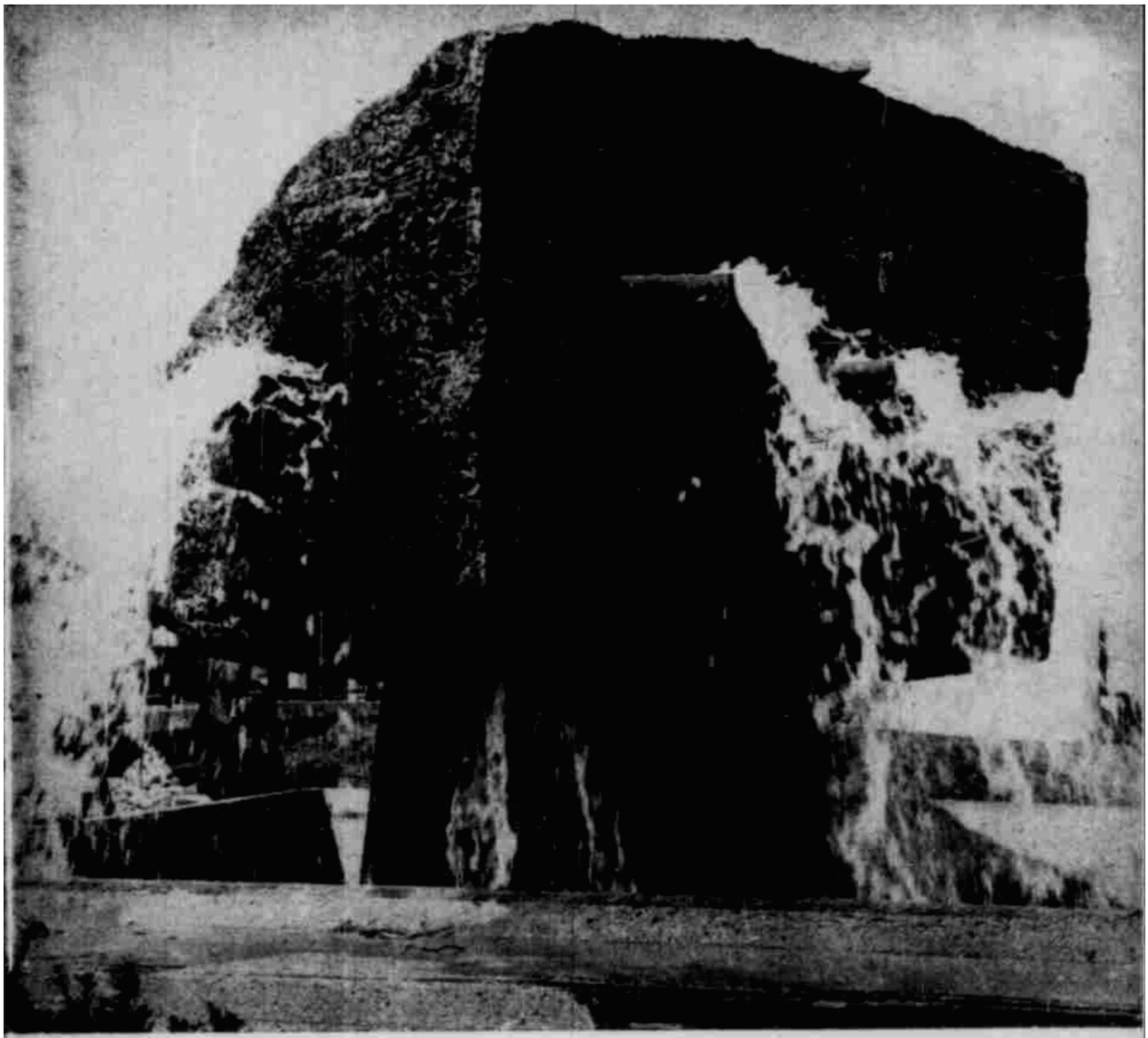


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Courtesy of Quebec Asbestos Mining Association and Quebec Asbestos Information Service

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ASBESTOS

VOLUME 48 JUNE 1967 NUMBER 12

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THE ECONOMICS OF BUILDING BETTER SEWERS

By: Marvin Watson, Johns-Manville Pipe Division

With today's technology and available materials, near perfect sewerage systems could be constructed. The problem is to determine the point between old methods and materials and gold plated systems at which a balance of performance vs. cost is achieved.

This involves consideration of performance characteristics of available materials. There are five of these characteristics which, altogether, measure the optimum economic value of a sewerage system. These are: 1) relative economic installation; 2) adequate structural strength; 3) the lowest possible infiltration and root penetration; 4) the best possible flow characteristics; and, 5) long life.

Obviously, each of these characteristics must be balanced against amortized cost and desirable quality levels then established to fit the job.

In order to determine the optimum system, performance characteristics must be converted to dollars. In sewerage financing there are three principal kinds of dollars. These are capital or construction dollars, operation dollars, and maintenance dollars. Strangely enough, some of these dollars are worth more than others. As a matter of fact, at least twenty construction dollars can economically be spent to eliminate one operation or maintenance dollar.

Spending an operation or maintenance dollar is like paying interest on borrowed money without paying back the principal. It has to be paid every year forever.

At 5% interest, $20.00 can be borrowed for construction for an annual interest payment of one dollar. If this construction eliminates one dollar or more of operation or maintenance cost, money is saved. At 4% interest, the value is $25.00 for one and at 3%, $33.00 for one.

One of the five performance characteristics conforms to the perpetual operation and maintenance cost pattern. It is infiltration and root penetration. Infiltration and root penetration are inseparable problems. One or the other can be expected throughout a system with inadequate joints, with infiltration in the wet areas and root penetration in the dry areas.



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A logical approach to determining the economic results of lower infiltration is to assume that the maximum infiltration for each type of pipe joint will be equal to the maximum amount allowable under existing specifications or currently recommended by the manufacturer for each of these joints.

These amounts range from 1500 gallons/inch diameter/mile/day to 100 gallons/inch/mile/day.

Assume that the cost of complete treatment, including plant cost amortization, is $100/MGD, which equals $3.65 per year for each 100 gallons per day. Twenty times $3.65, or $73.00 can be paid at the time of construction to eliminate 100 gallons per day infiltration. Consider the difference between 500 and 100 gallons/inch/mile/day. On an 18-inch pipe line this amounts to $5,256.00 per mile. This means that it would be worth up to one dollar per foot premium, at the time of construction, in wet areas to get the better joint.

Root penetration is more difficult to evaluate. However, past experience and accurate maintenance cost data will provide good guide lines. For example, one case history will give an idea of the problem. The following data is taken from a paper published by a city engineer of a major eastern municipality. The city has 250 miles of sewers and drains of which 125 miles are separate sanitary sewers. Joint materials are cement mortar or compound type joints. An average of 10.7 miles of sewers were cleaned per year at an estimated cost of $2,360.00 per mile including overhead. The author states that most sewer stoppages were caused by root growth. This amounts to 3.8 cents per foot per year, not just for the footages being cleaned, but for every foot of sewer pipe in this system. At a value of 20 construction dollars for one maintenance dollar, 76 cents per foot more could have been paid at the time of construction for better joints to eliminate the sewer cleaning expense for the entire installed footage. This is in addition to the value of eliminated infiltration and the resultant treatment cost which would have been achieved in the system's wet areas.

Evaluating the four other performance characteristics involves balancing performance vs. cost at the time of con-

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struction. The basis for these analyses is the installed cost per foot either estimated or more accurately determined by alternate materials bids.

Relative economic installation is automatically indicated in dollars by alternate materials bids. It is often the case that a more desirable higher-priced material, after consideration of installation advantages, is bid for less.

Adequate structural strength is a design consideration which must be made prior to specification. It involves the matching of trench loadings to construction methods and pipe classes. Obviously, inadequate strength will result in a collapse of the system and a total loss of the investment. On the other hand, if higher than adequate strength classes are used, the extra cost is wasted.

The argument most often used to justify higher than adequate quality levels is a desire for an extra factor of safety. The "factor of safety" has been properly defined as the "factor of ignorance", not stupidity but simply a lack of knowledge or an unknown quantity.

For every unknown that can be eliminated from a problem, the factor of safety and resulting cost can be lowered accordingly. Trench loading for example is a science and requires relatively low factors of safety.

The relative cost of predetermined adequate strength is automatically reflected in alternate materials bids.

The best possible flow characteristics offer three possible areas of saving. One is less slope which could, in certain topography, result in less excavation and backfill cost, less rock excavation, lower classes of pipe, less dewatering, and possible elimination or reduction of lift stations.

Another possibility is smaller and less expensive pipe sizes with resulting lower installation cost. This is possible of course because of higher velocity which is in itself an economic advantage-maximizing self-cleansing and minimizing the possibility of septicity.

