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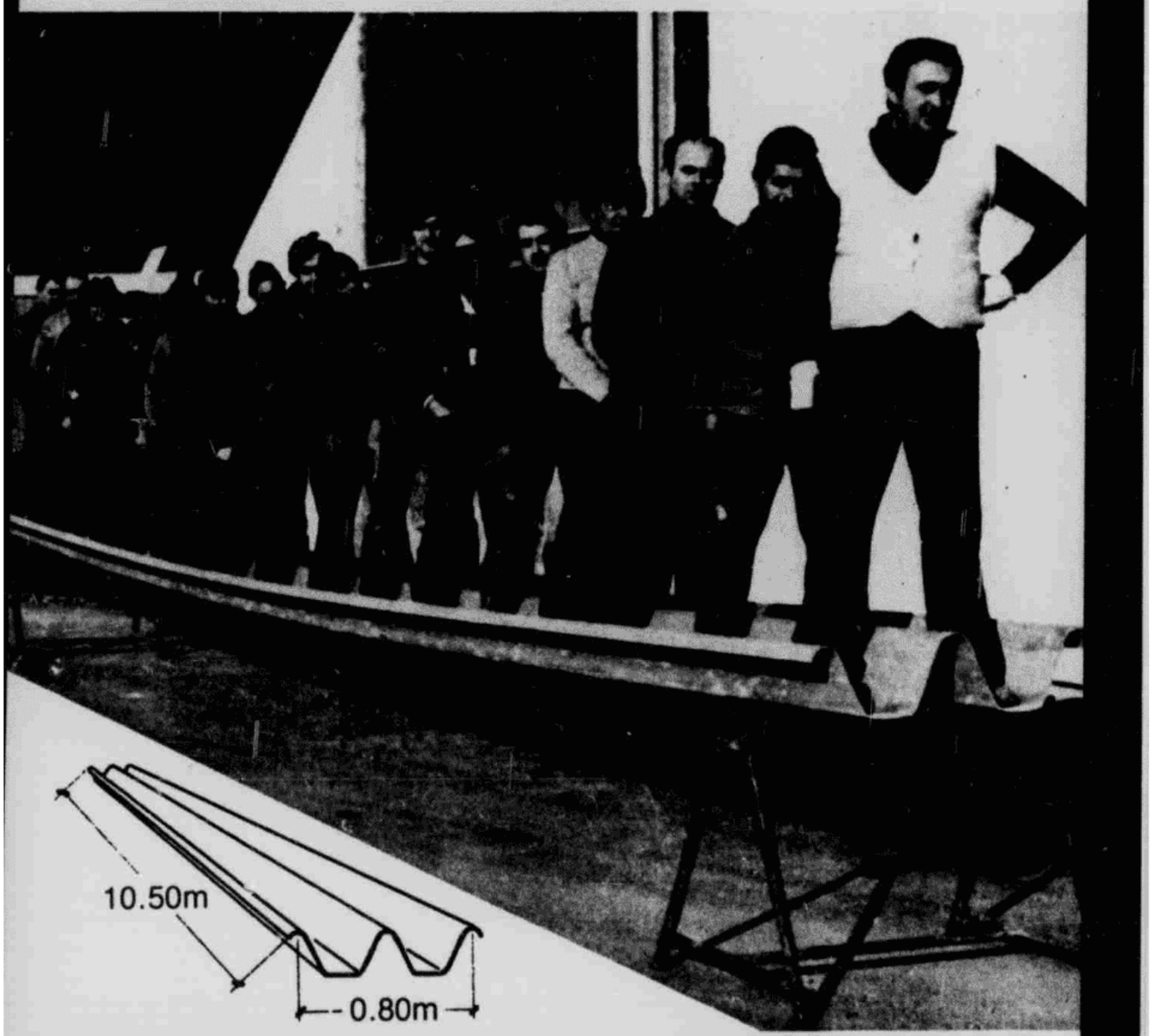
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IDENTIFICATION AND MEASUREMENT OF ASBESTOS FIBERS BY ELECTRON MICROSCOPY

BY: E. J. CHATFIELD, M.A., Ph.D. [CANTAB.]*

PART I

In the occupational setting, routine monitoring of air for asbestos fibers has for many years been performed by the membrane filter technique. The required air sample is collected on a cellulose ester membrane filter and this is examined using an optical microscope at a magnification of about 400 under phase contrast conditions. All fibers longer than 5 μm which have aspect ratios greater than 3:1 are then counted, and the results are expressed as fibers/ml of air. This technique has the advantages of simplicity and speed, and has found wide application in the asbestos mining and milling industry for routine air monitoring. The fact that the technique is non-specific, i.e. that no identification of the fibers is attempted, is of little concern since any fibers in such a well-characterized situation can be assumed to be from whatever material is being processed.

Detection and analysis of asbestos in the environment outside of the workplace presents an entirely different problem. A typical environmental air or water sample generally contains a large variety of minerals and organic debris, particles of which are often acicular. There are many minerals which have good cleavage in two directions, and the acicular fragments would be counted as fibers when using the optical technique. In the case of water samples, rod-shaped diatomaceous fragments are also frequently present. Consequently, a major requirement is for a fiber identification technique. This is also particularly important in view of a demonstrated difference in toxicity between some individual asbestos fiber types (e.g. Chrysotile and Crocidolite). Furthermore, there is a requirement to record all asbestos fibers, not merely those longer than 5 μm as defined in the occupational standard. This latter requirement arises because current medical evidence regarding the toxicity of small fibers, whether inhaled or ingested, is inconclusive. Moreover, there appears to be no conclusive work limiting toxicity to any particular fiber length. Although monitoring of only those fibers longer than 5 μm is ade-

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quate to give an indication, relative to past experience, of the inhalation hazard in a workplace, no information is obtained concerning the fibers in much smaller size ranges. These small fibers are undoubtedly present, and it should be appreciated that they usually constitute the majority when considered in terms of numerical, rather than mass concentrations. In the environmental sample, the optical microscope measurement would be meaningless, since very large variations in the size distribution occur and these must be accommodated. Of course, measurement of features using the optical microscope is limited by its resolution (about 300 nm for sodium light). In the selection of an instrumental technique, therefore, we must consider its ability to resolve fiber dimensions down to the unit Chrysotile fibril (about 30 nm), and also its ability to identify them. In terms of resolution, there are only two suitable instruments: the transmission electron microscope (TEM) and the scanning electron microscope (SEM).

TRANSMISSION ELECTRON MICROSCOPE

A modern TEM has a resolution of about 0.2 nm, which is more than adequate for resolving unit fibrils of Chrysotile. The image obtained also permits observation of some internal structure. *Figure 1* shows a very high magnification image of a unit fibril. Characteristic features can be seen, in particular the tubular structure. Note the high magnification necessary to observe these features (about 100,000), and the clarity of the image. Identification can be achieved using selected area electron diffraction (SAED), in which the electron diffraction pattern displayed by a single fiber can be inspected. This pattern is characteristic of the crystalline structure of the fiber. The SAED process is very rapid, is available on all modern instruments, and the experienced operator can identify fibers by visual inspection of their SAED patterns. The process of morphological and SAED inspection allows fibers of biological origin and acicular fragments of many other minerals to be eliminated from the fiber count. Unfortunately, not all Chrysotile fibers yield SAED patterns on which identification can be based. The previous history of the fiber, together with the operating conditions of the microscope, combine to give a large range of identification success using known Chrysotile fibers. For this reason, fiber counts for Chrysotile are usually based on morphology, together with a successful demonstration of satisfactory SAED patterns on a proportion of the fibers. In the case of amphibole fibers, there is no characteristic morphology on which identification can be based. Here a suspected fiber must have some regions with parallel sides, and

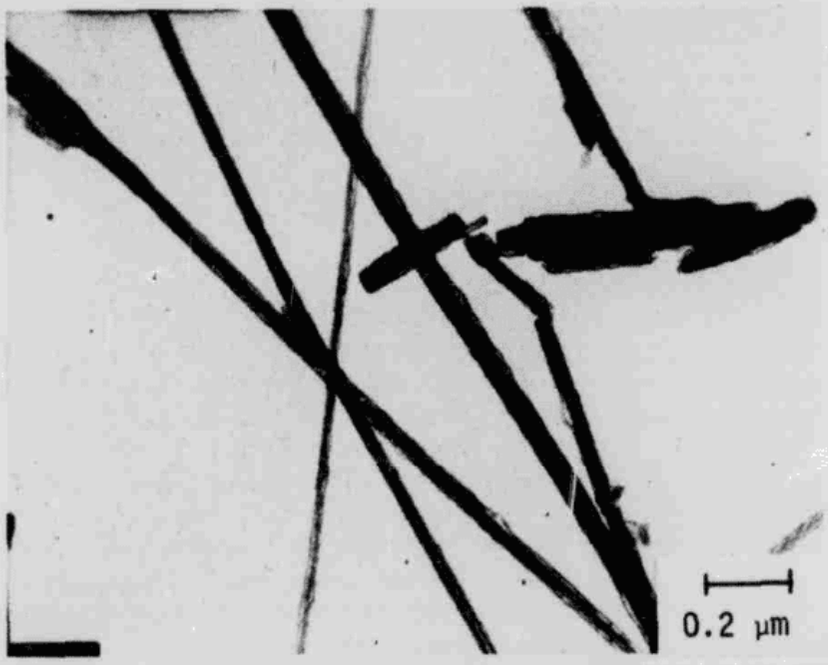
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perhaps some evidence of lengthwise striations or splintering. An SAED pattern visually resembling that obtained from reference amphibole fibers is then accepted as an identification. Morphologically similar fibers displaying incomplete SAED patterns, or no pattern at all, are often accumulated separately in a "probable amphibole" category.

A further identification aid is available on the TEM: the energy dispersive X-ray analysis system (EDXA). In principle, the sus-

Figure 1

HIGH MAGNIFICATION TEM MICROGRAPH OF CHRYSOTILE FIBRILS, SHOWING THEIR MORPHOLOGY



pected fiber is irradiated by the electron beam in the microscope, and X-ray emission from it is detected by a lithium drifted silicon crystal. The detector is a "proportional" type, in that the height of the output pulse is proportional to the energy of the incident X-ray. This field of technology has progressed very rapidly in the last decade, and with modern equipment it is now possible to accumulate the entire X-ray spectrum from a small particle in a few seconds. The peaks in the spectrum are characteristic of particular elements, and a semi-quantitative composition for the particle can be obtained. Thus the fiber which cannot be identified successfully by SAED can often be classified on the basis of its composition. However, the procedure is rather slow, requiring perhaps 30 seconds for acquisition of each spectrum, and about another minute for instrument manipulation and interpretation.

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For this reason, the technique is used for confirmation, rather than as the primary identification aid.

