 tonnes in 1977 to 71,000 tonnes in 1978. Msauli has nearly completed improvements to its recovery plant and underground mining operations. . . . Gefco and Msauli are managed by *General Mining and Finance Corporation Ltd.*

KIEMBAY PRODUCING IN THE USSR

According to "Engineering & Mining Journal," the *Kiembay asbestos deposit* at Orenburg Oblast', on the eastern slopes of the southern Urals, produced its first small tonnages of asbestos fiber in January, claimed by the Russians to be ahead of schedule. The first stage of the complex is to be completed later this year and full production (500,000 tonnes per year of Grades 3-6) is anticipated in the early 1980's. The output is to be shared among participating Comecon members.

CAPE MAY SELL AFRICAN INTERESTS

Newscasters are reporting that *Cape Industries Ltd.*, London, England, is negotiating the sale of its asbestos mining companies in South Africa to *Transvaal Consolidated Land and Exploration Co. Ltd.* The proposed transaction is subject to approval by British and South African authorities. Major shareholder in Cape is Charter Consolidated Ltd., which holds some 66.9% in the Group. South Africa accounts for nearly all of the world production of the Amosite and Crocidolite varieties of asbestos.

VERMONT EXPANSION PLANS

Vermont Asbestos Group, Inc., Lowell, plans to spend millions of dollars to expand its mining and milling operations over the next 15 years. Major mine development entails moving large quantities of barren rock to gain access to a 17-year supply of high-quality asbestos deposits. Quarry expansion includes the purchase of larger equipment, such as 50-ton hauler trucks. [U.S. Bureau of Mines]

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ANNUAL REPORTS—1978

TURNER & NEWALL LTD.

In the United Kingdom and overseas, Turner & Newall Ltd. is a leader in most of its manufacturing operations and is one of the U.K.'s larger exporters of manufactured industrial products. Although *1978 sales* at £541-million, were 31% higher than last year, *profit before tax* was £38.5-million, down 15%. *Profit attributable to stockholders* fell £8.6-million to £17.3-million, before a charge for extraordinary items of £7.6-million. The *factors contributing to the decrease* were lower profit margins on sales due principally to severe price competition in European markets, lower activity in Nigeria and two strikes in Canada . . . *Contributions to total Group sales* in 1978, by product division (with contribution to trading profit in parentheses) were: plastics and industrial materials—35% (26%), automotive components—27% (30%), construction materials—22% (18.5%), chemicals—8% (12%), asbestos mining and fiber distribution—8% (13.5%).

In September, the Group sold its minority shareholding in *United Asbestos Cement Berhad*, Malaysia, for £3.4-million. Faced with surplus capacity, *TAC Construction Materials, Ltd.*, Manchester, is closing certain manufacturing facilities at three sites, at a cost of £6-million. *British Industrial Plastics Ltd.*, near Birmingham, is reorganizing its engineering and moulding activities, at a cost of £3.8-million. During the year, T&N increased, from 32% to 68%, its shareholding in *Bureau Technique International SA*, a major distributor of automotive components in Belgium, and acquired an 80% interest in *Harlequin Wallcoverings Ltd.*, southern England, the 75% of the shares of *Transprints (UK) Ltd.* not previously owned; and *FIAAM Filters SpA*, a manufacturer of automotive filtration products in Italy.

Plastics and Industrial Materials—The expected growth of *British Industrial Plastics* did not fully materialize due to intense competition from Europe. *Storey Brothers and Co. Ltd.*, Lancaster, achieved a marked improvement in profit over the previous year. By penetrating new overseas markets and making further technical progress in its more specialized products, *TBA Industrial Products Ltd.*, Rochdale, managed to increase sales 4% and improve exports to 45% of sales revenue. Although sales of industrial textiles and sealing materials were slow early in 1978, a marked revival occurred later in the year. TBA further improved its high standards of quality and safety in the manufacture of asbestos products and more asbestos substitute products were developed and launched, with good reception.

Automotive Components—T&N companies in the U.K. were adversely affected by uncertain trading conditions in the more competitive environment, aggravated by strikes within the British vehicle industry and a recession in the world tractor market. Modernization and re-equipment of automotive gasket manufacturing facilities of *Engineering Components Ltd.*, Slough, will largely be completed by the end of this year. Higher profits were earned by *Flexitallic Gaskets Ltd.*, Cleckheaton, and its industrial product range was extended by the acquisition of *Hydra-Tight Ltd.*, a maker of bolt tensioning equipment. For the *Ferodo* companies in the U.K. (which increased trading profit 6%), higher sales in the replacement

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market were outweighed by the lower-than-expected British and European demand for original equipment for cars and tractors. In Germany, *Ferodo GmbH* earned higher profits and during the year opened a new branch in Hamburg. Following strong sales demand in the domestic and export markets, the Friction Materials Division of *Ferodo Italiana SpA* achieved a good result. *Hindustan Ferodo Ltd.* had a successful year, slightly improving profits despite industrial unrest and uncertain trading conditions in India. The manufacture of friction materials by *Turners Engineering Products (Nigeria) Ltd.* had been delayed, but will begin during the first half of 1979. In South Africa, *Ferodo* and *Payen Components* earned higher profits, the *Ferobrake* parts distribution companies in Natal and the Transvaal traded satisfactorily and T&N's partners' equity in *Flexitallic Gaskets Africa* was acquired and the firm relocated in Johannesburg. In the United States, *Flexitallic Gasket Co. Inc.* recovered from the depression of the previous year and *Nuturn Corporation* achieved its profit plan and built a new factory and warehouse at Smithville, Tennessee.

Construction Materials—Profit improvements were again achieved by the companies operating in Europe and higher demand in the U.K. more than compensated for lower exports. *Newalls Insulation Co. Ltd.* significantly improved trading profit and its new glass fiber line is to be in production by mid-1979. Despite a sharp decline in export demand for asbestos-cement products, *TAC Construction Materials Ltd.* succeeded in increasing sales over 10% and trading profit 42%, reflecting improvements in manufacturing performance. TAC launched an asbestos-free building board, called Tachboard, and announced plans to concentrate production of asbestos-cement sheets at Widnes and Tamworth and pipes at Erith. Investments are planned at these factories to improve productivity. In France, *Ets Degard et Fils SA* increased sales in 1978 but profit margins were reduced as cost increases were not recovered in prices. *Atlas Turner*, in Canada, received a major contract to supply panels for cooling towers in the United States and has begun a £1-million capital expenditure program to improve efficiency and increase capacity. *Turners Building Products Ltd.* continued to operate profitably in British Columbia. Further progress was made by *Asbestos Cement Ltd.* in expanding business into the rural areas throughout India. After several years of buoyant conditions in Nigeria, both *Turners Building Products (Emene) Ltd.* and *Turners Building Products (Arewa) Ltd.* suffered a large decrease in demand for their products. Demand is expected to improve and new capacity will be commissioned in 1979. In South Africa, *Turnall* sustained its 1977 level of profits, the plant in Zambia operated efficiently, good results were achieved by *TAP Building Products Ltd.* and *Unipipe (Pty) Ltd.* earned a profit for the first time. The two *Tegral* companies operating in the Republic of Ireland also earned higher profits.