Where "n" factors are concerned, a single type of material may have varying flow characteristics depending upon manufacturing methods and quality control. Certainly the roughness of a pipe wall affects its "n" factor but it is an established fact that the number of joints to offer resistance, the alignment of joints affected by the type of

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joints and tolerances, alignment to line and grade affected by pipe lengths, and actual inside diameters all work together to a greater degree to determine a pipe's flow characteristics. Some pipe manufacturers offer a choice of lengths, material characteristics, and types of joints.

With a hydraulic calculator, unit cost data and acceptable flow coefficients for each alternate to be considered, relative dollar values can be determined for flow characteristics.

Probably more words have been written and more city councillors have been confused about the life expectancy of pipe materials than any other aspect of the sewer business. This confusion is not justified, for two reasons. First, because today's technology allows, in most cases, the design of a sewerage system that will not develop conditions detrimental to any commonly acceptable high quality sewer pipe material. In those cases where this is not possible, the conditions are predictable and extra measures can be called for.

Second, no responsible manufacturer should recommend its material for questionable conditions. The "factor of ignorance" in this area also has been lowered to acceptable minimums. As for a cost value for long life, there should be no consideration for low quality materials of any kind and the cost of adequate quality materials would be reflected in alternate materials bids. Predetermined extra requirements, if any, would also be reflected.

The examples used may not fit individual conditions exactly, at all times, but the principles set forth here are tried and true and they will work when properly applied.

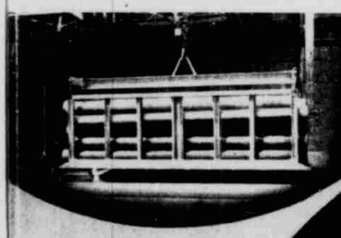
THE COVER—A picture of the Asbestos Plaza at Expo '67 appears on the front cover of this issue. It shows a huge piece of asbestos rock from which water is gushing through asbestos-cement piping that has been let into the rock. The photograph for this illustration was contributed jointly by Mr. John Gossip of the Quebec Asbestos Information Service and Mr. Paul A. Filteau, General Manager of the Quebec Asbestos Mining Association.

AUTOMATIC PLANTS TO MAKE SOCKETED PIPES

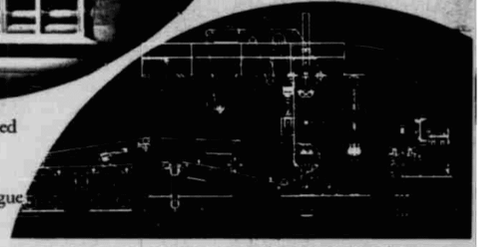


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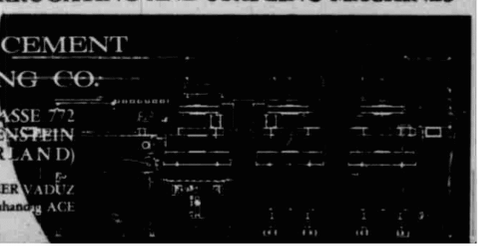


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Crocidolite & Amosite In A/C Pipe

The largest use of Amphibole mineral fibres, Crocidolite (Blue) and Amosite, is in the fast-growing asbestos-cement pipe industry. Asbestos-cement pipe, in sizes ranging from three to thirty-six inches, is being used increasingly for water supply and distribution lines, sewage lines, and for varied uses with municipalities and in industry. The product is competitive with other types of piping. It has unusually high strength, and it cannot rust, rot or deteriorate regardless of soil conditions.

The high performance characteristics of asbestos-cement pipe are due to the three virtually indestructible materials of which it is composed—asbestos fibres, silica, and cement. Most of the asbestos used in asbestos-cement pipe is Chrysotile, but a fairly high percentage of the furnish is Crocidolite and/or Amosite. These Amphibole mineral fibers are used by all major manufacturers to add strength and to speed production in the wet processing because Amphibole fibres provide rapid water release. Amosite does not offer the high strength of Blue asbestos, but it provides the same fast water release rate enabling high machine speed.

The choice of grade, type, and percentage of Amphibole fibre in the fanufacture of asbestos-cement pipe varies considerably among manufacturers. Because the characteristics of Chrysotile asbestos, from one mine to another, differ a great deal in fibre strength and in water release, the source of Chrysotile is a critical factor in determining the need for more or less Amphibole asbestos. Also, the physical specifications of the end product, particularly as concerns strength, must be considered, as well as the type of production equipment and other factors in determining the percentage of Amphibole and Chrysotile used in asbestos-cement pipe production. (North American Asbestos Corporation—February 1967 Asbestos News)

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Merger of Ruberoid into General Aniline

Stockholders of General Aniline & Film Corporation and The Ruberoid Co. have approved the merger of Ruberoid, a manufacturer of building materials, floor coverings and industrial products, into GAF, a diversified producer of dyestuffs, chemicals, photographic products and copying equipment. According to the merger agreement, GAF is the surviving corporation and Ruberoid will be operated as a division of GAF.

Dr. Jesse Werner will continue as chairman and president of GAF, *E. J. O'Leary*, former president and chairman of Ruberoid, became a vice-president and director of GAF and will continue as president of the new division, and *Seymour Milstein*, a senior vice president of Ruberoid, was elected to GAF's board of directors.

Except for the consolidation of certain Ruberoid corporate functions, such as financial and legal, with similar functions at GAF's corporate headquarters, in New York, no major changes in Ruberoid's operations and personnel are planned at this time. The Ruberoid division will continue to function from its New York headquarters.

Based on 1966 figures of both companies, the combined enterprise would have had total sales of approximately $484-million and total assets of $452-million. As part of the merger arrangements, GAF also purchased the shares of Ruberoid owned by W. R. Grace & Company.

SWICA—The Southwest Insulation Contractors Association held its 19th semi-annual meeting at The Inn of the Six Flags, Arlington, Texas, May 4th through 6th, 1967. Along with the usual order of business was a call to order by the President, C. E. Foster, a "Health & Safety Program" presented by the National Insulation Manufacturers Association, an address by Carl P. Wallace, immediate past president of the Mechanical Contractors Associations of Texas, reports of various committees, election of directors of officers, and a report on labor relations by J. N. Poche', Jr.

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GULF&WESTERN/HEDMAN—Gulf & Western Industries, Inc. is further expanding the activities of its natural resources, metals and chemicals division. Its wholly-owned Canadian subsidiary, Gulf & Western (Canada) Limited, has purchased 50% of the stock of Hedman Mines Limited and will provide additional financing for the completion of a substantial asbestos project. Under the terms of the agreement, up to US $2,000,000 in financing is to be provided. The New Jersey Zinc Company, a subsidiary of G&W, was active in the negotiations and will continue in various cooperative management, research and marketing activities.

The deposit of short fiber chrysotile asbestos, averaging 50% asbestos fiber, is located approximately 20 miles east of Matheson, Ontario, Canada. Ore reserves are estimated at 10,000,000 tons of probable ore, although the deposit has not been fully delimited. The mining and processing complex is expected to be operative in 1968. Mining operations are carried on by open pit methods. The plant will have an ore crushing capacity of 600 tons per day and an initial fiberizing capacity of 300 tons per day. A pilot plant is in operation, with the product being sold to the paper, paving and plastics industries in Canada, the United States and Europe.

J. J. Mangan will continue to direct operations in his present capacity as President and Managing Director. The new seven-man board of directors now consists of three former Hedman directors (J. J. Mangan, J. Conrad Levigne, and H. Kenneth Passmore) and four directors from New Jersey Zinc (Lindsay F. Johnson, Sidney S. Goodwin, Frederick H. Main and George W. Wunder).

R/M 'GATOR TAPE—Characteristics and properties of "Gator underground cable insulating tape are described in a two-page data sheet published by the Asbestos Textile Division of Raybestos-Manhattan, Inc. The new woven asbestos tape is impregnated with silicone and vinyl resins which impart moisture resistance and non-leachable flame resistance to the cotton carrier. Tests results are given for water pickup and tensile strength.

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BELL ASBESTOS/CONWEST—Bell Asbestos Mines Limited has purchased 193,470 shares of Cassiar Asbestos Corporation Limited from Conwest Exploration Company Limited. This leaves Conwest with 525,250 shares or 10% of the outstanding capital of Cassiar. Concurrently, Central Patricia Gold Mines Limited has sold 53,000 shares and McVittie-Graham Mining Company Limited has sold 3,530 shares, for a total purchase by Bell Asbestos of 250,000 shares. Conwest will continue to provide the management for Cassiar Asbestos. The decision to sell the shares is in accordance with the policy of the company to maintain a well diversified portfolio of investments. The uncertainties for the mining exploration industry arising out of the recommendations of the Royal Commission on Taxation have increased the desirability of greater diversification.