SCANNING ELECTRON MICROSCOPE

The SEM is the other instrument having suitable, if marginal, resolution for asbestos fiber analysis. In the secondary electron emissive mode, resolutions down to about 5 nm are claimed for currently available instruments. This is about one sixth of the unit fibril diameter, and is theoretically adequate for its measurement. Unfortunately, the impressive specifications quoted by the manufacturers can be somewhat misleading. In the TEM, for example, the instrumental resolution available usually exceeds that of the samples we can prepare. To some extent, the same is true of the SEM. The resolution figures quoted are usually taken from micrographs of ideal, electrically-conducting specimens. An organic filter surface, on which non-conducting particles are deposited, the whole specimen being covered by perhaps 5-10 nm of vacuum deposited carbon, is quite another situation. Here we notice that the quoted resolution cannot usually be obtained. Unfortunately, resolution is not the complete story; there are a number of other factors to consider. A rather more serious problem exists concerning contrast. The secondary electron mode usually employed in the SEM relies on topography for contrast. As features become smaller in height, their contrast from that of the supporting surface becomes smaller. Consequently, for smaller fiber diameters, although there may be adequate instrumental resolution, there is insufficient contrast for them to be seen against the background. The inability to discriminate the fibers is further aggravated by a decrease in the signal-to-noise ratio when attempts are made to increase the instrumental contrast. Abraham and DeNee[1] have employed simple backscattered electron imaging in the SEM to improve this situation, since the contrast obtained in the backscatter mode of operation is related to the mean atomic number. However, at small particle sizes, the contrast will again approach that of the substrate. There is also some loss of resolution due to the fact that the higher energy backscattered electrons can escape from deep within the sample.

With few exceptions, the SEM image is not a static image. The image observed by the operator is a persistence image on a cathode ray tube (CRT) which is renewed perhaps twice per second, in much the same way as a radar system image. Surveying such an image for widely separated fibers among other debris is very difficult. As in the TEM, for reliable fiber detection, the magnified image of a unit fibril should be presented at about 5 times the

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operator's unaided visual acuity, i.e. at about 0.5 nm. This implies a magnification of about 17,000, and represents about 5 scan lines for a conventional SEM high resolution display. The requirement is thus to search a large number of such fields of view at this high magnification for fibers. Reduction of the magnification will introduce the possibility that fibers will be overlooked. Each change of the field of view entails a delay while a new image is "painted" on the CRT. Thus scanning of a sample for fibers is essentially a discontinuous, successive field of view process, rather than the continuous scan of a large static image which is used in the TEM.

Thus we can see that although the SEM at first looks attractive for this type of analysis, there are some disadvantages; the principal objection to its use is its inability to reliably detect individual Chrysotile fibrils. So far as fiber identification is concerned, this is limited to observation of acicular morphology, and semi-quantitative chemical composition determination using EDXA.

SEM vs. TEM

Before moving on to the details of sample preparation, the question of the applicability of the SEM and TEM should be discussed further. It has already been established that for adequate definition of the individual fibril, a magnification of about 17,000 is necessary. This is best discussed in terms of a comparison between identical areas of typical specimens as seen in both the SEM and TEM. *Figures 2A and 2B* show high magnification micrographs of taconite tailings from a highly-publicized source. *Figure 2A* is an SEM micrograph of a carbon-coated Nuclepore filter on which some of the taconite tailings have been deposited; and *Figure 2B* is the corresponding TEM micrograph of the same area of deposit after the preferred specimen preparation. A number of interesting and relevant conclusions can be drawn concerning the realistic and practical use of the SEM. It is immediately evident that the larger particles have been retained in position during the preparation steps for the TEM sample. It is also evident that as the particles become smaller and thinner, they become almost indistinguishable on the SEM micrograph. Flat plates of laminar material, in particular, become invisible against the background gray level. A similar phenomenon exists for the fibers; it would be an interesting exercise to compare fiber counts obtained from *Figure 2A* with those subsequently obtained from the TEM micrograph. Many of the fibers seen in the TEM micrograph can only be recognized in the SEM micrograph by inspecting the relative disposition of the filter pores, and many fibers are

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not visible at all. If this situation exists in a comparison of micrographs, the visibility problem would certainly be compounded when viewing the SEM screen persistence image directly. *Figure 2A* was obtained using a 40-second exposure, in order to average out the image noise; the TEM image was constantly available at a quality comparable with that of the micrograph. The resolution of the SEM image in the micrograph can be judged from the 100 nm diameter filter pores; it is estimated to be about 20 nm.

Figure 2A

Figure 2B

SINGLE FIELD OF VIEW OF A NUCLEPORE FILTER ON WHICH TACONITE TAILINGS HAVE BEEN COLLECTED, AS SEEN IN THE SEM AND THE TEM



POSITIVE FIBER IDENTIFICATION

On the question of fiber identification, it has already been shown that both SAED and EDXA are available on the TEM, and only EDXA on the SEM. The criteria for the identification of asbestos have been, and still are, the subject of much controversy, particularly in view of the anxiety of regulatory bodies to es-

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tablish permissible concentration levels in air, water, food, drink and injectable drugs. Some aspects of the reliability of identification by SAED and EDXA have been discussed by Rudd[2]. It is immediately evident that if time and money were no object, an individual fiber can be positively identified in the TEM by using both techniques, so as to obtain both its crystal structure and its chemical composition. Positive identification of Chrysotile by its SAED pattern is relatively simple, particularly if the tubular morphology is also present. In Ontario, positive identification is accepted on the basis of morphology alone, provided that some fibers of similar morphology in the same sample have yielded recognizable SAED patterns. The identification of individual amphiboles, however, is much more involved. Apart from acicular shape, there is no characteristic morphology, although there may be evidence of splintering and longitudinal striations. Once having located a suspected amphibole fiber, the SAED pattern is inspected. If this is visually recognizable as similar in spacing, orientation and character to that from known reference fibers, identification is accepted as positive in the interim procedure for water[3], issued by the U.S. Environmental Protection Agency (EPA). One is aided in identification by the fact that the majority of the fibers lie with their longitudinal axes in the plane of the sample, and that with this restriction on their orientation the SAED patterns obtained from one fiber type are similar in appearance. Unequivocal identification by SAED alone is possible, and has been demonstrated[4]. However, this procedure invcives detailed measurements from photographic plates of SAED patterns for a number of different orientations of the fiber. Although valuable for special investigations, the technique is uneconomic for routine fiber counts, in which the identification of numerous fibers is required in each sample. The undeniable fact is that mistakes in amphibole identification can occur when using visual inspection of a single SAED pattern. Moreover, SAED becomes more difficult at both large and small fiber dimensions. Small fibers, perhaps 200 nm long, do not always yield satisfactory patterns, and in the case of large fibers they may be too thick to allow adequate beam penetration. There is not a sharp cut-off; rather there is a variable identification success which decreases with both increase and decrease of fiber size from some optimum value. In standard amphibole fiber suspensions, it has been shown that about 40% to 50% of the known amphibole fibers were successfully identified by SAED[5]. Others gave either patterns inadequate for recognition, or no pattern at all. The mistakes in identification are reduced substantially if EDXA is used in the TEM as a confirmatory technique. EDXA is, however, not used routinely on every fiber because of the time re-

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quired on each occasion to accumulate a satisfactory X-ray spectrum.

It should be appreciated that much apparently fibrous material viewed in the TEM can be discounted immediately on the basis of its appearance. The high resolution and electron beam penetration of the instrument gives the operator a significant amount of information about the suspected fiber before any attempt is made to obtain an SAED pattern. However, because of the limited morphological detail in the SEM image, in performing a fiber count the microscopist is forced to inspect the X-ray spectrum of every acicular particle. Assuming that a satisfactory EDXA spectrum is obtained, Rudd[2] argues that identification on this basis alone is questionable in most cases, since there are many minerals capable of yielding acicular fragments which have compositions close to the ranges of known asbestos varieties. A further complication is introduced by the scattering of the electron beam in the sample. Although the initial beam diameter may be as small as 5 nm, the scattering process in the thick SEM specimen results in X-ray generation from an area approximately 1 μm in diameter. Any other debris within this circle, and to a smaller extent outside it, will contribute to the resulting EDXA spectrum. It can easily be shown that other material even 10 μm from the beam position, makes such a contribution. As we have seen, much laminar and other small material is not visible in the SEM image, so if the particle being analyzed is smaller than about 1 μm we are not in a good position to judge whether or not the spectrum comes solely from the selected particle. The same argument is not true of the use of EDXA in the TEM, since here the sample substrate is thin enough for the beam to pass through without significant scattering.

SCANNING TRANSMISSION ELECTRON MICROSCOPE

Another instrument which should be mentioned is the scanning transmission electron microscope (STEM). Attachments are available which add STEM capability to the conventional TEM, and these offer resolutions of about 3 nm. A dedicated STEM instrument has recently become available (for about $400,000), which offers a resolution of about 0.2 nm, i.e. about the same as that of the conventional TEM. As in the case of the TEM, the STEM mode of operation requires a thin, electron transparent specimen, but the image formation process is similar to that of the SEM. It is also possible to obtain secondary electron or backscattered electron images from such specimens. However, in this application, currently available STEM equipment does not offer any significant advantages over the conventional instruments.

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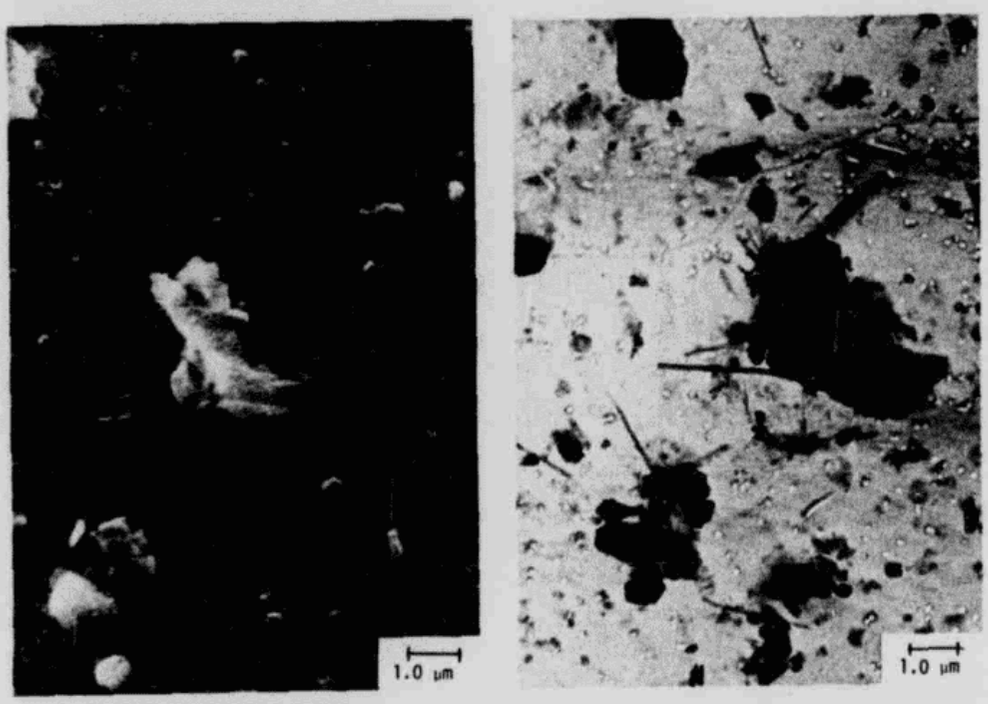
The above discussion indicates the principal reasons why investigators performing analyses of environmental samples for asbestos favor the use of the TEM, and why some regulatory agencies have also followed this route. It is evident that considerations of visibility (both resolution and contrast), together with the uncertainty of what other unobserved material is within the "analyzed volume", limit the usefulness of SEM-EDXA combination for this type of work. In summary, the SEM-EDXA technique can only be applied reliably to the analysis of particles greater than about 1 μm in dimension, and even assuming a valid analysis, identification as asbestos on this basis alone is open to criticism.