Chemicals—Philip A. Hunt Chemical Corporation, United States, had a successful year in 1978. Dollar sales revenue increased nearly 24% and operating profit rose more than 31%.

Asbestos Mining and Fiber Distribution—As predicted, prices for asbestos fiber were under pressure and demand was weak in all markets, with the exception of the United States. However, through improved operating efficiency, vigorous marketing and tight cost control, the mines controlled by Turner & Newall succeeded in increasing profits over the

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previous year. *Bell Asbestos Mines Ltd.*, Thetford Mines, Quebec, substantially completed the modernization of its surface installations and is now engaged in modernizing its underground mining methods. *Havelock Asbestos Mines (Swaziland) Ltd.* continued to maintain a highly-efficient and profitable operation. The mining difficulties have been overcome at *Dublin Consolidated Asbestos Mines (Pty) Ltd.*, South Africa, and operations have returned to a good level of profitability.

ASBESTOS CORPORATION LTD.

Operating results for the year 1978 included the second highest sales and the third highest net income in the history of Asbestos Corporation Ltd., although earnings were lower in 1978 than in 1977. *Net sales* increased to $147.1-million, exceeding 1977 sales by $1.7-million but 3% below the 1976 record. Sales grew in each succeeding quarter of 1978, reflecting the predicted recovery in the asbestos fiber market. *Net income* in 1978 was $15.7-million, or $5.51 per share, compared with $21-million, or $7.40 per share, in 1977. Profit margins were affected by the continuing high rate of inflation, lower prices due to weak conditions in the market in early 1978, significantly reduced sales of certain higher-priced fibers and increased operating costs including a $2.2-million foreign exchange translation loss. *Net working capital* increased $8-million to $68.7-million; the *long-term, debt-to-equity ratio* remained very healthy at 0.16:1, the ratio of *current assets to current liabilities* remained strong at 2.4:1 and *cash flow from operations* was $29.7-million.

The *weakened world demand for asbestos*, which began in 1977, continued throughout most of 1978, as several major consuming countries continued to be plagued by recessionary conditions. To curtail inflation, governments refrained from spending on public works and regional development projects which affected demand in the asbestos-cement pipe industry. In addition, reduced capital spending for new industrial plants in Europe and the Far East resulted in lower asbestos-cement sheet consumption. These factors affected Asbestos Corporation's market in 1978, since over 85% of its production (Grades 4, 5 and 6) is suitable for asbestos-cement products. Market research indicates that *long-term demand for asbestos is strong* and that shortages of good a-c fibers are likely to develop in the second half of 1979. Continued expansion in asbestos-cement manufacturing facilities, especially in the developing countries, promises a stronger demand for the principal grades of fiber produced by the company.

Asbestos Corporation spent or committed $29.1-million in the last three years to improve conditions in and around work areas via *advanced dust control methods and equipment.* With few exceptions, dust levels are well within government standards.

Proven ore reserves at year-end were 226,468,000 tons vs. 226,243,000 tons in 1977. Of these reserves, 80.7-million tons are at the British Canadian Mine, 78.8-million tons are at the King Beaver Mine, 31.6-million tons are at the Normandie Mine, and 17.4-million tons are at Asbestos Hill, leaving 17.9-million tons at other properties. A sufficient quantity of new ore was proven to more than replace the approximately 9.6-million tons of ore mined in Thetford and Asbestos Hill in 1978. In addition, there are 90-million tons classified as probable ore reserves and

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200-million tons classified as possible. Reduced sales of Nordenham fiber in 1977 and 1978 resulted in an increase in ungraded fiber inventory.

Thetford Operations—In 1978, 24.6-million tons of rock were mined, and 8.3-million tons of ore were processed, resulting in 213,400 tons of asbestos fiber compared with 209,200 tons in 1977. The operations at Thetford Mines consist of three complete primary and secondary finishing mills, together with four integrated ore preparation and storage plants. The mills are fed from three separate mines—the King underground and the Beaver and British Canadian open pits; producing 4,500, 31,000 and 60,000 tons of ore per day, respectively. The bulk of the underground ore is transported to the two mills at British Canadian, with a small tonnage going to the Normandie mill. The Beaver pit ore is beneficiated, dried and transported by 115-ton trucks to the Normandie mill. The Normandie plant has the capacity to mill in excess of 8,000 tons of rock per day, whereas each of the two British Canadian mills can process over 7,000 tons per day.

Asbestos Hill—In 1978, 6.6-million tons of rock were mined, 1.3-million tons of ore were processed, 218,000 tons of ungraded fiber were produced, resulting in 71,700 tons of asbestos fiber compared with 79,300 tons in 1977. The life of the Asbestos Hill Mine and its companion finishing mill at Nordenham, West Germany, has been extended for many years through the continued confirmation of feasible underground mining in the Northern Quebec permafrost. In 1978, as part of the underground mining development at Asbestos Hill, a 10-foot-diameter, 960-foot-long ventilation shaft was completed through to the surface. Underground development work will continue this year. The mine and plant are located in the Ungava Peninsula, 1,130 miles due north of Montreal. The operation consists of an open-pit mine, an ore preparation and storage plant and a primary mill which produces ungraded fiber. The mine produces 1.5-million tons of ore per year, at a waste-to-ore ratio of 3.5:1. The orebody is comprised basically of Group 4 fiber. The mill is designed to produce a high-quality ungraded fiber that yields 35% asbestos when processed in the mill at Nordenham. Ungraded fiber is loaded into bulk carriers for shipment to the Nordenham finishing mill, situated across the Weser River from Bremerhaven. The mill is a modern plant which automatically reclaims the ungraded fiber and produces high-quality, high-strength, asbestos-cement grades for customers throughout Eastern and Western Europe, North Africa and the Middle East.