TIS/PHILADELPHIA—The Philadelphia Chapter of The Thermal Insulation Society elected the following officers for the 1967-1968 year: President—Edward F. Kenna, Hydra-Matic Packing Company; First Vice President—William W. Evans, William W. Evans Company; Second Vice President—Francisco J. Labarta, Owens-Corning Fiberglas Supply & Contracting Company; Treasurer—John J. Pavolski, E. I. duPont DeNemours Company; and, Secretary—Robert J. Bodner, Baldwin-Ehret-Hill, Inc.

The monthly programs during the 1966-1967 season included talks on: "Critical Path Methods" by Walter J. Cosinuke of Catalytic Construction Company; "High Temperature Insulation" by Paul Maco of Asbestospray Corporation; "Coordinating the Working Job" by J. Hauber of Asbestos Worker's Local #14; "Low Temperature Insulation Materials", a panel discussion; "Credit Problems-Insulation Contractors & Manufacturers" by George Ashe, Attorney at Law & Consultant on Credit Matters; and, "Marketing to the Construction Industry" by Carson Mort of F. W. Dodge Company. The March 1967 meeting included a plant tour of Sun Ship Building & Dry Dock, Chester, Pennsylvania.

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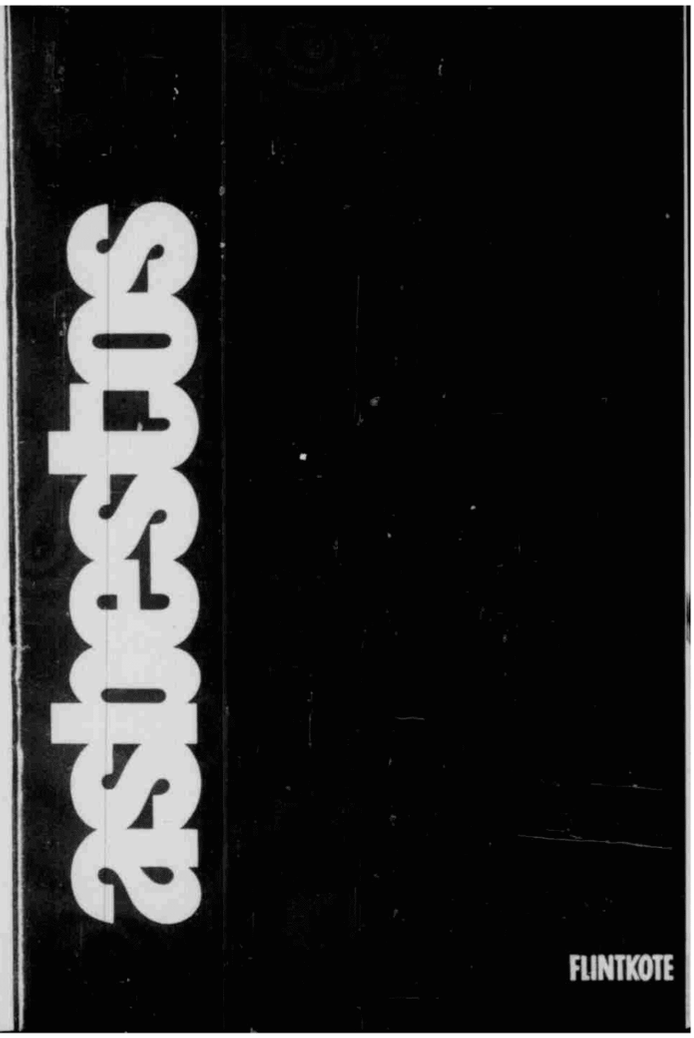
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SUPRADUR MANUFACTURING CORPORATION, a privately-owned manufacturer of building materials for the residential housing market, has acquired through lease and purchase arrangements the Kalamazoo, Michigan, concrete operations of a subsidiary of AMAX (American Metal Climax, Inc.). A wholly-owned subsidiary, *Precast/Schokbeton, Inc.*, has been formed by Supradur to own and operate the business. The new subsidiary will use the leased facilities to continue production of pre-cast architectural products by the Schokbeton process. *Robert A. Matthews*, who managed the AMAX Kalamazoo facility, has joined the new Supradur subsidiary as president.

During the last 20 years, Supradur has become well known for its asbestos-cement siding and roofing and has recently started manufacturing VS Vinyl Sidings. This newest acquisition is taking Supradur outside of the individual residential housing field and therefore means a considerable broadening of its activities. At the same time, however, the company is remaining in its field of manufacturing building materials.

INCENTIVES IN MANUFACTURING—Individual and Plantwide (Volume 2, Parts 6-11), by R. C. Scott, has just been republished. Growing wage demands, high backlogs, capacity limitations and labor scarcities have all combined to accelerate executive interest in all forms of factory incentives. This volume covers a continuation of previous material (Volume 1, Parts 1-5) reviewing the essentials of both individual and plantwide incentives. Copies may be obtained for $1.00 per volume from The Eddy-Rucker-Nickels Company, Department AM, 4 Brattle Street, Harvard Square, Cambridge, Massachusetts 02138.

REUBEN H. CHASE, formerly connected with Pabco, and more recently Director and Vice-President of Kohler & Chase in San Francisco, California and also interested in Products and Production Devices, Inc. in Atherton, California, has retired. He and his wife plan to enjoy mutual hobbies in their new home being constructed in the foothills of the California Sierras.



PARE-SOLEIL—The Louis-Hippolyte Lafontaine Bridge Tunnel is one of the important projects on the Trans-Canada Highway. It runs under the St. Lawrence River Ship Channel between Montreal Island and Charron Island for a portal to portal length of 4,561 feet with an overall length of 6,451 feet. A major problem that faced the designers of this bridge tunnel was the question of the high density of the sun's rays at the immediate entrances to and exits from the tunnel. This problem was discussed with *Atlas Asbestos Company* and their applicators, *Asbestos Erectors of Canada Limited*. After exhaustive studies by Atlas, a product was developed which met with the engineer's approval. This asbestos-cement corrugated product is known as "Pare-Soleil". The corrugations of "Pare-Soleil" are oval in shape and the depth of its section is to the full depth of the beams which act as struts between the retaining walls of the tunnel. The natural gray color of the "Pare-Soleil" sections present a very pleasing effect for the full 350 feet of the tunnel's entrance. The installation of the sections enables the engineer to provide a gradual rather than abrupt reduction of light intensity. For the first 350 feet of the tunnel's entrance the candle power is reduced to 1,000 fc, then over a distance of 1,100 feet it is further reduced from 1,000 fc to 12 fc, which is maintained throughout the length of the tunnel, to provide adequae lighting. These figures permit adequate reduction in the overall lighting to a motorist travelling at the rate of 60 mph. At this speed it requires only 15 seconds in time to cover this distance.

TROPAG's firm and business will be carried on in the same manner as previously under the partnership of *Bernhard Henning* together with *Rudolf Horl*. Both of these men have been connected with TROPAG for many years and are fully acquainted with the company's activities. The Asbestos Department will be handled under the management of *Juergen Wittekind*. These changes have occurred as a result of the passing of Oscar H. Ritter, who formerly managed the TROPAG firm.



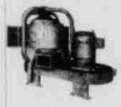
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Automobile Sales

MARCH 1967 motor vehicle factory sales from plants in the United States totaled 833,366 (passenger cars—684,096; trucks and buses—149,270). The total for March 1966 was 1,089,850. The total for the first three months of 1967 was 2,290,853 compared to 2,957,503 for the same 1966 period.

Motor vehicle factory sales from plants in Canada totaled 88,275 in March 1967 compared to 99,847 in March 1966.

United States motor vehicle imports for March 1967 were as follows: new passenger cars—88,462 valued at $149,046,330; used passenger cars—313 valued at $347,598; trucks and buses—8,845 valued at $17,760,111; and, automotive parts—valued at $52,347,039.

1967 AUTOMOBILE FACTS AND FIGURES is now available from the Automobile Manufacturers Association. Output of passenger cars and commercial vehicles in 1966 was the second best year on record. New highs were established in 1966 for motor vehicle registrations, vehicle miles of travel, highway motor fuel consumption, and automotive exports. There are over 800,000 automotive businesses, or one out of every six firms in the United States. These items and much more statistical information are included in this comprehensive publication.

AUSTRALIA—9,077,000 square yards of asbestos-cement sheets were produced during the FOURTH QUARTER of 1966: October—3,107,000; November—3,348,000; December—2,622,000. YEAR 1966 figures reached 33,010,000 square yards compared to 33,439,000 in 1965 and 31,065,000 in 1964.

ITALY EXPORTED 37,084 tons of asbestos-cement products during the first nine months of 1966 in comparison with 31,908 for the same period in 1965. Imports for the same period reached 10,852 tons in 1966 against 10,482 in 1965.

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QUEEN'S AWARD/SCAPA — Her Majesty the Queen of England has graciously been pleased to confer The Queen's Award to Industry, 1967, on Scapa Group Limited, of which Scapa Dryers, Inc. is an associated company. The Award was made in recognition of the outstanding export achievement of Scapa Dryers Limited, Blackburn, England, makers of wet and dryer felts for use on paper and board machines, and of special synthetic felts for the asbestos-cement products industry.