Turning specifically to Chrysotile, *Figures 3A and 3B* show a similar SEM-TEM comparison for fibers obtained from a contaminated lake in Northern Ontario. Once more, the fiber count obtained from even the SEM *micrograph* would be much lower than

Figure 3A

Figure 3B

SINGLE FIELD OF VIEW OF A NUCLEPORE FILTER ON WHICH CHRYSOTILE FIBERS FROM A WATER SAMPLE ARE PRESENT, AS SEEN IN THE SEM AND THE TEM



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that from the TEM. The visibility problems of thin plates and Chrysotile fibers are demonstrated graphically by these micrographs.

On the question of the time required for analysis, preparation of samples for the TEM involves only one extra step beyond that required for the SEM. Although this involves some elapsed time, the actual manipulation is minimal. Furthermore, experienced operators find that the TEM-SAED approach requires less instrument time and incurs less operator fatigue than the SEM-EDXA method.

THE SECOND AND FINAL PART OF THIS ARTICLE BY DR. CHATFIELD WILL BE PUBLISHED IN THE NEXT (MARCH 1978) ISSUE OF "ASBESTOS".

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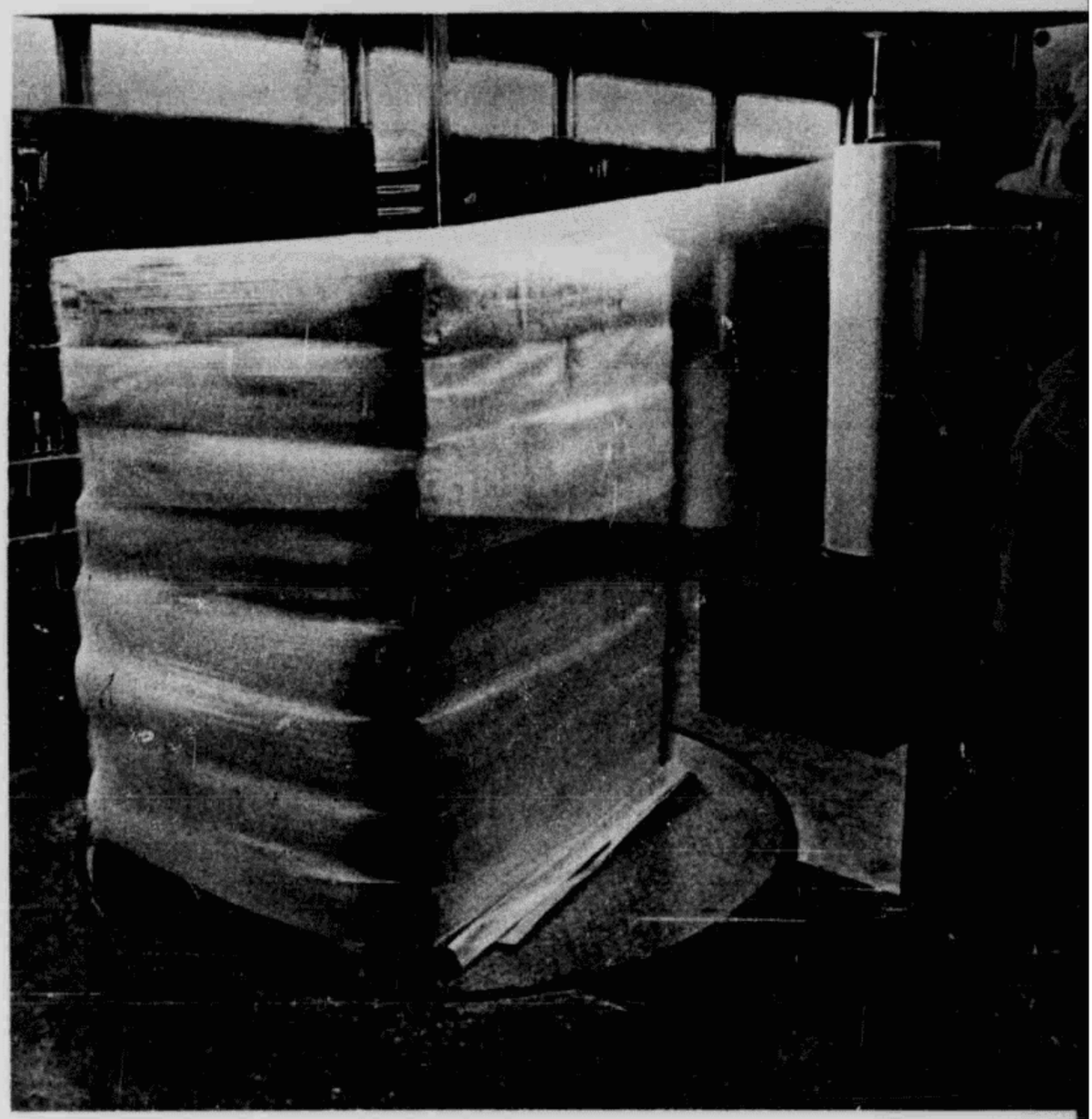
THE ASBESTOS FACTBOOK, 3RD EDITION—Compiled by the staff of ASBESTOS Magazine; written in layman's terms; offers useful information on the origin, locations and uses of asbestos; gives the chemical compositions of the various types of the mineral; contains data concerning testing methods and grades. [28 pages; $1.00 per paper-bound copy; order from ASBESTOS Magazine]

CHRYSOTILE ASBESTOS TEST MANUAL, 3RD EDITION—Prepared jointly by the Asbestos Textile Institute, Inc., and the Quebec Asbestos Mining Association; provides 34 standard methods for testing the physical and chemical properties of Chrysotile asbestos fiber. [$18.95 to the U.S., Canada and Mexico; $21.95 to all other countries; place orders with ASBESTOS Magazine]

ASBESTOS/A REMARKABLE MINERAL FIBER—Reference book on asbestos by Marion S. Badollet; presents technical information on asbestos minerals and data on the chemical, physical and optical properties of Chrysotile, Riebeckite, Anthophyllite and Tremolite; contains electron micrographs, thermal analyses and X-ray diffraction patterns. [80 pages; $20.00 per copy; advance payment required; order from ASBESTOS Magazine]

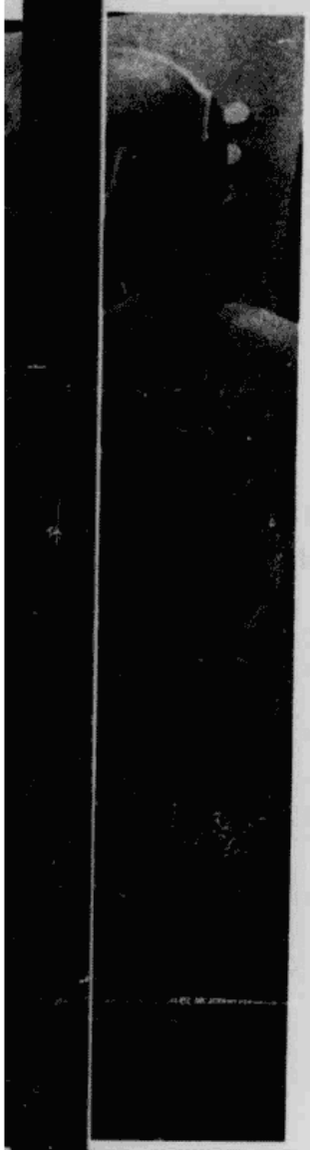
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MARKET CONDITIONS

GENERAL BUSINESS

As 1978 gets underway, news of the economy is generally good. Gross National Product for 1977 showed a "real" growth of 4.9%, approaching the Administration's target of 5.1%. The unemployment rate dropped to 6.4% in December, pleasantly surprising even the most optimistic forecasters. Housing starts exceeded 2.2-million in December, a 21% gain over the year earlier figure and personal income rose 11.1% in the same month, the largest gain in four years. Durable goods orders increased sharply in December but the figure was swollen by several very large orders for aircraft which were placed in that month.

On the opposite side of the ledger, sales of domestic automobiles were weak in January, wholesale food prices continued to move upward and polls showed consumer confidence in the future of the economy was dropping. Businessmen shared this pessimism by indicating that 1978 capital spending would grow only about 4.5% over that of 1977, less than had been predicted only a few months ago. Climbing short-term interest rates were triggering withdrawals of funds from savings institutions leading to concern about the future of the housing market.

The President has presented to the Congress a record budget for 1978 as well as a proposed program for tax reform. The budget can be characterized as "moderate" in most respects in that it includes no large, new spending programs. The tax proposals include cuts which would total about $25-billion for individuals and business. Discussion of details of either proposal is not warranted at this point since it is obvious that the Congress will come up with substantial changes in both of them.

Despite the generally favorable outlook for business, the stock market's decline continues and the Dow Jones Industrial Average hit a new 33-month low in late January. In the absence of any momentous single causative event on either the national or international scene, the protracted decline must be attributed to a combination of many factors, all of which add up to a very real uncertainty on the part of investors as to the future course of the national and worldwide economies. While the future is never absolutely certain, the market responds to the *degree* of uncertainty felt by the participants and this is obviously quite high at the moment.

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OVER A QUARTER CENTURY OF EXPERIENCE

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A major fear of investors is inflation. In his State of the Union address, Mr. Carter put forth a "new" program to combat inflation. Insofar as it stresses voluntary cooperation of labor and business to restrain wage and price increases, it differs little from the "non-program" of 1977 and promises to have about the same "non-effect". Some day our leaders may admit that government actions are the root causes of most of the inflation from which we are suffering and that the only cure lies in government restraint in spending and other inflation-causing activities. Rather than exercising such restraint, the government, by increasingly using indexing as a means of insulating certain select groups from the full ravages of inflation, is, in effect, telling us it has no intention of curbing its excesses. Under these conditions, the average citizen can anticipate no relief from continually rising price levels.