AN UPDATE ON THE CURRENT STATUS OF THE POSSIBLE ACQUISITION OR EXPROPRIATION OF ASBESTOS CORPORATION LTD. BY THE PROVINCE OF QUEBEC IS GIVEN ON PAGE 34 OF THIS ISSUE OF "ASBESTOS."

SUPRADUR MANUFACTURING CORPORATION

Sales by Supradur Manufacturing Corporation and its subsidiaries in 1978 totaled $27.2-million, 15.7% over 1977; *net income* rose 121% to $1.3-million; and year-end *retained earnings* increased 13.6% to $8.3-million. *Contributions to sales, by product category* (with contribution to income from operations in parentheses), were: 41% for siding and roofing (53%), 27% for precast concrete (19%), 20% for heating equipment (20%) and 12% for fabricated sheet metal (8%). K. Fred Netter, President, reports that Supradur's financial position remains strong. *Current*

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assets at year-end totaled $13.5-million vs. *total current liabilities* of $4.7-million; *net working capital* amounted to $8.8-million, equal to $8.74 per share; *cash and equivalents* totaled $4-million, or $3.97 per share; and *shareholders' equity* was $9-million, or $8.71 per common share. . . . As a first move toward expanding into the security systems industry, Supradur secured an option to purchase *DTI Security, Inc.*, Sunnyvale, California. It is anticipated the company will exercise its option later this year.

Sales of *mineral-fiber siding and roofing materials* increased again in the domestic market. Export sales declined, but sales of European-made products more than offset the decline and Supradur's overseas business actually increased. In the fall of 1978, another shift was added at the plant at Wind Gap, Pennsylvania. Although the company normally ships from stock, a backlog of unfilled orders began developing near the end of the year and production capacity was increased during the first quarter of 1979. . . . *Precast/Schokbeton, Inc.*, the precast concrete subsidiary in Kalamazoo, Michigan, operated under much more favorable conditions in 1978 and finished the period at a profit. . . . Sales of *heating and air conditioning products* in Canada were at about the same level as the previous year, but profits, after conversion into U.S. dollars, were significantly improved. . . . Sales of *precision fabricated sheet metal products* increased some 25% in 1978. . . . *Export sales and foreign operations* were conducted through Suprawall Corporation, VSG Ambit Vertriebs A.G., Hambau GmbH and Brixite A.G.

ASBESTOS STOCK QUOTATIONS

Close—May 15, 1979

Abitibi Asbestos	C$.75
Advocate Mines	C$2.20
Armstrong Cork	17
Armst. Cork (pfd 3.75)	42
Asarco	16¾
Asbestos Corporation	C$44.50
Bendix	36⅞
Bendix (pfd 3)	36⅞
Carlisle	19½
Cassiar Asbestos	C$10.00
CertainTeed	15¼
Charter Conso.	pence 163
Colt Industries	39¼
Colt Ind. (pfd 1.60)	30½
Colt Ind. (pfd 4.25)	84
Conwest	C$5.75
Flintkote	30⅜
GAF Corporation	10⅝
GAF (pfd 1.20)	14¾
Gulf & Western	14⅜
G&W (pfd 2.50)	32⅜
G&W (pfd 3.87)	69⅜
IC Industries	24¾
IC Ind (pfd 3.50)	40⅜
Jim Walter Corporation	30
Jim Walter (pfd 1)	10
Jim Walter (pfd 1.60)	32
Johns-Manville	23⅞
Johns-Manville (pfd 5.40)	62¼
Kennecott Copper	22⅛
Lear Siegler	18⅜
Lear Siegler (pfd 2.25)	46
Maremont	25¼
McAdam Mining	C$.35
National Gypsum	19½
Pathfinder	Bid C$.26
	Asked C$.28
Porter (pfd 5.50)	75¼
Raybestos-Manhattan	30
Rio Algom	C$32.00
Rio Algom (pfd 5.80)	C$78.50
Supradur	Bid 4¾
	Asked 5½
Union Carbide	36¼
United Asbestos Inc.	C$2.90
Woodsreef Minerals	C$.37

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MEN ON THE MOVE

THE ASBESTOS INFORMATION CENTRE LTD.

Charles M. Fenton has succeeded *Harry Hardie* as Chairman of The Asbestos Information Centre Ltd., London, England. He has been active in the AIC for several years and is a past Chairman of the Asbestosis Research Council. Mr. Fenton is Vice Chairman and Group Managing Director of BBA Group Ltd.

CASSIAR ASBESTOS CORPORATION LTD.

Brian G. Pewsey, Vice President-Operations, will be working out of the Vancouver, British Columbia, office of Cassiar Asbestos Corporation Ltd. He will continue responsible for mine operations at the Cassiar Mine, ongoing requirements relative to the closure of the Clinton Creek Mine and exploration activity for the company. . . . *Peter C. Jones* has been appointed Mine Manager of the Cassiar Mine, effective June 1, 1979. He will be directly responsible to Mr. Pewsey.

SOUTHERN TEXTILE CORPORATION

Southern Textile Corporation, Charlotte, North Carolina, has named *James R. Hicks* as Plant Engineer. His extensive background in industrial textile processing and quality control is expected to contribute much toward the maintenance and improvement of product quality.

TURNER & NEWALL LTD.

As of May 1, 1979, *Allan A. S. Rae* is a Non-Executive Director of Turner & Newall Ltd., Manchester, England. He is Chairman of the Board of the CIBA-GEIGY group of companies in the United Kingdom and a Member of the Executive Committee of CIBA-GEIGY Ltd., Basle, Switzerland. . . . Also announced was the appointment of *S. M. Gravett* as Controller-Group Accounting, succeeding *J. H. Haselwood*, retired. Mr. Gravett joined the T&N Group in 1969 as Specialist-Accounting Development, TAC Constructions Materials Ltd.

WATTS, GRIFFIS AND McOUAT LTD.