Over the past three years, the felts exported from Scapa's Blackburn plant have averaged 69% of the total production. During the same period, the value of these exports increased by 48%. Scapa felts are exported to more than forty countries. As well as an expanding operation at Waycross, Georgia, the Scapa Group has a manufacturing plant operating successfully at Joliette, P.Q., Canada, and has sales companies in Helsinki, Finland, and Melbourne, Australia. An extensive network of sales agents is retained to cover all major markets, and their activities are fully supported by a large staff of highly-trained technical representatives.

ASBESTOS CORPORATION LIMITED, in a reorganization of their sales force, has now raised to four the number of Regional Sales Managers covering world markets. Region No. 1 (United States and Canada) will be serviced by *P. E. Leclerc*. In the United States, the two remaining offices of Asbestos Corporation Service have been closed and customers will now be served through existing representatives reporting directly to Mr. Leclerc at the company's head office in Thetford Mines, P.Q., Canada. Other regions will be serviced as follows: *A. C. Steel*, Region No. 2 (Central and South America, Mexico, United Kingdom, and Western Europe); *A. W. G. Gibb*, Region No. 3 (Scandinavia, Central and Eastern Europe, Egypt, Australia and New Zealand, and Japan); and, *A. S. Johnson*, Region No. 4 (Southern Europe, Northern Africa, and Middle and Far East).

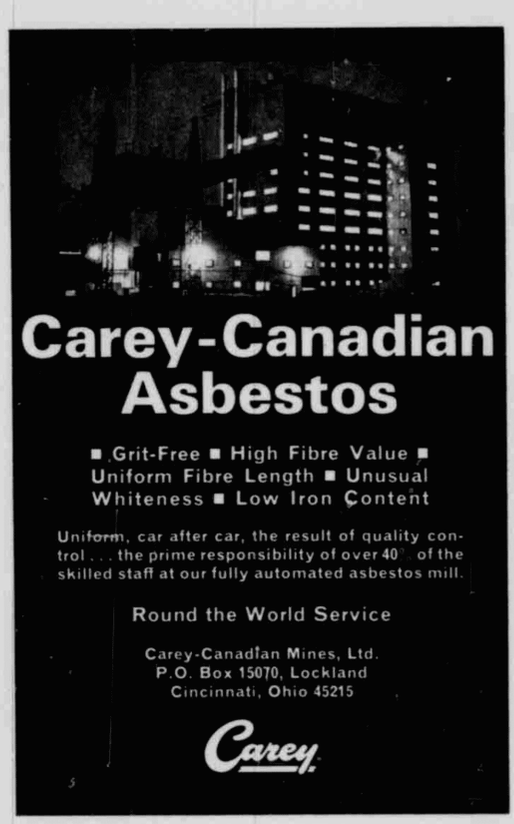
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BLACKBURN, ENGLAND

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CAREY INSULATION—A new 8-page brochure (Form No. 6551 Rev.) is available from The Philip Carey Manufacturing Company. It lists all types of Philip Carey industrial insulations and insulating cements for use in power, chemical, petroleum, petro-chemical, commercial and manufacturing industries. An Insulation Selection Guide on the front cover lists applications for high temperature equipment, super heated surfaces, medium and high pressure steam surfaces, low and medium pressure steam lines, cold water pipes, heating and air conditioning ducts and equipment. A Cement Selection Guide lists applications for pointing up pipe and block insulation, all fittings, refractory coating and patching, finishing over molded insulations, bonding insulation to metal surfaces and waterproofing. Throughout the brochure, product photographs and descriptions supply information on the Carey line of industrial insulation for temperatures from 35°F. up to 2,000°F.

ASBESTOS CORPORATION OF AMERICA, Garwood, New Jersey, has developed a new asbestos line used in the filling of polypropylene. It is trademarked under the name APLEX and grades 101, 202, 301 and 303 are available. APLEX 303 is very unique in the fact that the compounders are not required to use any additional additives; that is, they are able to mix this material immediately with the polypropylene. The company has also developed an excellent material which is used in the paint field and is especially suited for corrosion resistance areas. One more new item is L-FIL asbestos which is used in the filtering area.

IAI TRANSLATION #4—Two New Serpentine Group Minerals: Fluorantigorite and Fluorochrysotile, by Wang Pu and Lu Wan-chuen, is available from the Institute for Asbestos Information, or through ASBESTOS (per copy: U.S. $2.90; 20/- sterling; or, Australian $2.50).



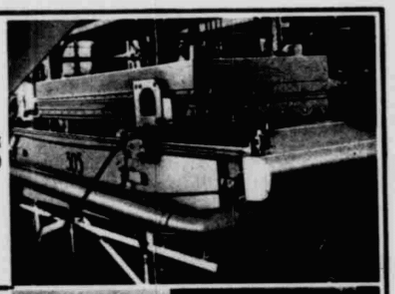
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DO YOU WANT TO MANUFACTURE ASBESTOS CEMENT SHEETS BOTH FLAT AND CORRUGATED, COLOURED AND NOT COLOURED, **BY USING ONLY SHORT FIBERS** WITHOUT EMPLOYING CORRUGATING MACHINE, MOULDS, FELTS, DECANTER CONES, AND KEEPING AT THE SAME TIME THE SHEET QUALITIES FULLY UP TO THE STANDARD REQUIREMENTS?

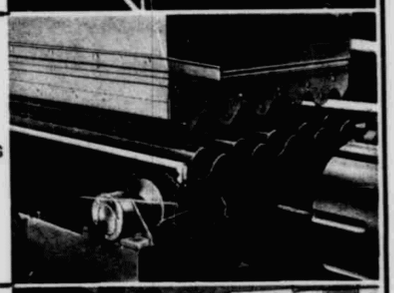
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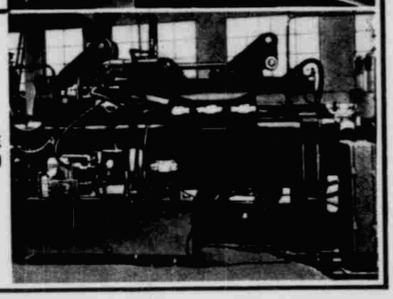
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Building

APRIL 1967—Recovery of the construction industry suffered a setback as April's contracts for future work declined. Total construction contract value amounted to $4,389,071,000—13% below the year-ago figure. Interruption of the strong first quarter advance in contracting occurred in spite of a new spurt of industrial and commercial building projects. The gaps showed up in the key areas of housing, utilities, and highways.

Nonresidential building contracts, at $1,830,452,000, came within 3% of the year-ago total. April-to-April comparisons showed that hospital contracts were strong this year. Manufacturing building remained unchanged from last year's high level, while commercial and educational building showed moderate declines.

Residential building contracts totaled $1,627,281,000—a 21% decline from a year earlier. Both single-family housing and apartment contract value showed seasonally-adjusted declines.

Nonbuilding construction value totaled $931,338,000—18% below the year-ago amount. Both highways and utilities were down sharply and gains were limited to sewerage disposal and water supply projects.

FIRST FOUR MONTHS 1967: Nonresidential $6,101,136,000 down 1%; Residential $5,189,400,000 down 23%; and, Nonbuilding $3,583,026,000 down 7%—total construction $14,873,562,000, down 11% from the first four months of 1966. (F. W. Dodge Company, a division of McGraw-Hill, Inc.)

"ASBESTOS BULLETIN"

Keeps you abreast of all developments. Each issue contains over 100 abstracts relating to the manufacture of asbestos-based products. Special chapters on asbestos mining, asbestos-cement, friction and asbestos-reinforced plastics. Annual Subscription £9.15.0d. Back copies half-price.

"ADVANCED MATERIALS"
by C. Z. Carroll-Porczynski

This valuable new book deals with numerous new aero-space materials, including several chapters on asbestos and asbestos composites. About 1,000 references. Price £2.18.6d.

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BRAZIL, Rio de Janeiro
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A subsidiary of American Smelting and Refining Company

SDI/JOHNS-MANVILLE—A radically new type of filter, announced recently at a Water Resources and Pollution Control seminar presented by the Newark College of Engineering, offers great promise in the successful and economical treatment of industrial wastes and the tertiary treatment of sewage to produce usable water. Called the *Moving Bed Filter (MBF)*, the equipment has been under development for almost two years by Scientific Developments, Inc. of New Jersey. In July of 1966, research and development personnel of J-M joined forces with SDI to assist in furthering the equipment development. The MBF is unique in that it has solved one of the most urgent problems in sewage treatment, removal of 90-98% of the phosphate, as well as removal of 60-70% of BOD that remains after conventional primary and secondary treatment.