HOUSING & CONSTRUCTION

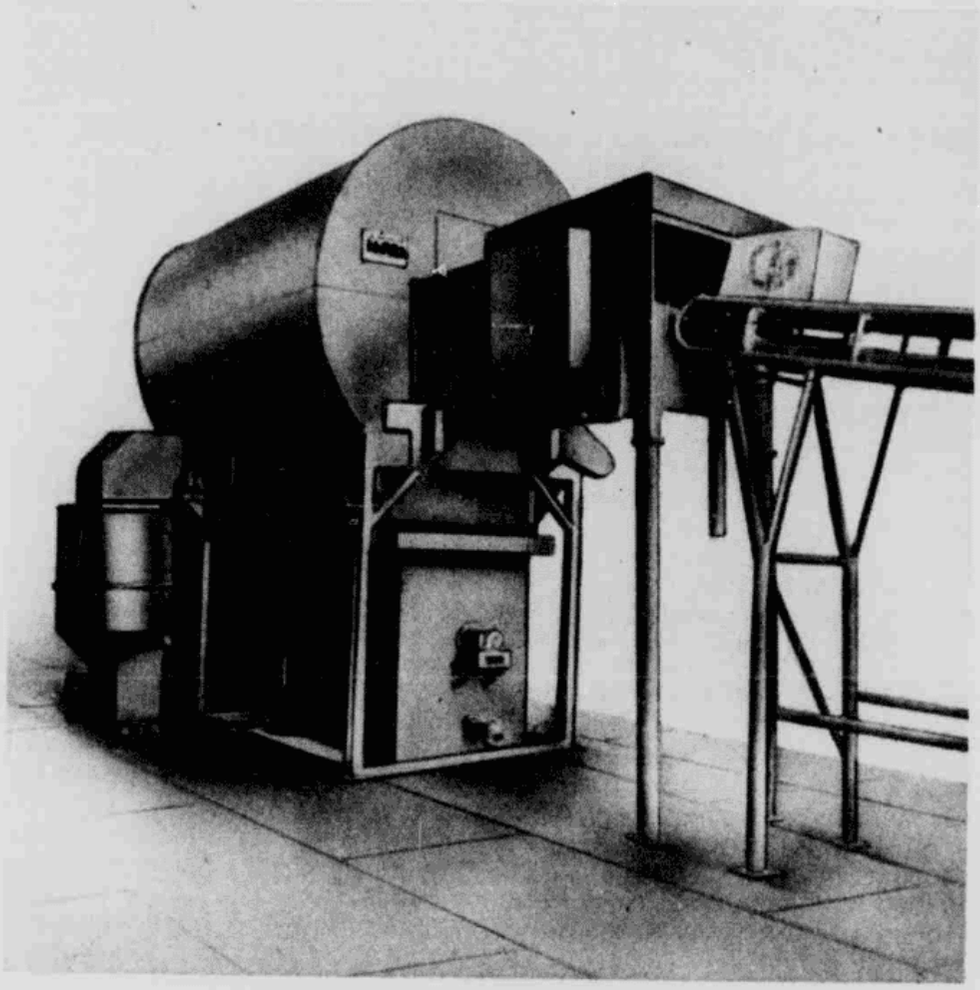
YEAR 1977—The construction industry wound up 1977 on a sharply rising trend with $10.4-billion of newly-contracted projects in December bringing the total of new construction for the year to a record $139.2-billion, 26% more than the 1976 total and the biggest yearly gain in nearly three decades of cyclical ups and downs. The seasonally-adjusted Dodge Index (1967 = 100) advanced to 299 in December from 258 in November and 244 in October. Residential building showed the biggest advance in 1977, a 39% increase over 1976 to a record $61.4-billion. The yearly total of nonresidential building contract value, reflecting a weak start and a strong finish, amounted to $35.3-billion or an annual gain of 18%. The $2.8-billion of contracts in December for public works and utilities brought the 1977 nonbuilding construction total to $42.5-billion, 18% over 1976. [F. W. Dodge Division, McGraw-Hill Information Systems Company]

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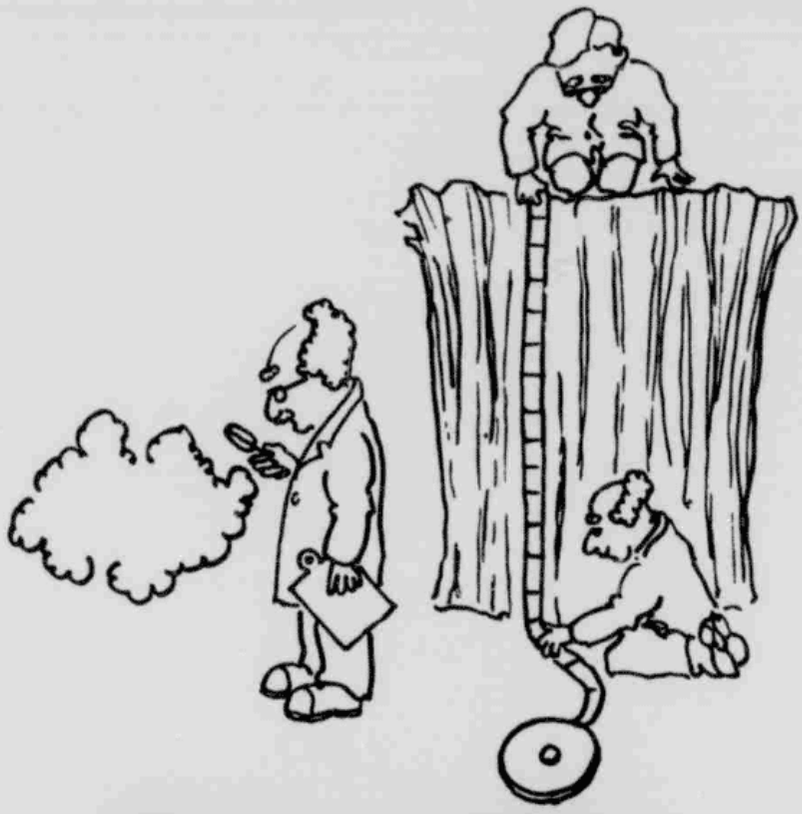
We begin this review of what took place in 1977 in the area of occupational health and safety, as it concerns the Asbestos Industry, by issuing kudos to the Asbestos Information Association/North America (AIA/NA), and other like organizations around the world, for their untiring efforts to keep the Industry current on developments concerning asbestos/health issues and their continuing work with various government agencies toward setting meaningful and realistic asbestos regulations.

Insofar as the AIA/NA in the United States is concerned, the *1978 budget* was recently approved to continue support of the Association's program of informing and guiding the industry in North America on risks to health from exposure to asbestos dust, and workplace practices and engineering procedures for control of dust and asbestos waste. . . . Early in the year, AIA/NA revised its By-Laws to provide for the *addition of an Associate Membership category*, thereby encouraging participation in its work by a broader spectrum of the asbestos-using industrial community. . . . On September 1, AIA/NA *relocated its headquarters* from Washington, D. C., to 1745 Jefferson Davis Highway, Crystal Square 4, Suite 509, Arlington, Virginia 22202—Telephone: (703) 979-1150. . . . For those who may be interested in *regulatory actions at State level*, AIA/NA has available a report, at $2.50 per copy, which gives the status of each State's occupational safety and health and air pollution programs and summarizes State and certain municipal actions and/or proposed actions with regard to the use of asbestos. . . . Still available are AIA/NA's five Recommended *Work Practice Manuals* ($1.35 per manual, plus postage) on the Fabrication and Use of Asbestos Paper Products; Shop and Field Fabrication of Asbestos Sheet Products; Molding and Fabrication of Asbestos Containing Plastic Products; Fabrication and Use of Asbestos Friction Materials; and Use and Handling of Asbestos Textile Products.

NAS SCIENCE WEEK

The New York Academy of Sciences recognizes our ability to identify many harmful agents and to evaluate their risk but it also understands that simply identifying hazards is not sufficient, and it is necessary to apply this knowledge to prevent human disease and death. In posing the question: How should society use scientific information for regulation and control?—the Academy states this may well be not a scientific problem but a political, legal, economic, social and administrative one, insofar as it is at the interface between advancing science and the public's interest. To consider this urgent question the Academy has scheduled *Science Week* in New York City, June 21-30, 1978. Events will include three major international scientific conferences, workshops, courses and field trips (several

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asbestos-related)—and social functions. One of the three conferences, the *International Conference on Health Effects of Asbestos Exposure*, will be held June 24, 25 and 27. Co-chaired by Irving J. Selikoff, M.D., and E. Cuyler Hammond, Sc.D., it will analyze recent progress made by the Asbestos Industry in approaches to control; new information defining disease hazards; and current studies of epidemiologists, physicians, mineralogists, pathologists and others. The discussions will focus on those data needed to evaluate environmental hazards and determine how they can be controlled. Also to be reviewed and studied are hazards to the public and what risks might be associated with asbestos contamination of public water supplies. . . . How are we to use accumulating scientific information to control environmental hazards? How are different countries and different agencies approaching the problem? These and other crucial questions will be considered at the *International Conference on the Public Health Control of Environmental Hazards*, to take place June 28-30.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

A *major reorganization* and new directions are evident under the new Administration. *Dr. Eula Bingham*, Associate Director, Department of Health, University of Cincinnati School of Medicine, was nominated by President Carter and confirmed by the U.S. Senate March 18, 1977, to head the Occupational Safety and Health Administration (OSHA). Under broad plans announced in May, Dr. Bingham said OSHA would redirect its inspection efforts to workplaces with the most serious safety and health hazards. She also announced the Agency would no longer concentrate on nitpicking violations of safety and health rules. . . . In the Federal Register of December 13, 1977, OSHA proposed revocation of selected standards or portions of standards presently contained in *OSHA General Industry Safety and Health Standards* [29 CFR, Part 1910]. The provisions proposed for revocation are those which generally have no direct or immediate relation to employee safety or health.

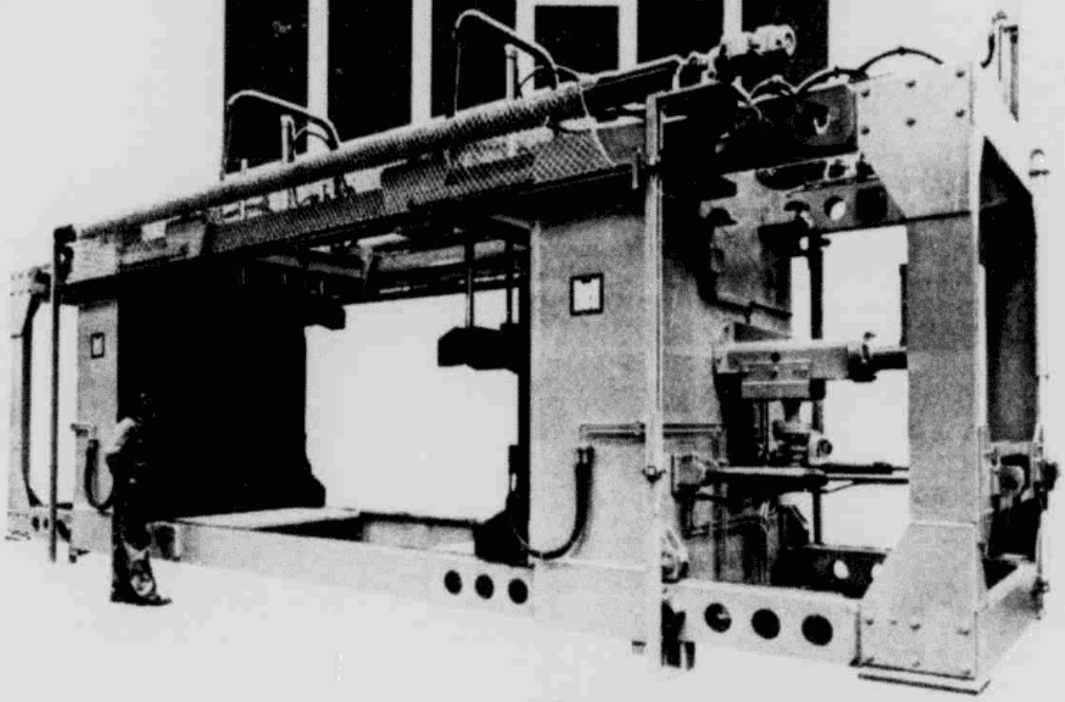
OSHA Asbestos Standards

The revised *OSHA Asbestos Manufacturing Standard*, including the two fibers per cubic centimeter limitation, has been in effect since July 1, 1976. On October 9, 1976, substantial revisions to the Standard were proposed, based on new medical evidence and advances in monitoring and protective technologies. Most importantly the revisions, if adopted, would reduce permissible exposures to an 8-hour, time-weighted average of 0.5f/cc and the ceiling limit to 5f/cc, determined during any 15-minute sampling period. On December 15, 1976, the National Institute for Occupational Safety and Health (NIOSH) recommended a further lowering of the exposure limitation to 0.1f/cc (100,000 fibers per cubic meter). NIOSH says the recommendation is based on the lowest concentration at which asbestos fibers can be reliably monitored using phase contrast microscopy. . . . OSHA is preparing a *Technological Assessment and Economic Impact Analysis for Asbestos*. The document will incorporate three existing Economic Impact Analyses on Asbestos into a single study, with the necessary updating of obsolete data. Under the OSHA contract, *Research*

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Triangle Institute will consolidate and update its studies with those of *CONSAD Research Corporation* relative to the economic impact of two fibers and one, one-half and one-tenth fiber per cubic centimeter permissible levels of exposure to asbestos in the workplace. AIA/NA has learned it is OSHA's objective to complete this work before the end of April 1978. . . . Still to be proposed by OSHA is its *Asbestos Standard for the Construction Industry*. Meanwhile, AIA/NA's study of asbestos in the construction industry, being conducted by *Equitable Environmental Health, Inc.*, remains in a "hold" status.