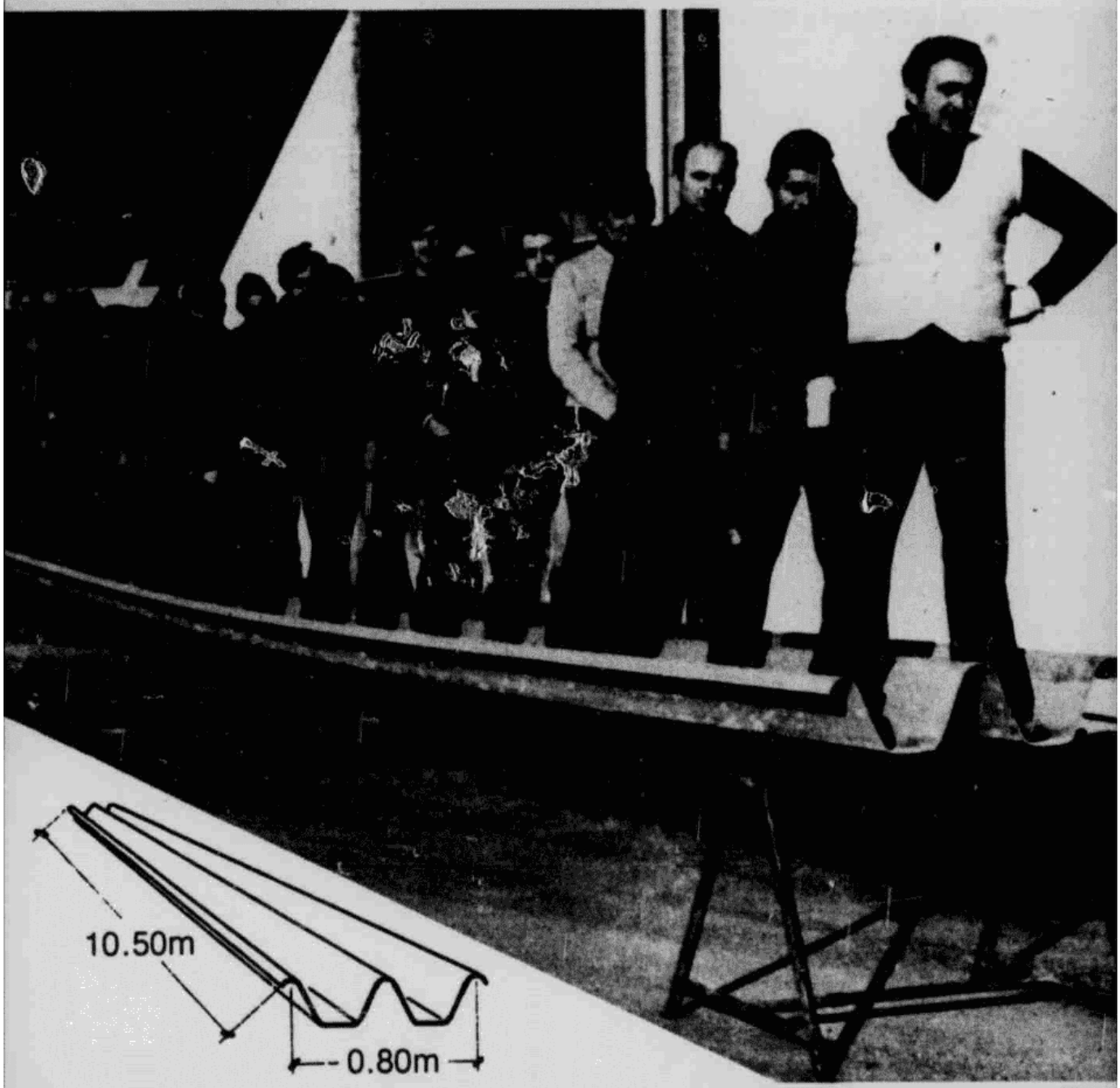
Newly-elected officers of Watts, Griffis and McOuat Ltd., Toronto, Ontario, include *A. T. Griffis* as Chairman, *J. F. McOuat* as President, *Ross D. Lawrence* as Executive Vice President and *James Bates* as Vice President. Dr. Griffis will reduce his involvement in day-to-day administration and will concentrate on technical matters. Mr. McOuat will continue to provide liaison between the offices at Toronto, Anchorage, Alaska, and Houston, Texas. Administration and direction of projects in the Middle East will be the duties of Mr. Lawrence and Mr. Bates will have prime responsibility for mining projects. . . . *Ronald Garofolo* has been appointed an Associate of WGM. He has over 30 years experience in engineering and marketing in the mining industry and will assist the consulting firm with equipment procurement and staff recruitment for the Al Masane underground development project in Saudi Arabia.

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BIRTHDAY GREETINGS to . . .

L. J. Adams, Vice President-Marketing, Atlas Turner Inc., Montreal, Quebec, July 14.
D. C. Cook, General Mill Superintendent, Cassiar Mine, Cassiar Asbestos Corporation Ltd., Cassiar, British Columbia, July 15.
Dr. Ernst J. Schmidheiny (Switzerland), Chairman, Everite Ltd., Johannesburg, Republic of South Africa, July 16.
W. Ray Blankenship, Vice President-Sales, Pipe & Plastics Group, CertainTeed Corporation, Valley Forge, Pennsylvania, July 17.
Ronald L. Cutler, Vice President-Sales, Friction Products Group, Abex Corporation, New York City, July 17.
Harry A. Jensen, President, Armstrong Cork Company, Lancaster, Pennsylvania, July 17.
Alfred Yondola, Vice President and Treasurer, Supradur Manufacturing Corporation, New York City, July 17.
Richard J. Boehm, Manager-Field Personnel Operations, Asarco Inc., New York City, July 18.
William R. Doughty, Chief Executive, Building and Insulation Division and a Director, Cape Industries Ltd., London, England, July 18.
Lawrence B. Lee, Controller, Raybestos Manhattan Industrial Products Company, North Charleston, South Carolina, July 18.
W. R. Stadelman, President, Ontario Research Foundation, Sheridan Park, Mississauga, Ontario, July 18.
Roy A. Jann, Vice President-Marketing, Raybestos Friction Materials Company, and a Corporate Vice President, Raybestos-Manhattan, Inc., Trumbull, Connecticut, July 19.
Victor L. Persbacker, Vice President-Administration, Abex Corporation, New York City, July 20.
William S. Simpson, Chairman of the Board and Chief Executive Officer, Raybestos-Manhattan, Inc., Trumbull, Connecticut, July 21.
Robert C. Congdon, Eastern Regional Manager, Carey Canada Inc., Lebanon, New Jersey, July 23.
Charles J. DeBiase, Senior Vice President, Building Materials Group, Johns-Manville Corporation, Denver, Colorado, July 23.
J. F. Collins, Vice President-Marketing, Union Carbide Corporation, Metals Division, Niagara Falls, New York, July 24.
Dimitry Poutiatine, Director of Marketing, Asbestos Fiber Division, Johns-Manville Corporation, Denver, Colorado, July 25.
M. Sanfeliu, Joint Managing Director, Frenos y Embragues S.A., subsidiary of BBA Group Ltd., Barcelona, Spain, July 25.
Richard C. Wareham, President, Special Materials Inc., Milwaukee, Wisconsin, July 26.
J. P. Farrell, a Deputy Chief Executive, Building and Insulation Division, Cape Industries Ltd., London, England, July 31.
George Sidlo, Manager, Ragland Plant, Cement Asbestos Products Company, Ragland, Alabama, July 31.
W. Horace Beasley, Vice President-Controller, Cement Asbestos Products Company, Birmingham, Alabama, August 1.
B. G. Pewsey, Vice President-Operations, Cassiar Asbestos Corporation Ltd., Vancouver, British Columbia, August 1.