CANADIAN JOHNS-MANVILLE CO. LTD., in order to speed and simplify dealer invoicing, will adopt a new pricing system which is better suited to electronic data processing. The present system of pricing by discounts will be replaced by a "net price" system. In the past it was found that the use of one list price and a variety of discounts led to invoicing errors which cost both the customers and the company time and money. The problem is increased by the use of computer systems. These errors will be substantially reduced by the introduction of a system of net prices for various types of customers, and for various quantities, etc. First to get the new net price lists will be insulating board products made at the company's North Bay, Ontario, Canada, plant. Announcements will be made by the company as other products are brought into the net pricing system.

ASTM STANDARD C220-67—Standard Specification for Flat Asbestos-Cement Sheets (to appear in Part 12 of the 1967 Book of Standards): *Revision*—in Section 3(c), the water absorption for Type F has been changed from "22" to read "25."

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MARKET CONDITIONS

General Business.

General business continues to show recessionary trends in some lines and slight improvement in others. Prognosticators are now looking for no pronounced change in the situation until about the fourth quarter and some are predicitng a rather sharp upward move at that time. As this is written, there is worldwide concern over developments in the Middle East which have reached a point of crisis. There is no doubt this situation will be used by those opposed to the U.S. involvement in Vietnam to attempt to get this country to start de-escalation of military acion in that area as the price of cooperation to prevent the start of another war in another area. It is too early to attempt to predict the outcome of this new crisis in world politics.

Concern over this situation has made itself evident in a downward movement of the stock market and a general "jittery" feeling on the part of most businessmen and investors.

Asbestos—Raw Material.

Quebec asbestos fibre shipments for the Industry during April 1967 totalled 87,546 tons, a reduction of 32,903 tons or approximately 27% from the same period last year.

Year to date shipments at 331,878 tons are running 51,894 tons or 13% lower than those of 1966 for the same period.

Asbestos—Manufactured Goods.

Asbestos Textiles. The sale of asbestos textiles through the second quarter of this year was maintained at the anticipated high level. Several manufacturers have announced a price increase, but it is still too early to predict what impact these increases will have on third quarter activity.

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More resilience – that's one of the reasons why amphibole fibres are the best choice for insulation products. Other features are their high strength and good filtration characteristics which make them ideal components in wet asbestos cement processes.
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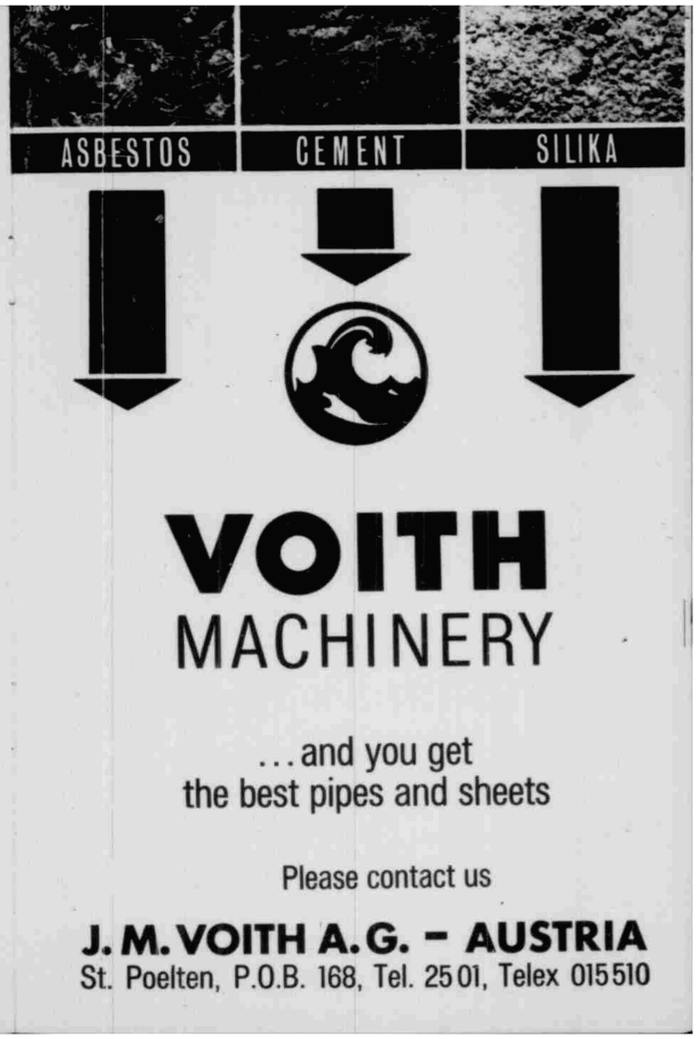
Asbestos Brake Lining. The service market for this material is good but the market for original equipment is off at the present time. Improvement in volume of sales is expected in the near future.

Asbestos-Cement Shingles, Roofing & Siding. The bad weather has adversely affected the use of these materials both on new jobs and modernization. Although this delay will be felt throughout the year, an improvement is expected as mortgage money continues to becomes easier to obtain.

The above comments have been made by various informed executives in the Industry. All comments are welcome.

SHORT FIBRE AMOSITE GRADINGS—North American Asbestos Corporation has introduced two new gradings of short-fibred amosite. These gradings, designated RK and 6605, are very much shorter in fibre length than the traditional amosite gradings—and lower in cost. Both gradings will be priced in the area of the lower group 5 chrysotile fibres. However, these gradings will provide the fast filtering and relatively higher bulking properties characteristic of the longer grades of amosite and, therefore, it is expected they will open an entirely new area of applications both in wet processing and in dry operations. Inquiries and orders may be directed to North American Asbestos Corporation.

THE FREE WORLD'S LARGEST ASBESTOS PRODUCER, by A. R. Dennis, Supervisor of Industrial Engineering at the Jeffrey Mine of Canadian Johns-Manville Company Limited, Asbestos, Quebec, Canada, appeared in the May 1967 issue of the Canadian Mining Journal. This historical report traces the development of mining practices and equipment at Jeffrey Mine, covers statistics of the mine from 1881 to 1966, and contains many photographs including one of the open pits during the period between 1890 and 1895.



PRODUCTION

Canada—JANUARY 1967 asbestos production amounted to 80,129 tons (Quebec—65,169; Newfoundland, Ontario, and British Columbia—14,960). This compared with the January 1966 total of 84,350 tons. (Dominion Bureau of Statistics)

Canada—FEBRUARY 1967 asbestos prodduction amounted to 82,541 tons compared to 101,834 in February 1966. Total for the first two months of 1967 is 162,670 compared to 186,184 for the same period in 1966. (Dominion Bureau of Statistics, Ottawa)

Cyprus—FIRST QUARTER 1967 production of asbestos amounted to 515 short tons; all during March. (Ministry of Commerce & Industry, Nicosia)

South Africa—FOURTH QUARTER 1966 production of asbestos totalled 69,521 short tons (Amosite—24,503, Chrysotile—8,418, Cape Blue—34,739, Transvaal Blue—1,861). YEAR 1966 production totalled 276,597 short tons compared to 240,752 in 1965. The breakdown for 1966 is as follows: Amosite—95,937, Chrysotile—36,782, Cape Blue—135,700, and Transvaal Blue—8,178. (Department of Mines, Johannesburg)

Advocate Mines crushed 514,140 tons of asbestos ore during the first three months of 1967 as compared to 401,168 for the same period in 1966. Fibre produced amounted to 16,157 tons against 16,024, recovery was 3.14% compared with 3.99% and fibre shipped amounted to 14,721 tons against 13,555.

Golden Gate Explorations—An evaluation program is currently being made by a large but undisclosed company of Golden Gate's 76-claim Rex asbestos property near Haines Junction, Yukon. (Northern Miner)

The Mineral Industry of the Philippines (preprint from the 1965 U.S. Bureau of Mines Minerals Yearbook, 10¢)—Crude mineral production, the value of which rose one-fifth in 1965 to about $146-million, was roughly 3% of the gross national product. Production of asbestos amounted to an estimated 500 metric tons in 1965 compared to 532 in 1964 and 382 in 1963. Imports of asbestos reached 1,894 metric tons in 1964, principal sources being Canada, Australia, and Rhodesia-Nyasaland. Imports in 1963 were 1,354 metric tons.

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ASBESTOS FIBRES

IMPORTS & EXPORTS

Exports From U.S.A.