NBS/OSHA Workshop on Asbestos

In the opinion of the National Bureau of Standards (NBS), even under favorable circumstances (e.g. homogeneous samples, easily identified fibers, etc.), the existing OSHA procedure (the membrane filter method of measurement) is useful only for determining fiber content and not asbestos content. This opinion is part of the findings from a study undertaken by NBS under contract to OSHA. Shortly after the findings were made available, NBS and OSHA sponsored a workshop/meeting to discuss current problems of *defining and measuring asbestos*. The consensus of opinion was that much is yet to be learned about the toxicity, measurement and definition of asbestos. . . . In his presentation at the workshop, *Dr. Paul Kotin*, Senior Vice President for Health, Safety and Environment, Johns-Manville Corporation, said he believes a level of exposure to asbestos exists at which adverse health effects do not result and nothing of which he is aware rules out the dose-response relationship. The problems associated with long, thin fibers were emphasized by the majority of speakers who addressed the asbestos-health relationship. *Dr. Mearl F. Stanton*, National Cancer Institute, stated that more work needs to be done on inhalation studies. . . . It appears that no decisions were reached and there remain great variances of opinion as to the best methodology to follow to adequately measure asbestos. The membrane filter method with optical microscope was criticized. Also discussed was the adverse economic impact if more sophisticated analytical techniques were prescribed.

OSHA Generic Cancer Policy

The Federal register of October 4, 1977, carried OSHA's first comprehensive proposal for regulating cancer-causing substances which would establish a procedure for *identifying, classifying and regulating potential carcinogens* in U.S. workplaces. The intent of the proposal is to set new procedures and a framework for regulating worker exposures to potential occupational carcinogens; scientifically-based policies to identify and classify such substances; and three model standards for use in specific rulemaking involving such substances. . . . In classifying each toxic substance encountered, OSHA will rely on evidence from human epidemiological studies, adequately designed and conducted animal studies, or both. Classification of a substance in Category I would trigger the immediate issuance of the model emergency temporary standard, followed quickly by established rulemaking procedures. OSHA proposes to classify

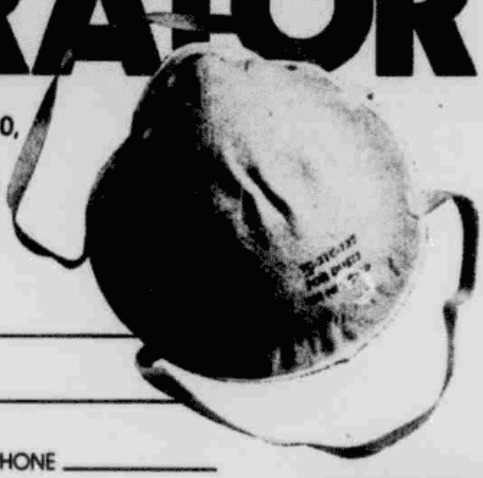
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in Category I those substances whose carcinogenicity has been established in humans, or in two mammalian species of test animals, or in one species if those results have been replicated. *Asbestos has been so defined.* . . . Permissible exposure limits in the emergency temporary rule and in the proposed permanent rule for Category I substances would be set at the lowest level feasible. Where the record indicates that suitable substitute substances exist, OSHA can propose to prohibit the use of a Category I substance. . . . In prescribing methods of compliance, the most significant difference between the model emergency rule and the proposed permanent rule for Category I substances is that the emergency rule would permit greater reliance on respirators to reduce exposures and the permanent rule would require substantial reliance on engineering and work practice controls to reduce exposures—with respirators permitted only as an interim means of protection. . . . In response to an inquiry from AIA/NA concerning the proposal's effect on the OSHA Asbestos Manufacturing Standard, an OSHA official stated the Agency does not intend to "recycle standards for carcinogenic substances now in being" unless those standards are not consistent with "lowest level feasible". . . . Written comments on the proposed cancer policy must be submitted no later than February 28, 1978. The informal public hearing will be held May 16, 1978.

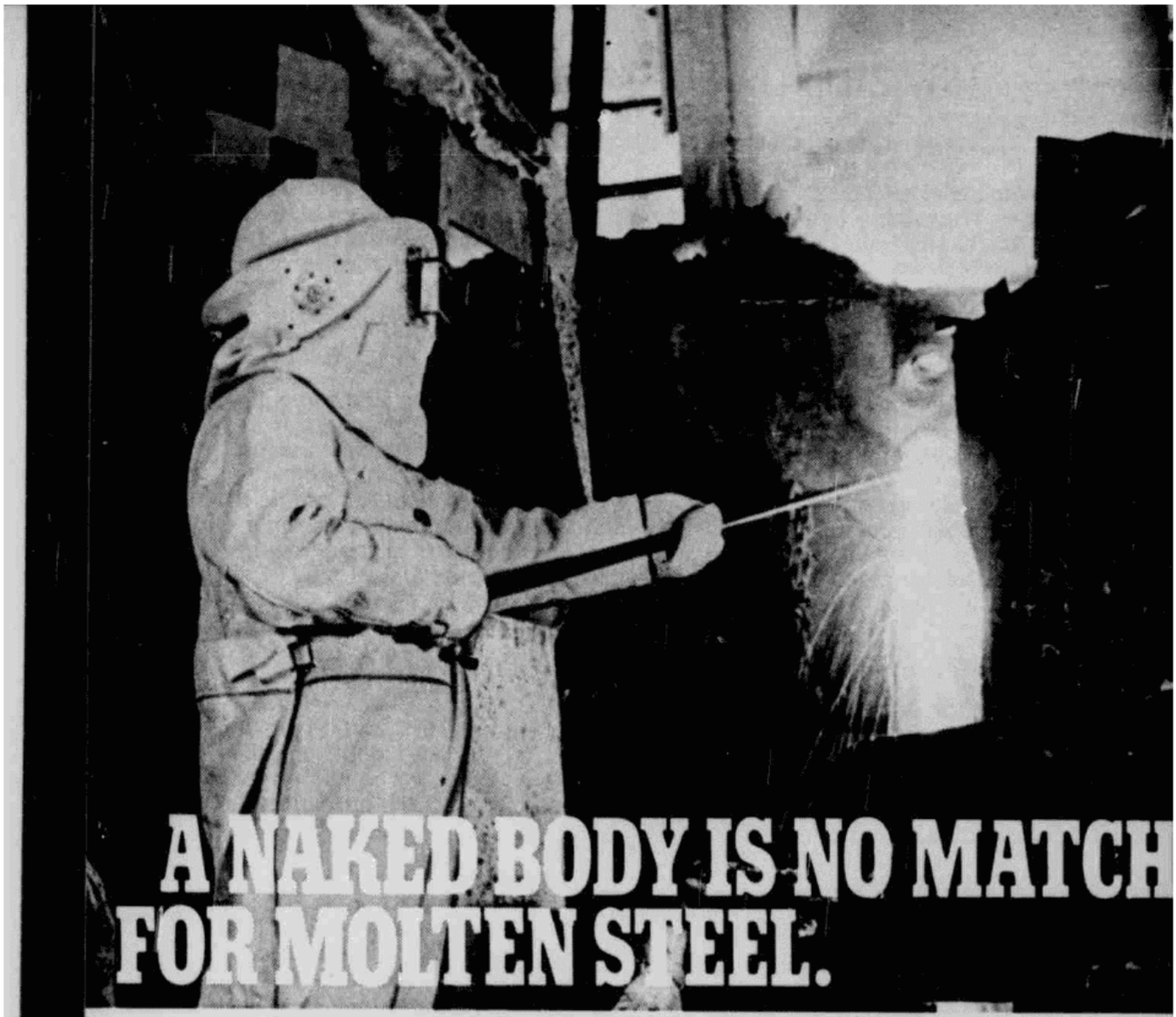
OSHA Recordkeeping Rules

In the Federal Register of December 30, 1977, OSHA issued minor amendments to its recordkeeping regulations under *CFR 29, Part 1904—Recording and Reporting Occupational Injuries and Illnesses,* effective January 1, 1978. The amendments cover certain safety and health recording and reporting rules to reduce the recordkeeping burden on employers which continue to provide necessary injury and illness data. The reduction is being accomplished by replacing Forms OSHA 100 and OSHA 102 with a new Form OSHA 200 — Log and Summary of Occupational Injuries and Illnesses. Posting requirements and reporting procedures are simplified. The substantive or conceptual aspects of the system are not altered. Employers with ten or fewer employees are exempt from recordkeeping requirements except for those selected to participate in the annual statistical survey. Employers who maintain a computer-generated recordkeeping system are given until June 1, 1978, to adapt their systems to the new requirements.

OSHA to Propose Labeling Standard

OSHA intends to soon issue a proposed labeling standard. Advance notice of the proposed rulemaking appeared in the Federal Register of January 28, 1977. The proposal will include provisions on *labeling, material safety data sheets and employee education.* The sheets would be required for each and every hazardous substance processed by a manufacturer and employers would be required to advise employees of the existence, contents and right of access to the data sheets. . . . Caution labels are now required by the OSHA Asbestos Manufacturing Standard in "raw materials, mixtures, scrap waste, debris and other products con-

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taining asbestos fibers". Generally, labels are not now required where asbestos fibers have been modified by a bonding agent, coating or binder. AIA/NA has specifically recommended to OSHA that substances now subject to labeling requirements in existing OSHA health standards, e.g. asbestos, be exempt from any generic labeling regulations.

Interagency Agreement

Concerning the regulation of toxic and hazardous substances, there appeared in the Federal Register of October 11, 1977, an *interagency agreement* between the Department of Labor (OSHA), the Consumer Product Safety Commission, the Environmental Protection Agency and the Department of Health, Education and Welfare (Food and Drug Administration). By signing the agreement, the four agencies hope to increase their cooperative efforts, share more data and in some instances, share expenses. They may begin mutual training programs, exchange personnel, jointly sponsor awards or grants and, when practicable, hold joint public hearings for rulemaking.