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Thomas A. Dougherty, Senior Vice President, Pipe & Plastics Group, CertainTeed Corporation, Valley Forge, Pennsylvania, August 3.

N. George Belury, President and Chief Executive Officer, Abex Corporation, and Group Vice President-Commercial Products, IC Industries, Inc., New York City, August 4.

Joe B. Cordell, President and Chief Operating Officer, Jim Walter Corporation, Tampa, Florida, August 4.

R. W. Forth, President, Raybestos-Manhattan (Canada) Ltd., Peterborough, Ontario, August 4.

H. Kenneth Passmore, Secretary-Treasurer and a Director, Hedman Mines Ltd., Timmins, Ontario, August 5.

R. E. Byrne, Jr., Domestic Sales Manager-Asbestos, Union Carbide Corporation, Metals Division, Niagara Falls, New York, August 6.

C. G. Morgan, President, Continental Products Corporation, Chicago, Illinois, August 7.

Gerard A. Piche, Vice President and Mine Project Manager, Johns-Manville Canada Inc., Asbestos, Quebec, August 7.

R. C. Braun, Secretary-Treasurer, Niagara Insulations, Inc., Buffalo, New York, August 8.

Dewey E. Childers, Quality Control Manager, Southern Textile Corporation, Charlotte, North Carolina, August 8.

John L. Myers, Marketing Manager-Asbestos, Union Carbide Corporation, Metals Division, Niagara Falls, New York, August 8.

Thomas P. Jackson, Product Manager-Packing Rings and Textiles, Industrial Products Division Johns-Manville Sales Corporation, Denver, Colorado, August 9.

H. B. E. Stowe, General Manager, Shabanie Mine, Rhodesian & General Asbestos Corporation (Pvt) Ltd., Shabanie, Rhodesia, August 11.

Grant V. Wilson, President, Grant Wilson, Inc., Chicago, Illinois, August 11.

G. A. McCammon, Vice President-Finance, Asbestos Corporation Ltd., Montreal, Quebec, August 12.

Thomas J. Toerner, Marketing Manager, Norristown Division, Nicolet Inc., Norristown, Pennsylvania, August 12.

Gaston Verreault, Production Manager, Lac d'Amiante du Quebec Ltee, Black Lake, Quebec, August 12.

Paul Kotin, M.D., Senior Vice President-Health and Safety and Environment, Johns-Manville Corporation, Denver, Colorado, August 13.

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RETIRED, BUT NOT IDLE

DR. C. Z. CARROLL-PORCZYNSKI
GUILDFORD ASBESTOS CO. LTD.

Dr. Charles Z. Carroll-Porczynski, after 30 active years in the Asbestos industry, recently retired as Managing Director of Guildford Asbestos Co. Ltd., Guildford, Surrey, England. In that capacity, he had represented Lac d'Amiante du Quebec Ltee in the United Kingdom and in other countries, and now has signed a long-term general consulting agreement with LAQ, with special responsibility for Spain, Czechoslovakia, Greece, Turkey, Egypt and Iraq.

Prior to his association with the Industry, Dr. Carroll-Porczynski, after relinquishing his Army Commission, studied textile chemistry, science and technology at Leicester and Huddersfield Polytechnics and undertook post-graduate work at the Department of Textile Industry, University of Leeds, earning a degree of Doctor of Philosophy.

A world-renowned authority on asbestos, inorganic and manmade fibers, Dr. Carroll-Porczynski has authored several books. Among them are "Asbestos—From Rock to Fabric," "Natural Polymer Manmade Fibers," "Manual of Manmade Fibers," "Inorganic Fibers" and "Advanced Materials, Refractory Fibers, Composites." For the past twenty years, he has served as Editor of the "Asbestos Bulletin," reviewing over 15,000 patents and research papers related to asbestos science, technology and usage.

Although on a reduced scale, Dr. Carroll-Porczynski will remain active in the asbestos business and will continue his successful "textile science" farming activities.

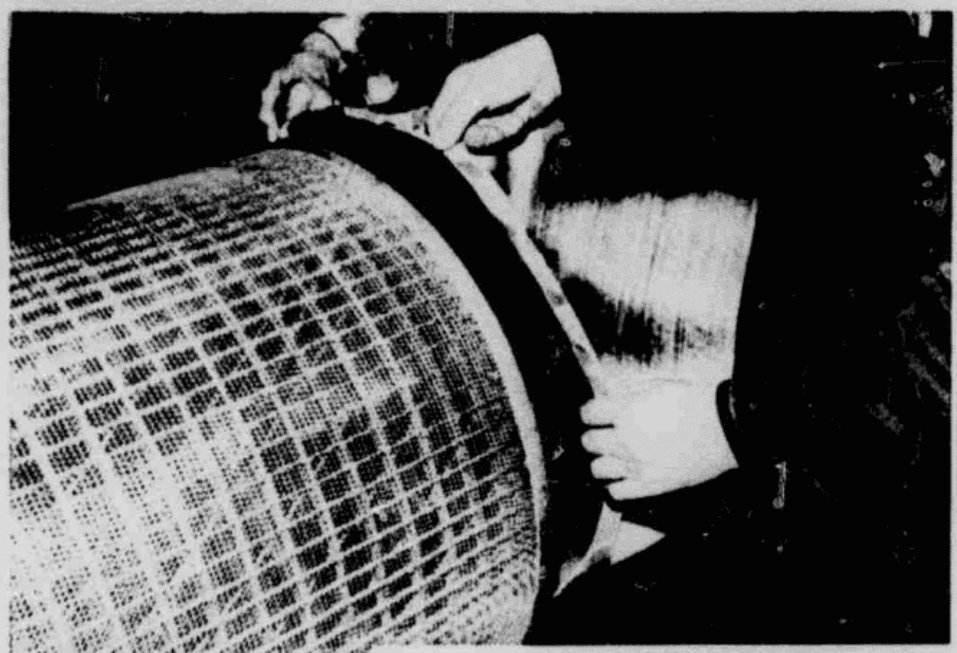
MARION W. OLIVER
RM INDUSTRIAL PRODUCTS CO.