(Figures from U.S. Bureau of the Census) JANUARY 1967

Unmanufactured Asbestos:			
Crude & Spinning Fibers	s.tons	109	$ 22,984
Non-Spinning Fibers	s.tons	2,017	312,823
Waste & Refuse	s.tons	680	54,049
		2,806	$ 389,856
Manufactured Asbestos Goods:			
A-C Shingles & Clapboard	Lb	501,621	$ 42,794
Other A-C Articles	Lb	1,164,272	141,296
Gaskets & Packing	Lb	339,496	342,285
Textiles & Yarns	Lb	101,172	100,213
Mfrs. other than Friction Materials		..	390,072
Clutch Facings, including Linings	No	87,502	77,436
Brake Linings for automotive use	Lb	270,137	166,230
Brake Linings, Other	Lb	179,001	109,385
			$1,369,711

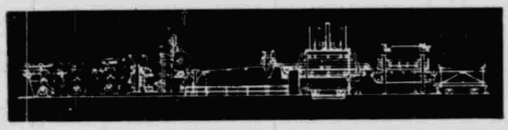
South Africa Exports—FOURTH QUARTER 1966: 55,609 short tons of asbestos were exported, valued at R6,395,692 (Amosite—22,839, R2,273,365; Chrysotile—5,959, R508,583; Cape Blue—25,350, R3,430,331; Transvaal Blue—1,461, R183,413). Exports for the YEAR 1966 amounted to 234,540 short tons, valued at R26,771,962: Amosite—85,881, R8,537,548; Chrysotile—25,847, R1,996,094; Cape Blue—114,601, R15,199,357; Transvaal Blue—8,221, R1,038,963. The total exports for 1965 reached 209,575 short tons, valued at R23,419,439. (Department of Mines, Johannesburg)

Swaziland Exports—Asbestos was the chief commodity imported by Britain from Swaziland during MARCH 1967. The asbestos was valued at R984,000 which brings the total value of asbestos imported by Britain from Swaziland to R1,280,000 during the FIRST QUARTER 1967.

Statistical Summary of the Mineral Industry, including asbestos production, imports and exports (by country and description) for the years 1960 through 1965, has been issued by the Overseas Division, Institute of Geological Sciences, London, England. (Price £1 7s. 6d. net)

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Exports From Canada

(Published by Dominion Bureau of Statistics) JANUARY 1967

Unmanufactured Asbestos:

Short Tons

	Crude	Milled Gp 3	Milled Gp 4&5	Shorts Gp 6-9
United States	..	1691	19,386	32,532
United Kingdom	..	637	2,877	3,157
South America	..	34	6,944	706
Central America & Mexico	..	7	2,003	265
Europe	10	2,548	13,781	7,990
Japan	..	68	3,739	8,142
Other Countries	..	336	8,570	1,349
	10	5,321	57,300	54,151

Total Unmanufactured Asbestos—116,782 Valued at—$15,414,000

Manufactured Asbestos Goods:

Asbestos Brake Linings & Facings	$ 16,000
Asbestos-Cement Building Materials	95,000
Asbestos Basic Products, Other	29,000
	$ 140,000

Cyprus Exports—FIRST QUARTER 1967 exports of asbestos totaled 3,520 tons, valued at £149,061: January—494, £21,576; February—1,004, £44,396; and, March—2,022, £83,089. (Ministry of Commerce & Industry, Nicosia)

The Mineral Industry of Cyprus (preprint from the 1965 U.S. Bureau of Mines Minerals Yearbook, 5¢)—Minerals remained one of Cyprus' most important resources, accounting for about 34% of its total export. Asbestos was among the nonmetals which continued to be the principal source of foreign exchange. Directly, mining contributed 8% to the estimated 1965 gross national product of $348-million. The 1965 value of mineral production totaled about $30-million, about 20% higher than values of 1962. Production of asbestos amounted to an estimated 14,302 metric tons in 1965 against 11,827 in 1964. Exports of asbestos reached 11,499 metric tons in 1964 which compares to 13,676 in 1963. Principal destinations in 1964 were to Thailand, Denmark and Sweden. Imports of asbestos were 2,732 metric tons in 1964 against 4,658 in 1963. Principal sources in 1964 were Yugoslavia, Egypt and Czechoslovakia. The island's only asbestos mine is situated in the Greek Cypriot belt of the Troodos Mountain.

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Pure asbestos yarns

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A6

INDUSTRY NEWS

HAPPY BIRTHDAY

Erwin C. Gutzwiller, Vice President-Manufacturing, Roofing Granule Division, The Ruberoid Co., New York City, June 20.

Ladd L. Wilson, President, Protective Papers, Inc., Hollister, California, June 20.

J. W. Weber, President & Treasurer, American Asbestos Textile Corporation, Norristown, Pennsylvania, June 22.

C. Branton Wheatley, President & Treasurer, Philadelphia Asbestos Corporation, Philadelphia, Pennsylvania, June 22.

Malcolm Meyer, President, Certain-teed Products Corporation, Ardmore, Pennsylvania, June 23.

Paul W. Garrett, Staff Legal Counsel, The Ruberoid Co., New York City, June 24.

F. Pearson, Managing Director, BBA Group Limited, Cleckheaton, Yorkshire, England, June 26.

Dr. Gordon Taylor, Executive Director, The Flintkote Company Limited, London, England, June 26.

Edward F. Briggs, Vice President, J-M Sales Corporation & General Sales Manager, Aerospace Products Department, Johns-Manville Corporation, New York City, June 27.

Julien O. Heppes, Vice President & General Manager-Floor Tile Division, The Ruberoid Co., New York City, June 28.

I. C. Campbell, Vice President & Secretary-Treasurer, Asbestos Corporation Limited, Thetford Mines, Quebec, Canada, July 3.

Arthur I. Rank, Jr., President & Treasurer, Universal Insulation Company, Philadelphia, Pennsylvania, July 3.

Howard E. Walker, Director of Research, The Flintkote Company, New York City, July 5.

S. David Skinner, Vice President-Engineering, National Gypsum Company, Buffalo, New York, July 6.

C. L. Hoshaw, Manager of Insulation Technical Service and Construction, The Philip Carey Mfg. Co., Cincinnati, Ohio, July 7.

Captain W. A. Janitch, R.E., Vice President, Asbestos Corporation Services Limited, London, England, July 10.

Alvin M. Ehret, Jr., Chairman of the Board, Baldwin-Ehret-Hill, Inc., Trenton, New Jersey, July 11.

August D. Becht, Industrial Relations Representative, The Ruberoid Co., New York City, July 12.

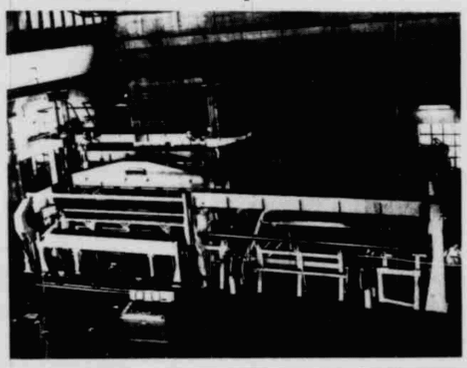
John F. Sullivan, Jr., President & Treasurer, Asbestos & Magnesia Materials Company, Chicago, Illinois, July 13.

Carlo M. Weber, Manager, Careystone Corrugated Department, The Philip Carey Mfg. Co., Cincinnati, Ohio, July 14.

To all these gentlemen we extend congratulations and best wishes on the occasion of their birthdays.

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CALZONI

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ACSCO Limited, Turin, Italy, has acquired the assets and interests of Acindustries (1965) Limited, Cyprus, a private Limited Company by shares which was formed with the object of establishing in Cyprus a plant for the production of pressure and non-pressure asbestos-cement pipes. (AC/M, January 1967)

ACSCO Limited—Deformation of asbestos-cement pipes occurring during the process of initial hardening (ovality) has been studied and resolved by Asbestos-Cement Service Company Limited, Turin, Italy. The new pipe hardening plant designed by this company combines rotation at variable speeds of the pipes according to their respective diameter together with the conveying process. This permits to obtain a perfectly cylindrical pipe at the end of the line. (AC/M, January 1967)

Hume Industries (Far East) Limited, as part of its policy of expansion and modernization, has commenced the construction of a new asbestos-cement sheeting plant at its Bukit Timah works. The new plant will be adequate to supply the entire Singapore market while providing considerable surplus capacity for further development of exports. Part of the new equipment which will be of the most modern type available will be manufactured in Singapore, and specialized items have been ordered from overseas. The estimated cost of the project is $2-million. The new plant will be in production in the second half of 1967 and will initially produce the present range of Hume sheeting products. At a later date, it will also be used for a number of new products now in the development stage.

Cape Asbestos 1966 Annual Report—The external sales of The Cape Asbestos Company Limited and its subsidiaries amounted to £25,971,000, compared with £22,305,000 in the previous year. Net profit before tax was £2,123,617 against £2,007,845 in 1965, and profit after taxation was £1,292,198 against £1,207,567.

In Africa, capital expenditure on the Amosite fields, where the reconstruction and extension of the Penge mine treatment plant and the development of the mine to provide adequate supplies of ore is being carried out, reached its peak and capital spending in South Africa during 1966 totalled £1,602,050.

The Geology and Mineral Resources of the Pharmakas-Kalavasos Area, by Th. M. Pantazis, Geologist, has been issued as Memoir No. 8 by the Geological Survey Department, Ministry of Commerce & Industry, Nicosia, Cyprus. (Price: £1.500 mils).