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY & HEALTH

The National Institute for Occupational Safety and Health (NIOSH) released to the Public Citizen Health Research Group (HRG), an off-shoot of Ralph Nader's consumer advocate organization, a list identifying *265 trade-name products containing one or more carcinogens* regulated by OSHA. The list includes the name of the manufacturer of the product and the percentage of the carcinogen contained therein. Almost all of the products listed cite asbestos as the carcinogenic substance. HRG mailed the list to some 20 labor unions, recommending verification of the current composition of the products listed. If any of the products still contain a carcinogen, HRG asked that OSHA be requested to inspect the workplace for compliance with the appropriate Standard and bargain with management to eliminate or reduce the occupational exposure. NIOSH has asked manufacturers for information on procedures developed to guarantee that exposed employees are educated on possible health risks; steps taken to design systems to reduce exposure of employees; and evidence of steps taken to warn users of the products. . . . Under new Public Law 95-210, signed by President Carter on December 13, 1977, NIOSH would be able to *obtain mailing address information from the Internal Revenue Service* upon written request from the Secretary of Health, Education and Welfare. The use of this data would be restricted to the purposes of locating and determining the health of persons who may have been occupationally exposed to a hazardous substance or to advising such persons of the possible need for medical treatment. . . . *Mt. Sinai School of Medicine* is engaged in a $180,000 NIOSH contract to investigate the health hazards from asbestos fibers that may result from brake lining repair and maintenance. . . . *Stanford Research Institute* is to evaluate asbestos samples and other substances under a $204,234 NIOSH contract. Six rounds of samples for 250 laboratories in the Proficiency Analysis Testing Program are planned using concentration levels to approximate samples taken in 8-hour periods in environments contaminated at one-half the 2x current threshold limit value (TLV) levels.

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ENVIRONMENTAL PROTECTION AGENCY

On March 4, 1977, the U.S. Senate unanimously confirmed *Douglas M. Costle as Administrator* of the Environmental Protection Agency (EPA). Appropriately, Mr. Costle headed the 1969-70 task force which recommended the creation of EPA. A 37-year-old attorney, he is the former Commissioner of Connecticut's Department of Environmental Protection and recent Assistant Director for Natural Resources and Commerce for the Congressional Budget Office. During confirmation hearings, Mr. Costle said the costs of pollution control are substantial but the record clearly shows they are tolerable and sustainable for the U.S. economy—and new jobs are being created. . . . A *Natural Resources Agency* may be established within the Department of the Interior as a means of consolidating all executive and administrative branches concerned with U.S. natural resources, including EPA. In expressing opposition to the merger of EPA into the suggested conglomerate, former EPA Administrator *Russell E. Train* said that important public scrutiny and debate on often conflicting issues of environmental values as opposed to "developmental" values would be lost in a single department.

EPA Asbestos Emission Standard

The EPA Administrator proposed on March 2, 1977, to amend the *National Emission Standard for Asbestos* (CFR 40, Part 61), in effect since October 14, 1975. The proposed amendments would extend coverage of the demolition and renovation provisions to all materials which are friable and contain over 1% asbestos by weight. The current provisions apply only to insulation and fire-proofing materials. The proposed amendments similarly would extend the coverage of the asbestos spraying provisions by prohibiting the spraying on buildings, structures, structural members, pipes and conduits any materials which contain more than 1% asbestos by weight. The prohibition would include spray-on application of paints, decorative sprays and weatherproofing. Materials in which asbestos fibers are encapsulated or impregnated with a bituminous or resinous binder during spraying and which are not friable after drying would be exempt from the regulation. . . . The U.S. Supreme Court dealt a blow last month to EPA efforts to enforce regulations designed to keep asbestos from escaping into the air during the demolition of buildings. The court voted 5-4 to dismiss an indictment against a Michigan wrecking company on the grounds the regulation it was accused of violating was not a numerical emission standard for asbestos but rather a *mere work practice requirement* aimed at minimizing asbestos emissions.

EPA Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) has been in effect since January 1, 1977. In essence it authorizes EPA to require and obtain industry-developed data on the *production, use and health effects of chemical substances.* It also empowers the Agency to regulate the manufacturing, processing, distribution in commerce, use and disposal of

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chemical substances. The authority to set workplace standards remains with OSHA. Procedures for implementation of the Act were proposed April 21, 1977. The final regulations were promulgated in the Federal Register of December 2, 1977, effective as of that date. . . . On December 23, 1977, EPA published its final *inventory reporting requirements* for chemical substances under TCSA. The regulation does not require the asbestos industry to comply with reporting provisions since "naturally occurring chemical substances" will automatically be included in inventory. It is expected, however, that *asbestos will be included in the future* when EPA will require data on a selective basis from manufacturers and processors of naturally-occurring chemical substances which may present unreasonable risks to health or environment. . . . In the January 12, 1978, Federal Register it was reported that EPA had set up a *Data Security Task Force* to study security procedures to protect confidential business information submitted under TSCA. Procedures were effective January 1, 1978.

EPA Investigates Crushed Stone

In early 1977 analysis of air samples taken by EPA and Mt. Sinai School of Medicine in Montgomery County, Maryland, near gravel roads where unbound crushed stone was in use revealed a wide range of concentrations of asbestos, some extremely low and others as high as 17-million fibers per cubic meter. An analysis of geologic maps shows certain quarries around the U.S. produce crushed stone from pits located within or near serpentinite rock deposits. Most serpentinite contains at least a small percentage of asbestos. Consequently EPA has begun a *nationwide study* to determine the danger of asbestos emissions from the use of crushed stone made from serpentinite rock. The study should determine if a Federal standard is needed to limit asbestos emissions from this source.

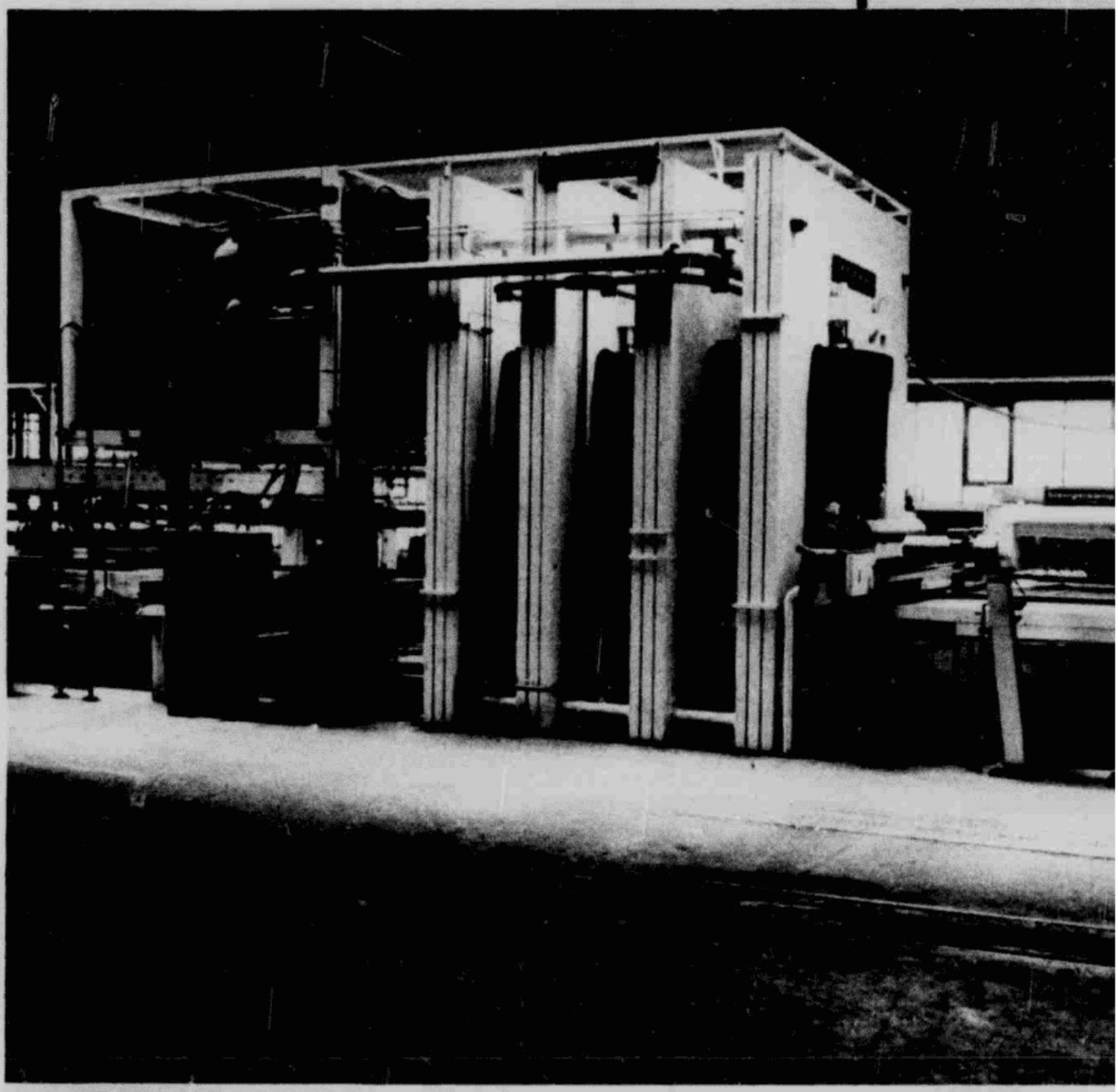
EPA Blurbs

Economic Dislocation Early Warning System— EPA is attempting to identify all industrial plant closings which have resulted from Federal, State or local pollution control regulations. The Agency promptly transmits the information to the Labor Department so that adverse employment effects can be minimized. EPA requests it be contacted by any firm which has closed or plans to close a facility where inability to meet pollution control regulations is a substantial factor. [FR 9/13/77]. . . . *Mineral and Mineral Processing Point Source Category*—EPA's final regulations under CFR 40, Part 436, limit the discharge of pollutants into navigable waters from existing crushed stone, construction sand and gravel, industrial sand, phosphate rock and mining operations. In effect since August 11, 1977, the rules require the treatment of wastewater discharged from the afore-mentioned operations. [FR 7/12/77]. . . . *Wastewater Treatment Projects*—A record $6.7-billion in Federal sewage clean-up grants was awarded during Fiscal Year 1977 to finance specific wastewater treatment projects across the U.S. With this accomplishment, EPA has now awarded essentially the full $18-billion made available for this purpose.