Marion Washington Oliver retired April 1, 1979, as Vice President of Materials and Environmental Affairs for the Raybestos Manhattan Industrial Products Company, North Charleston, South Carolina, a Division of Raybestos-Manhattan, Inc. "Chief" Oliver's 40-year tenure with the company began in 1941 when he was employed as a Supply Clerk. This followed graduation from Newberry College with a B.S. degree in Political and Social Science and one year as a teacher and athletic coach.

He served four years as a Captain in the Chemical Corps of the United States Army, during which time he was awarded several campaign ribbons and battle stars as well as the Bronze Star and the Presidential Unit Citation. He returned to the company in 1946 as a Technician in the GARCO Research and Development Laboratory, later to be promoted to Quality Control Technician, Director of Quality Control, Factory Manager and Assistant General Manager. In 1973 Mr. Oliver was named General Manager and, later, Vice President, Engineering and Development, for RMIPCo. He had held his most recent post since June 1977. In addition to a productive career with R/M, Mr. Oliver was, and is, active in community affairs and during the 1960's had served on several committees of the Asbestos Textile Institute. As with all busy people, Mr. Oliver has not been idle since his retirement. He is now Senior Consultant to the President and will serve in this capacity for the next two years.

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VALUABLE LITERATURE

EXCEPT FOR THE FIRST LISTING, ORDERS FOR THE FOLLOWING MAY BE PLACED THROUGH ASBESTOS MAGAZINE. PLEASE INCLUDE REMITTANCE WITH ORDER AND SPECIFY JUNE 1979 AS DATE OF LISTING. ALL CHECKS MUST BE ISSUED IN U.S. FUNDS ON A U.S. BANK.

MINERALOGICAL TECHNIQUES OF ASBESTOS DETERMINATION—Lecture notes of short course held May 1979 in Quebec; co-organized by Robert L. Ledoux, Editor of the notes, and Professor Guy Perrault; sponsored by the Mineralogical Association of Canada; is concerned with Mineralogy/chemistry; crystallography of amphibole asbestos, technical evaluation of Chrysotile ore bodies, measurement of asbestos fibers in the workplace and in the general environment, determination of asbestos fine dust according to mass concentration, evaluation of Chrysotile by chemical methods, methods for the evaluation of asbestos dust concentration at the workplace and techniques of asbestos determination-research perspective. [287 pages; Canadian $10.00; order from The Business Manager, Mineralogical Association of Canada, c/o Department of Mineralogy, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6, Canada]

ASBESTOS/VOLUME I: PROPERTIES, APPLICATIONS AND HAZARDS—Edited by L. Michaels and S. S. Chissick, University of London; reviews the mineralogy, chemistry and physics of asbestos; contains chapters on asbestos-related diseases and their prevention, including sections on pathology and epidemiology, monitoring and identifying asbestos, dealing with asbestos problems, the use of asbestos in buildings, alternatives to asbestos in industrial applications, nonoccupational asbestos emissions and exposures and literature relating to asbestos. [535 pages; $62.50; John Wiley & Sons, Inc.]

1978 ANNUAL BOOK OF ASTM STANDARDS—Part 18 on thermal and cryogenic insulating materials, building seals and sealants, fire tests, building constructions and environmental acoustics [1220 pages; 204 standards; $37.00]; *Part 48* covering all 5,600 ASTM standards and tentative standards as well as proposed methods and other related material [300 pages; $5.00]; *Proceedings* containing the official reports of each ASTM technical committee for the year 1978 [608 pages; $19.00]. [Add 3% for shipping to the United States, Mexico and Canada and 5% to all other countries; American Society for Testing and Materials].

TAILING DISPOSAL TODAY: VOLUME 2—Proceedings of the Second International Tailing Symposium held May 1978 in Denver, Colorado; edited by G. O. Argall, Jr.; reflects the broad theme of mineral waste management, with special emphasis on tailing management; conveys new approaches to water management, flow, analysis, quality control, purification and reuse; is categorized into sections on the energy minerals industries, the minerals extraction industries, seepage/water control/failure resistance, reclamation/vegetation/abandonment and regulations affecting tailing disposal. [600 pages; $35.00; Miller Freeman Publications, Inc.]

METHODOLOGICAL APPROACHES TO DERIVING ENVIRONMENTAL AND OCCUPATIONAL HEALTH STANDARDS—By E. J. Calabrese; establishes a method for deriving standards which may be applied in new situations; evaluates strengths and limits of toxicological and epidemiological studies in the standard-setting process; provides a history of the develop-

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ment of air, water and industrial health standards; compares standards and methodologies in the USSR and other countries with those of the United States. [416 pages; $33.25; John Wiley & Sons, Inc.]

FILTRATION DICTIONARY—Reference guide containing over 550 definitions of terms relating to liquid-solid separation, air/gas/dust filtration, filter media, equipment engineering, ancillary equipment, particle technology and contamination control. [110 pages; $14.00; add $4.00 for air mail to the United States; The Filtration Society]

NEW ASBESTOS PATENTS

U.S. PATENTS MAY BE PURCHASED FROM THE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231, @50¢ EACH. PHOTOPRINTS OF NON-U.S. PATENTS MAY BE PURCHASED FROM THE SAME SOURCE AT A COST OF 30¢ PER PAGE. REMITTANCES SHOULD BE IN COIN, CURRENCY OR CHECK AND THE NUMBER OF THE PATENT, NAME OF INVENTOR AND DATE OF ISSUE SHOULD BE GIVEN.

U.S. 4,137,367—An additive composition for use in lubricants, paints, oil well drilling fluids, rubber, etc., comprises Chrysotile asbestos etched superficially with dilute acid and then contacted with octyltriethoxysilane or other organo-silane in a solvent system under mild conditions to render the fiber surfaces celophilic; T. E. Sample, Jr., & J. M. Horn; assigned to Dresser Industries, Inc., January 30, 1979; 8 pages.