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PERSONNEL NEWS

AMERICAN SMELTING & REFINING CO.

DR. ALBERT J. PHILLIPS—retired as Director of Research on April 30th, 1967, after reaching mandatory retirement age.

J. STUART SMART, JR—Vice President; will be Director of Research and Market Development, replacing Dr. Phillips.

ASBESTOS CORPORATION LIMITED

A. L. PENHALE—chairman of the board of directors; had been president since 1948.

W. W. OUGHTRED—president and chief executive officer; had been executive vice-president since May 1965.

P. H. RIORDON—vice-president and general manager; formerly vice-president, operations.

F. A. CUNNINGTON—vice-president, operations; formerly production manager.

THE BAUER BROS. CO.

JOSEPH C. SHOUVLIN—elected to the newly created position of Chairman of the Board and Chief Executive Officer. He had been president since 1946. DANIEL R. SHOUVLIN, JR. was elected President and his brother, ROGER J. SHOUVLIN, was named Executive Vice President. Other staff changes announced include the naming of ROBERT SELLERS as Secretary-Treasurer, and EUGENE B. KUNK as Assistant Secretary-Treasurer.

CAPE ASBESTOS GROUP

F. W. R. DOUGLAS, R. A. W. CAINE and G. A. HIGHAM—appointed to the Board of The Cape Asbestos Company Limited.

T. MUIR WARDEN—resigned from the board of The Cape Asbestos Company Limited.

G. W. FLINT—director, The Cape Asbestos Company Limited, replacing Mr. Warden.

THE FLINTKOTE COMPANY LIMITED

DR. GORDON TAYLOR—executive director.

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THOMAS HARDMAN & SONS LTD.

R. G. BARLOW—appointed to the Board of Directors. Mr. Barlow has been with Hardman for nearly five years and will continue as General Manager in addition to taking up the duties of a Director.

JOHNS-MANVILLE CORPORATION

MRS. LOUISE HARDYZER—assistant secretary.

ROBERT F. ORTH—retired as general manager of the Pipe Division effective December 31, 1966; had been with J-M for 42 years.

DON L. HINMON—(a vice president) has been named general manager of the Pipe Division, succeeding Mr. Orth.

HERBERT MORTON BALL—vice president and general counsel; remains secretary of the company.

DUDLEY T. COLTON, SR.—vice president; as general manager of the J-M International Division, he is responsible for the company's overseas sales and manufacturing operations.

KARL V. LINDELL—vice president; is general manager of the J-M Asbestos Fibre Division and remains chairman of the board of Canadian Johns-Manville Company Limited; will maintain his headquarters at Asbestos, Quebec, Canada.

THORNTON R. SMITH—named to the newly created position of controller of J-M and elected an officer of the company; the position combines accounting and analysis activities with responsibilities for data processing and operations research.

NICOLET INDUSTRIES, INC.

JOHN K. WHITTAKER—vice-president marketing; had previously served as vice-president and general manager of Modiglass Fibers, Inc., when it was a subsidiary of Nicolet and remained with that company after it was sold to Reichhold Chemicals, Inc. in 1960.

RAYBESTOS-MANHATTAN, INC.

JOHN F. D. ROHRBACH—Chairman of the Board; had been President since 1948.

WILLIAM S. SIMPSON—President and Chief Executive Officer.

WILLIAM H. WHITE—Secretary and Treasurer; SAMUEL J. SANDLING—Assistant Treasurer; and, STANLEY DANCZ—Assistant Secretary.

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ASBESTOS STOCK QUOTATIONS

Close—May 31, 1967

Abex	31¾	Flintkote (pfd-A)	84½
Abitibi	*$10.00	Garlock	16⅛
Asarco (3-A)	61⅝	Gen Aniline (com)	21¾
Armstr. Cork (com)	49½	Gen Aniline (pfd)	28⅝
Armstr. Cork (pfd)	75	Gulf&Western (com)	50¾
Asbestos Corp	$20.50	Gulf&Western (pfd)	201
Carey	39½	Gulf&Western (pfd)	75
Cassiar	*$16.25	Johns-Manville	53⅛
Certain-teed (com)	15½	Natl Gypsum (com)	37¾
Certain-teed (pfd)	17¾	Porter	93
Conwest	*$5.55	Raybestos	56½
Fibreboard	36¾	Unarco	9¼
Flintkote (com)	20¼	Uniroyal (com)	39¼
		Uniroyal (pfd)	143

*Canadian currency

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ASBESTOS PRICES

ARIZONA— Per Ton of 2,000 lbs., f.o.b. Globe, Arizona

(As of July 10, 1964)

No. 1 Crude	$1,410.00 to	$1,650.00
No. 2 Crude	610.00 to	900.00
AAA	..	800.00
Group No. 3 (Non-Ferrous Filtering & Spinning)	425.00 to	750.00
Group No. 4 (Non-Ferrous Plastic & Filtering)	385.00 to	500.00
Group No. 5 (Plastic & Filtering)	250.00 to	400.00
Group No. 7 (Refuse & Shorts)	58.00 to	90.00

CANADA— Per Ton of 2,000 lbs. f.o.b. Mine

(As of April 1, 1967) Canadian Currency

Crude No. 1	$ ..	$1,410.00
Crude No. 2	..	760.00
Group No. 3 (Spinning Fibre)	360.00 to	588.00
Group No. 4 (Shingle Fibre)	198.00 to	335.00
Group No. 5 (Paper Fibre)	140.00 to	165.00
Group No. 6 (Waste, Stucco or Plaster)	..	101.00
Group No. 7 (Refuse or Shorts)	47.00 to	85.00

CASSIAR— Per Ton of 2,000 lbs., f.o.b. North Vancouver, B.C.

(As of April 1, 1967) Canadian Currency

AAA grade (non-ferrous spinning fibre)	$ 810.00
AA grade (non-ferrous spinning fibre)	643.00
A grade (non-ferrous spinning—Canadian Group 3)	484.00
AC grade (asbestos-cement—Canadian Group 4)	345.00
AD grade (asbestos-cement—Canadian Group 4)	284.00
AK grade (shingle fibre—Canadian Group 4)	241.00
AS grade (shingle fibre—Canadian Group 4)	200.00
AX grade (shingle fibre—Canadian Group 5)	177.00
AY grade (shingle fibre—Canadian Group 5)	126.00

VERMONT— Per Ton of 2,000 lbs., f.o.b. Mine

(As of April 1, 1967) U. S. Dollars

Group No. 3 (Spinning & Filtering)	$ 319.00 to	$ 342.00
Group No. 4 (Shingle Fibre)	183.00 to	296.00
Group No. 5 (Paper Fibre)	129.00 to	153.00
Group No. 6 (Waste, Stucco or Plaster)	..	93.00
Group No. 7 (Shorts & Floats)	40.50 to	78.00

BUILT ON A ROCK

Crude Asbestos is the rock on which our business is built. We use it to make everything for which asbestos is best, from yarns and cloths to all types of jointings and packings. Our factories lead in production; our Research Laboratories keep us at the head of development; Asbestos is *our* subject.

THE ASBESTOS DIVISION OF **SCANDURA LIMITED**

A MEMBER OF THE BBA GROUP CLECKHEATON · YORKSHIRE · ENGLAND



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ASBESTOS PATENTS

U.S. Patents on Asbestos and Asbestos Products, by Oliver S. North.

U.S. Patents may be purchased from The Commissioner of Patents, Washington 25 D.C., at a cost of 50 cents each. Remittance should be in coin, currency, or check, and the number(s) of the patent(s), name(s) of inventor(s), and date(s) of issue should be shown.

U.S. Patents issued from April 18th through May 9th, 1967.

3,314,906—Vinyl Asbestos Composition Stabilized With Melamine and Rosin, G. E. Bagley and W. F. Goodyear, Jr., April 18, 1967.

3,314,915—Molding Composition For Making Thermal Barriers and Method of Making Same, F. P. Baughman and B. F. Douglas (assigned to Taylor Corporation, Valley Forge, Pennsylvania), April 18, 1967.

3,314,916—Process For Making Fiber-Filled Polytetrafluoroethylene Packing Materials, M. E. Cupery, April 18, 1967.

3,317,303—Traction Rolls and Material Handling Apparatus Employing Such Rolls, N. Shorr (assigned to Pittsburgh Plate Glass Company, Pittsburgh, Pennsylvania), May 2, 1967.

3,317,643—Producing High Temperature Calcium Silicates, A. D. Denny (assigned to Owens-Corning Fiberglas Company, Toledo, Ohio), May 2, 1967.

Asbestos Corporation Limited reported that during 1966, world demand for asbestos fibre, particularly the so-called shingle fibre used in the manufacture of asbestos-cement sheets and pipe, was strong throughout the year. Sales of spinning fibre were increased over 1965.