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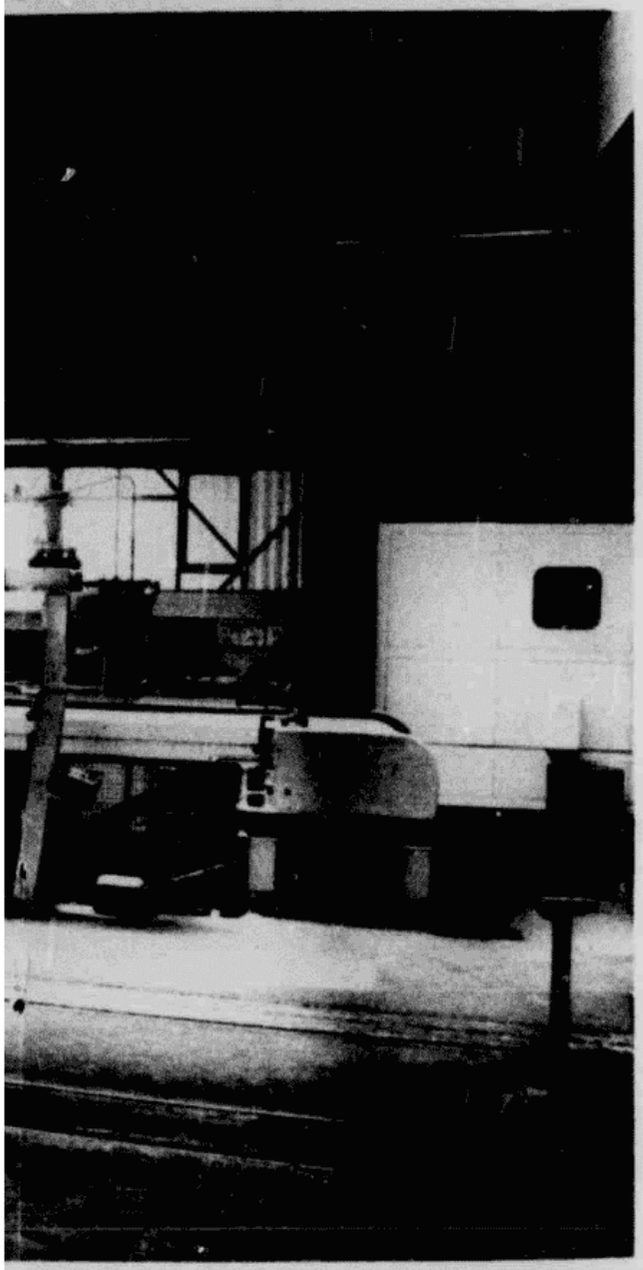
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One benefit of building the plants will be that many industries, especially smaller ones in municipal areas, will be able to tie in to the publicly-owned waste treatment works, providing their wastes are treatable by the public systems and do not interfere with the systems' operations.

CONSUMER PRODUCT SAFETY COMMISSION

In addressing the risk of cancer associated with the inhalation of asbestos fibers, the Consumer Product Safety Commission (CPSC) *banned the use of certain interior wall and ceiling patching compounds* containing intentionally-added, respirable, free-form asbestos and of asbestos-containing *artificial emberizing materials* (embers and ash). As of January 16, 1978, manufacturers of the patching compounds are prohibited from making or shipping the products to distributors, retailers and consumers. After June 12, 1978, distributors and retailers may not sell, offer for sale or distribute the compounds in commerce for application in consumer environments. Patching compounds labeled as and marked and sold solely for industrial use in a non-consumer environment are not subject to the ban. The ban does not cover caulks, sealants and similar materials which are not available in dry form and which are not ordinarily sanded. The ban on the emberizing materials became effective on the date the rule was promulgated in the Federal Register, December 15, 1977. . . . *A. T. Kearney, Inc.*, was contracted by CPSC to identify asbestos-containing products which may release free fibers under reasonable foreseeable use and which may expose consumers to respirable asbestos fibers. . . . The staff of CPSC submitted for the Commission's consideration *proposed guidelines for a carcinogen policy*, similar to OSHA's proposed generic cancer policy. The draft document includes a discussion of the broad regulatory policy and sets forth procedures for implementation.

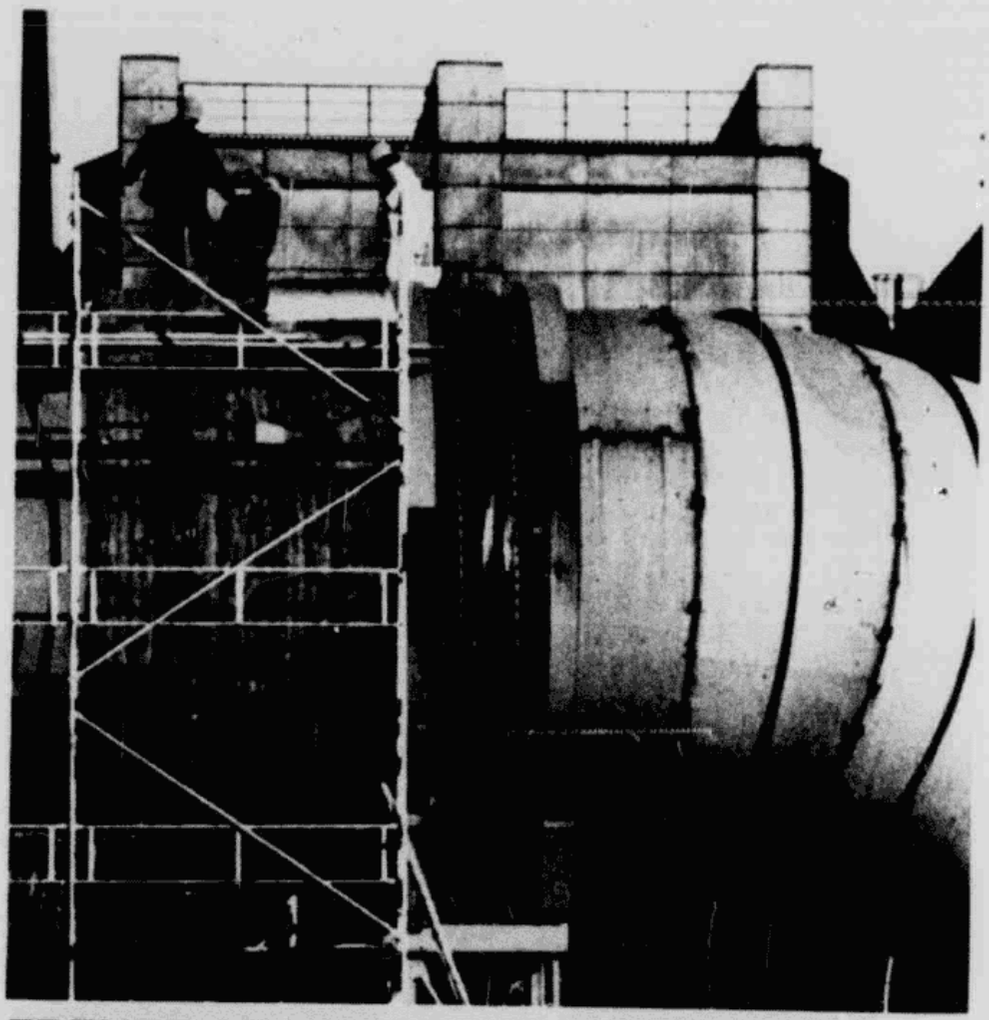
U.S. BUREAU OF MINES

Updated *safety recommendations* for the Nation's most widely-used kinds of *blasting materials* (those based on ammonium nitrate) were issued in September by the Bureau of Mines (USBM), U.S. Department of the Interior. The Bureu believes that industry's voluntary acceptance of its recommendations would provide increased safety over a broad range of operating conditions at surface and underground mining operations. . . . An engineering guide to the design and maintenance of safer, environmentally-sound impoundments for *disposing of noncoal mineral processing wastes* was issued by USBM in January 1978. Of particular interest are details on the newest techniques for reducing seepage into ground water and for improving the stability and safety of embankments.

MINING ENFORCEMENT AND SAFETY ADMINISTRATION

Effective March 7, 1978, Senate Bill 717 *transfers the responsibility for administering mine safety and health* from the U.S. Department of the Interior to the U.S. Department of Labor. . . . On July 7, 1977, the Mining

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Enforcement and Safety Administration (MESA) proposed to amend *health standards* for metal and nonmetallic *open-pit and underground mines*. The proposal would reduce the 8-hour, time-weighted average airborne concentration of asbestos dust to which employees may be exposed from five to two fibers per cubic centimeter greater than five microns in length, thereby conforming to the OSHA Asbestos Manufacturing Standard. Further, MESA is continuing its studies into the necessity and feasibility of further reducing the 2f/cc exposure limit in view of OSHA's proposal to lower the level from 2 to 0.5f/cc and NIOSH's recommendation for a limitation of 0.1f/cc. AIA/NA has advised MESA that no further reduction in the Standard appears necessary or reasonable. The Association maintains there is no new evidence to indicate the 2f/cc level for occupational exposure to asbestos dust does not adequately protect the health of the working population. . . . MESA proposed on October 17, 1977, to *consolidate injury and illness reporting requirements* for U.S. mine operators into one uniform system. Reportable accidents and injuries would be restricted to mine-site occurrences but occupational illnesses would include any illness or disease which may have resulted from work at a mine or for which a compensation award is made. The proposed system is the same as that now used by OSHA. The final ruling was published in the Federal Register of December 30, 1977, effective January 1, 1978. . . . MESA issued a series of new regulations to protect the health and safety of workers in the U.S. mining industry. Dealing with open-pit and underground mines and other operations, the rules were issued as mandatory standards and definitions on June 8, 1977, effective July 8, 1977. Major consideration is given to *electrical hazards and safety practices in hoisting workers in the mines.*

U.S. DEPARTMENT OF COMMERCE

Under the Procedures for a Voluntary Consumer Product Information Labeling Program (CFR 15, Part 16), a notice appeared in the December 14, 1977, Federal Register announcing a finding of need to *label thermal insulation for homes* and that the Commerce Department is developing a proposed Performance Information Labeling Specification for the products. To obtain technical information, last month NBS held a meeting with technical experts to discuss aspects of the testing and rating of thermal insulation.

SMALL BUSINESS ADMINISTRATION

An amendment to the Small Business Act and the Small Business Investment Act authorizes the Small Business Administration to provide *guarantees of financing for small businesses* to acquire facilities for the control of air, noise or water pollution or contamination. Proposed rules appeared in the Federal Register of December 8, 1977. [CFR 13, Part III]

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U.S. NAVY

In early October it was learned the U.S. Navy, Department of Defense, will *screen 1,500 to 3,000 workers* at Naval Shipyards at seven locations for asbestos-related ailments. The program is similar to that conducted in June among workers with a history of asbestos exposure at the Naval Shipyard in Long Beach, California. . . . On October 17, 1977, HRG charged the U.S. Navy with *neglecting its duty to warn, treat and/or offer compensation* to former shipyard employees exposed to high levels of asbestos. Specifically, according to a report from AIA/NA, HRG said the Navy should screen all shipyard personnel records from 1935 to date to identify any retired or active employee likely to have been exposed to asbestos; to advise all exposed employees to receive an annual lung examination; and to inform all exposed workers of their rights to compensation and establish a presumption of disability for workers significantly exposed. Meanwhile the Chief of Naval Operations has advised the Office of Civilian Personnel it has an obligation to notify former employees of their possible exposure to airborne asbestos fiber during their employment with the Navy but that mass media notification be used rather than attempt to individually contact each person. . . . An *Asbestos Policy Task Group* was established by the Navy in August to study the current use of asbestos-containing products and identify possible asbestos-health problems.

FOOD AND DRUG ADMINISTRATION

The Food and Drug Administration, U.S. Department of Health, Education and Welfare (HEW) awarded an $85,000, one-year contract to *Lancaster Laboratories, Inc.*, and *Structure Probe, Inc.*, to study the *presence of asbestos in food.* The project includes the development of methods for isolating fibers in food and testing those fibers to determine if they are asbestos.