U.S. 4,138,463—In the production of rigid friction material structures from a dry friction composition, a mixture of asbestos, a thermosetting resin powder and friction modifying particles is heated and plasticized in a plasticizing screw, the plastic mass extruded into a preform cup, the charge in the cup molded under heat and pressure and the final shape cured; E. E. Moneghan; assigned to Pennwalt Corporation, February 6, 1979; 18 pages.

U.S. 4,142,951—An improved, long-lasting diaphragm for use in the electrolysis of brine in a chlor-alkali cell at low anolyte pH value is fabricated from a vacuum-drawn polymeric fluorocarbon-bonded mixture of preferably about equal parts of Crocidolite and Chrysotile asbestos; R. N. Beaver & C. W. Becker; assigned to Dow Chemical Company, March 6, 1979; 4 pages.

U.S. 4,146,402—Fiber-reinforced structural units of improved bending and impact strength are fabricated from a mixture of gypsum plaster, blast-furnace slag or electric open-hearth furnace slag, sodium sulfate or potassium sulfate, aluminum sulfate, sodium fluoride and asbestos; K. Kira, Y. Makino, T. Matumoto & Y. Murata; assigned to Mitsubishi Mining and Cement Co. Ltd., March 27, 1979; 8 pages.

U.S. 4,146,527—In a dry method for manufacturing brake lining pads or the like, a solidified blend of graphite and a liquid phenolic resin is ground, the ground material mixed with asbestos, copper powder, barium sulfate and rubber dust, the mixture compression molded into desired shapes and the shapes cured and finished; Y. Yamamoto, R. Tomikawa, K. Ueda, M. Imao, T. Suzuki & T. Inoue; assigned to Aisin Seiki K. K., March 27, 1979; 5 pages.

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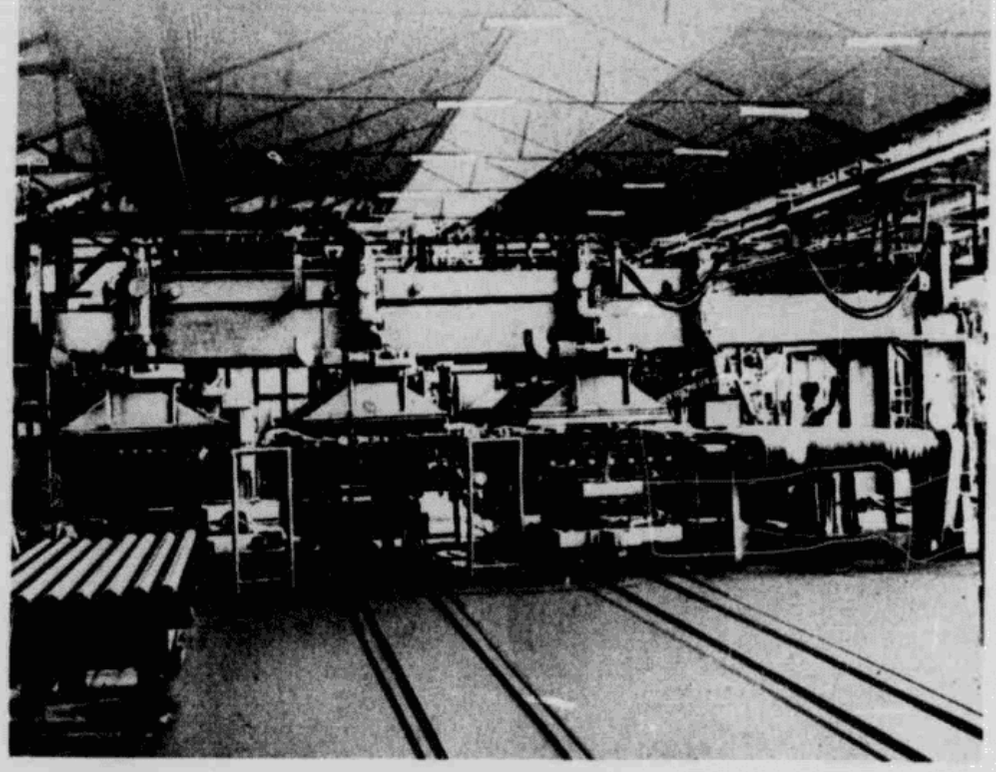
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CALENDAR OF EVENTS

SPECTROSCOPY—World Conference, sponsored by Alena Enterprises of Canada; Lisbon, Portugal, *July 2-3.*

WATER POLLUTION CONTROL TECHNOLOGY—A course of the Center for Professional Advancement; Chicago, Illinois, *July 9-11.*

CHANGING CONCEPTS OF OCCUPATIONAL MEDICINE—Course conducted by the Industrial Health Foundation; San Francisco, California, *July 9-12.*

HAZARDOUS WASTE MANAGEMENT PRACTICES—Course of the University of Wisconsin-Extension; Madison, Wisconsin, *July 9-13.*

STACK SAMPLING PROCEDURES—Technical seminars of the Research Appliance Co.; *July 12-13* at Denver, Colorado; *August 2-3* at Chicago, Illinois.

OCCUPATIONAL RESPIRATORY PROTECTION—Course #593 of the National Institute for Occupational Safety & Health; Las Vegas, Nevada, *July 16-19.*

HEARING CONSERVATION/NOISE CONTROL—Sponsored by Hearing Conservation Noise Control, Inc.; to be held at the University of Maine, Bangor, Maine; 27th Occupational Hearing Loss Institute, *July 16-20;* 16th Industrial Hearing Conservation Institute, *July 16-18;* 2nd Noise Measurement and Control Course, *July 16-20.*

INTRODUCTION TO INDUSTRIAL HYGIENE/A PROFESSIONAL APPROACH—Course presented by the American Industrial Hygiene Association; Chicago/Urbana, Illinois, *July 16-20.*

OCCUPATIONAL SAFETY AND HEALTH—Summer Training Institute of the University of North Carolina at Chapel Hill, Duke University and North Carolina State University; Boone, North Carolina, *July 16-27.*

TRANSFER AND UTILIZATION OF PARTICULATE CONTROL TECHNOLOGY—2nd Symposium sponsored by the U.S Environmental Protection Agency; Research Triangle Park, North Carolina, *July 23-27.*

APPLICATIONS OF X-RAY ANALYSIS—1979 Denver Conference of the Denver Research Institute; Denver, Colorado, *July 30-August 3.*

INSTITUTE FOR BRIQUETTING AND AGGLOMERATION—16th Biennial Conference; San Diego, California, *August 6-9.*

AUSTRALIA'S ROLE IN THE WORLD MINERAL INDUSTRY—1979 Annual Conference of The Australasian Institute of Mining and Metallurgy, Perth, Australia, *August 6-22.*

CORROSION—Education seminars of the National Association of Corrosion Engineers; Basic Corrosion and Corrosion Prevention by Cathodic Protection, *August 12-17* at Portland, Oregon; Corrosion Prevention by Coatings, *August 19-24* at Tuscaloosa, Alabama.