Cable Address "Fraruggles" Telephone (201) 379-2186

ASBESTOS FIBRES

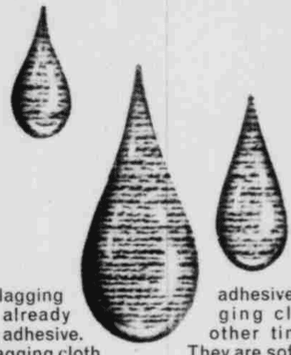
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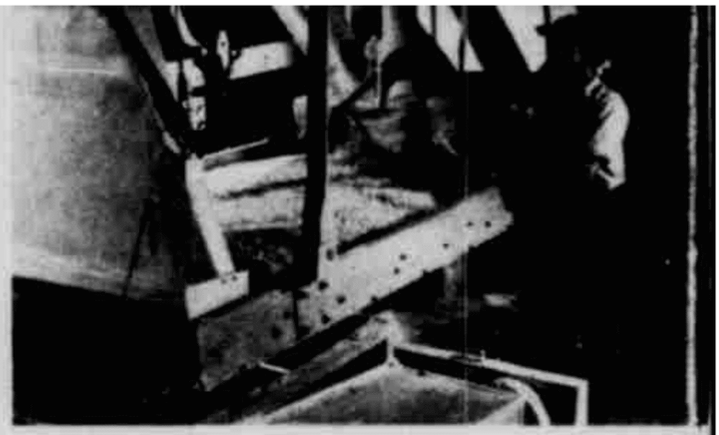
ASBESTOS TEXTILE DIVISION

RAYBESTOS-MANHATTAN, INC.

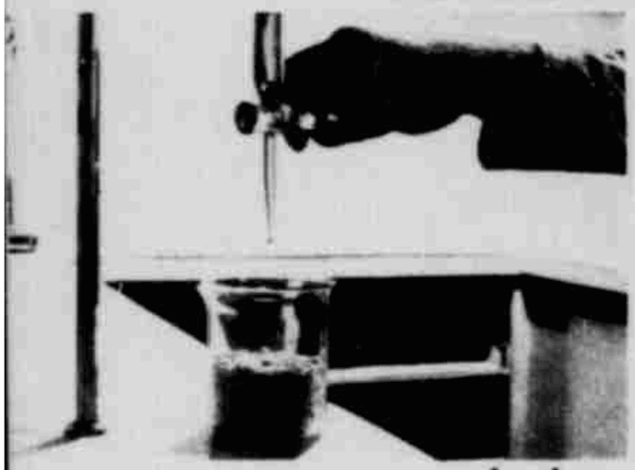
Manheim, Pa. 17545



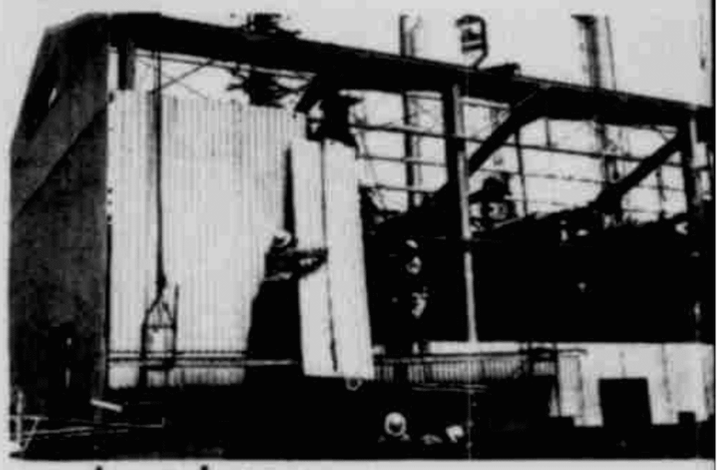
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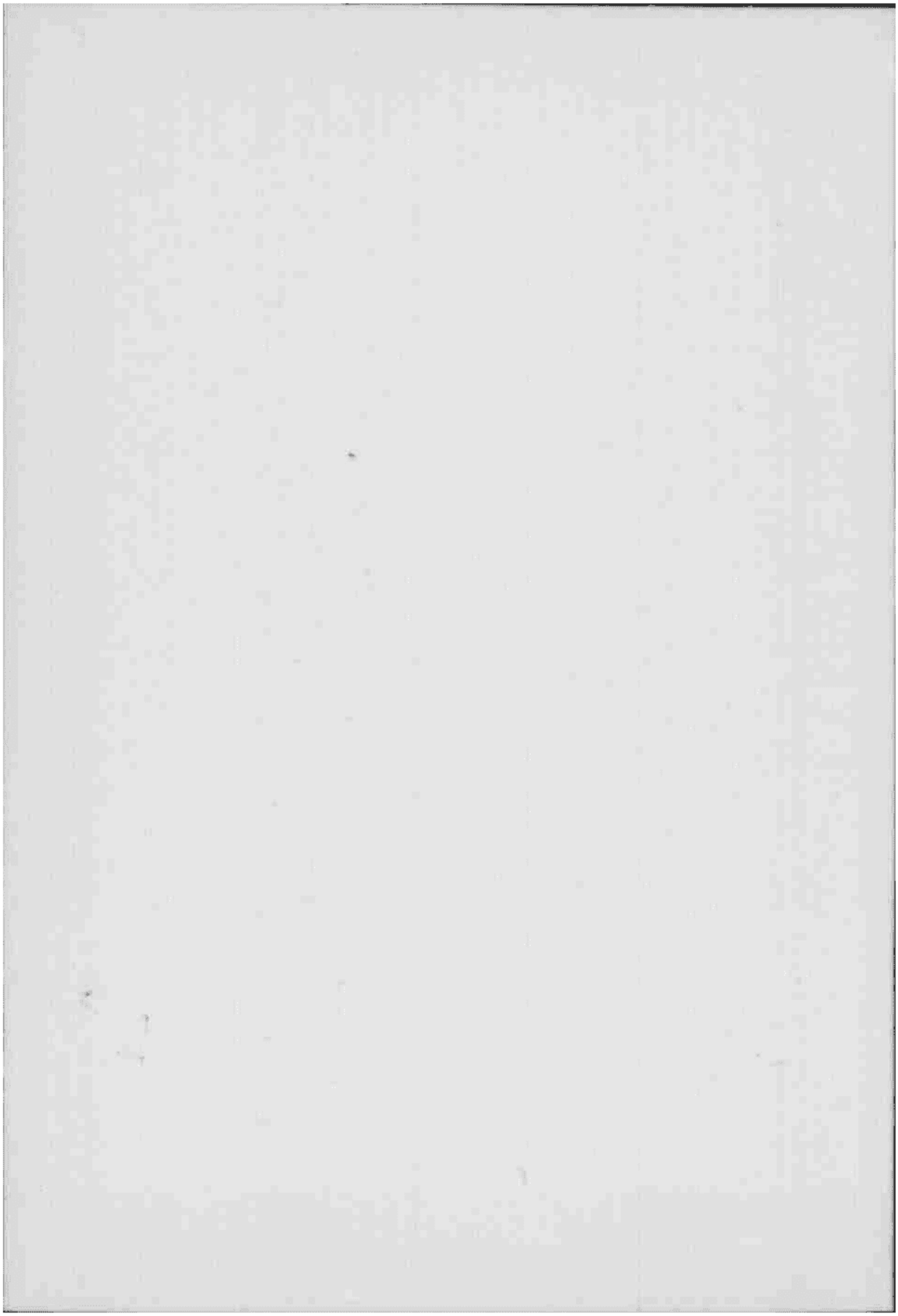
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100 MILLIMETERS

INSTRUCTIONS Resolution is expressed in terms of the lines per millimeter recorded by a particular film under specified conditions. Numerals in chart indicate the number of lines per millimeter in adjacent "T-shaped" groupings.

In microfilming, it is necessary to determine the reduction ratio and multiply the number of lines in the chart by this value to find the number of lines recorded by the film. As an aid in determining the reduction ratio, the line above is 100 millimeters in length. Measuring this line in the film image and dividing the length into 100 gives the reduction ratio. Example: the line is 20 mm. long in the film image, and 100/20 = 5.

Examine "T-shaped" line groupings in the film with microscope, and note the number adjacent to finest lines recorded sharply and distinctly. Multiply this number by the reduction factor to obtain resolving power in lines per millimeter. Example: 7.9 group of lines is clearly recorded while lines in the 10.0 group are not distinctly separated. Reduction ratio is 5, and 7.9 x 5 = 39.5 lines per millimeter recorded satisfactorily. 10.0 x 5 = 50 lines per millimeter which are not recorded satisfactorily. Under the particular conditions, maximum resolution is between 39.5 and 50 lines per millimeter.

Resolution, as measured on the film, is a test of the entire photographic system, including lens, exposure, processing, and other factors. These rarely utilize maximum resolution of the film. Vibrations during exposure, lack of critical focus, and exposures yielding very dense negatives are to be avoided.

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