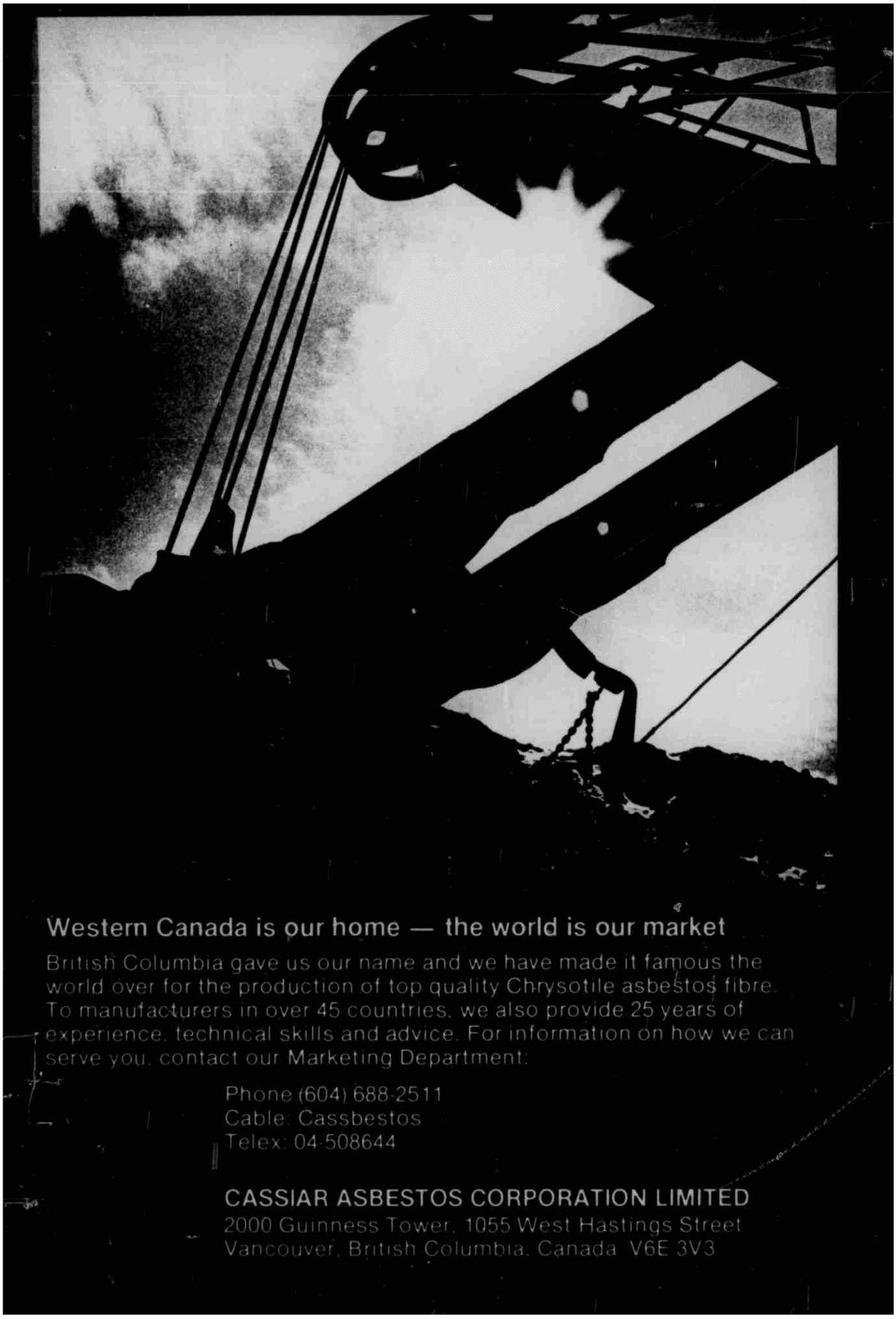
ROCK MECHANICS—4th International Congress, organized by the Swiss Society for Soil and Rock Mechanics; Montreux, Switzerland, *September 2-8.*

MOLECULAR SPECTROSCOPY—14th European Congress organized in cooperation with Gesellschaft Deutscher Chemiker; Frankfurt am Main, Federal Republic of Germany, *September 3-7.*

INTERNATIONAL MINING EXHIBITION—Organized by the Turkish National Committee of the World Mining Congress; Istanbul, Turkey, *September 15-22.*

4TH INTERNATIONAL CONFERENCE ON ASBESTOS—Will cover economic geology, geology and mineralogy, chemistry and physics, mining, recovery and refining, industrial uses, quality control and environmental aspects; Torino, Italy, *May 26-30, 1980.*

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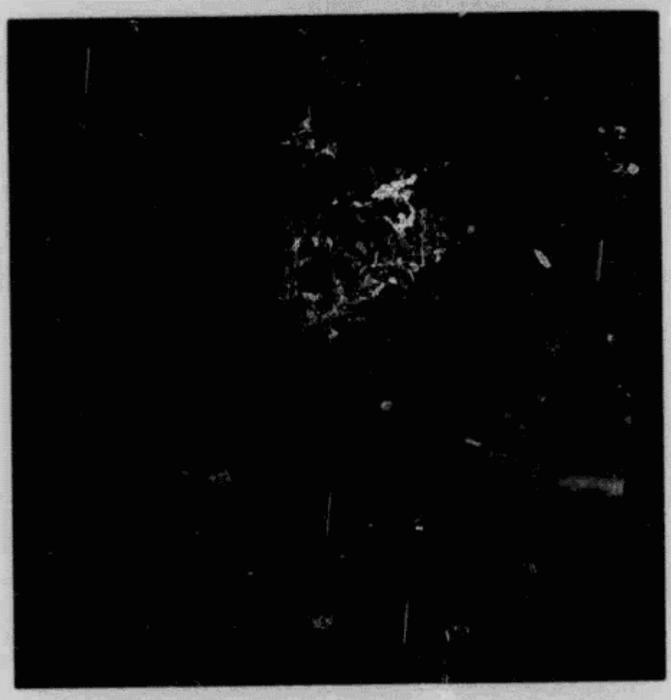
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