NIOSH/HEW FIBER-COUNTING CONTRACT

NIOSH and HEW awarded a contract to *Leeds & Northrup Company* to develop an *automated fiber-counting instrument* for measuring worker exposure to fibrous aerosols, particularly asbestos, glass fiber and mineral wool. L&N will develop, design and construct a prototype instrument which will analyze particles collected on membrane filters from personal air sampling devices, in an attempt to improve the accuracy and throughput in handling sample filters. The program is directed to classification of particles by shape factor, in addition to size. The prototype unit is to be delivered to NIOSH for evaluation in late 1978.

ASBESTOS HEALTH HAZARDS COMPENSATION ACT

The Asbestos Health Hazards Compensation Act was introduced August 2, 1977, as Bill HR 8689 by *U.S. Representative Millicent Fenwick (R-NJ),* with *Representative Edward Beard (D-RI)* as co-sponsor. It pro-

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vides for *equitable compensation and exclusive benefits* to those who are disabled as a result of employment-related diseases caused by the inhalation or ingestion of asbestos and/or the inhalation of asbestos coupled with the inhalation of cigarette tobacco smoke; to household members; and to surviving dependents of persons whose deaths were due to such disease. The Bill has been referred to the House Committee on Education and Labor. Hearings are tentatively scheduled early this year.

SMOKING & OCCUPATIONAL HEALTH

In his address before the National Commission on Smoking and Public Policy in May 1977, *Dr. Paul Kotin* said: Cigarette smoking has an unparalleled effect in facilitating and enhancing the toxic effect and manifestation of disease associated with environmental agents. In the practical sense, were it not for the association of cigarette smoking with occupational exposure to chemical or physical carcinogens. . . ., lung cancer in these occupational groups would virtually disappear as a hazard of the workplace. . . . According to the *Center for Disease Control*, "asbestos workers who smoke have 90 times the risk of developing lung cancer as do non-smoking, non-exposed persons. . . ."

NEW TOXICOLOGY CENTER

Construction has begun on an *Environmental Inhalation Toxicology Center* at Brookhaven National Laboratory, Upton, New York. The Center will deal primarily with the pulmonary effects of combinations of airborne contaminants, including asbestos and glass fiber. Operations are set to begin in September 1978.

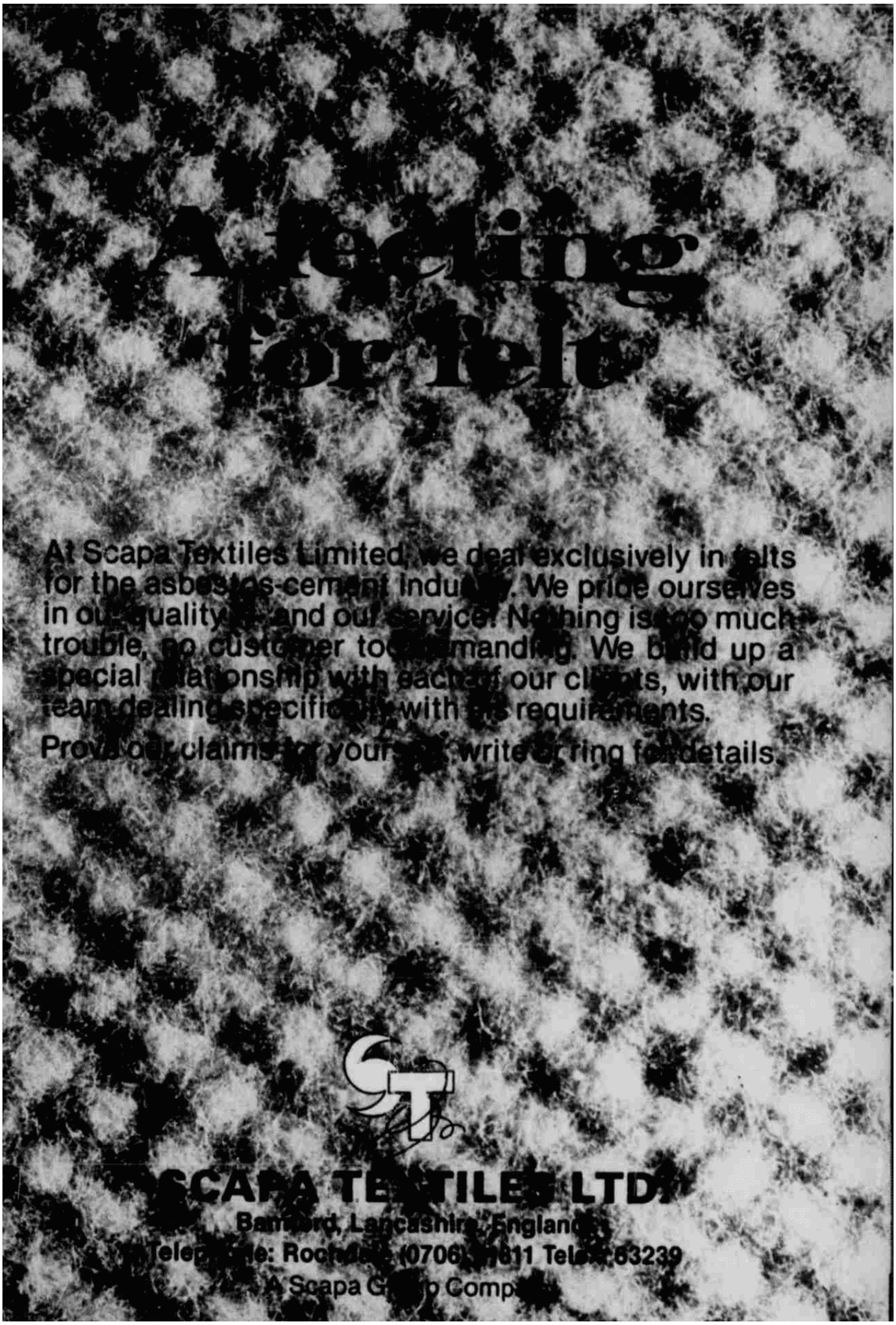
UNION WORKER HEALTH INSTITUTE

It was learned from AIA/NA that organized labor plans to establish its own *institute for worker health* because trade unions find it imperative to join forces in the struggle against disease and death in the workplace. It was said the institute would help labor move aggressively toward preventive occupational health practices, where crises would be anticipated and prevented.

A/C PIPE PRODUCERS ASSOCIATION

The Comprehensive *Fifth Annual Meeting and Industry Conference* of the Association of Asbestos Cement Pipe Producers (AACPP), held in April, focused on the Association's commitment to unify the knowledge and resources of the international community of a/c pipe producers. Several important papers were presented by spokesmen from industry, academia and the regulatory community concerned with asbestos fiber, supply, energy, water and sewer construction and the asbestos/health issue. During one of the lively sessions at the event, Dr. Selikoff said there exists a safe level of exposure to asbestos and that this threshold is found

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at the level of an asbestos industry worker's home environment, implying the general public's exposure to asbestos dust does not constitute a danger to health. . . . Among the Association's several educational publications is *"A/C Pipe and Health"* which discusses the facts, pro and con, about the risks and the realities of asbestos exposure from a/c pipe. The 28-page brochure directly addresses the controversy over asbestos in drinking water and sorts out the perceptions and the facts about the role of a/c pipe in releasing asbestos into potable water. . . . Still available are copies of AACPP's booklet containing *"Recommended Work Practices for A/C Pipe."* The recommendations are the result of extensive field testing and study. They are intended as general guides to achieve safe, clean jobsite conditions when working with a/c pipe products.

CANADA

NATIONAL EMISSION RULING

The Canadian National Government established *new asbestos emission regulations* effective December 31, 1978, which will allow a maximum of two fibers per cubic centimeter of air to be emitted to the surrounding air from crushing, drying and milling operations and from dry rock storage areas. The Standard stipulates that monitoring operations in individual plants shall begin immediately to enable enforcement agencies to identify problem areas.

QUEBEC SETS CEILING

An Order-In-Council was passed in June 1977 which sets a *ceiling of 2f/cc by January 1981* for asbestos operations in the Province of Quebec. The Provincial Government is financing research on ways to measure adherence to the Standard.

ONTARIO EXPOSURE GUIDELINES

The *Occupational Health and Safety Act of 1977* was introduced in the Ontario legislature in November. It covers the need for greater openness and employee participation, the development of dual responsibility on the part of labor and management, comprehensive treatment of dangerous substances and clarification of the right to refuse to perform unsafe work. According to the Ontario Labor Minister, occupational exposure standards will be recommended for asbestos and eventually guidelines will be set for about 2,500 substances. Regulations adopted in 1976 by the Ontario Government limit the asbestos exposure level in the Province to 2f/cc.

QUEBEC ASBESTOS MINING ASSOCIATION

Following six months of trial and testing by the Quebec Asbestos Mining Association (QAMA), two *continuous monitoring* and internal checking, time-weighted *measuring instruments* have proven to be highly superior in performance over other industrial units. The APM Ambient Pollution

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Monitor is considered the best available instrument for continuous monitoring. The Respirable Dust Monitor designated the RDM 101-4 was selected as QAMA's standard internal checking instrument. Also, the Tyndallometer, an instrument which measures respirable dust, was recommended for certain applications at the mills. . . . For several months QAMA has been conducting research to determine the *quantity of asbestos fibers and other material in suspension in the waters* of the Nicolet and Becancour Rivers in the Eastern Townships of Quebec. A particularly important aspect of the research involves the development of one or several methods for rapid evaluation of various parameters.

MONTREAL HEALTH INSTITUTE

The Montreal Institute of Occupational and Environmental Health, created and supported by QAMA, recently approved *four important research projects* which will attempt to evaluate new methods to further reduce the quantity of airborne asbestos dust; to identify the risks following exposure to various levels of dust; and to determine more accurately the causes of illness related to asbestos. The projects bring to over $5-million the total subsidies paid by the Institute in the last few years.

SHERBROOKE UNIVERSITY PROJECT

The University of Sherbrooke will conduct a *five-year, $5-million study* of several aspects of the asbestos industry in Quebec. The research will examine the effects of asbestos on human health and the technology, use and marketing of asbestos products. It will be financed by the Quebec Department of Natural Resources, Environment Canada and grants from industry and public organizations.

UNITED KINGDOM

U. K. ASBESTOS INFORMATION COMMITTEE

The U.K. Asbestos Information Committee (AIC) continues its efforts on behalf of the British asbestos industry to gather facts concerning the health risks of exposure to asbestos and to keep management, the workforce and the public informed concerning these facts and the safe handling of asbestos and asbestos-containing products. . . . Among its several informative, instructive booklets is *"Miracle Fiber/Killer Dust?"*, an excellent color brochure which enumerates the benefits and dangers of using asbestos materials and summarizes the history of research into the health hazards of asbestos exposure and of efforts to reduce the levels of exposure. It is pointed out that many people who would otherwise have perished in fires or on the road are alive today because of asbestos. . . . Another of AIC's meaningful endeavors is its sponsorship of a *panel of speakers* trained in the art of effective speech and lecture presentation. The speakers are available to attend engagements throughout the Country and, in addition, can be matched to the requirements of a particular audience. . . . Research commissioned by AIC has been conducted during

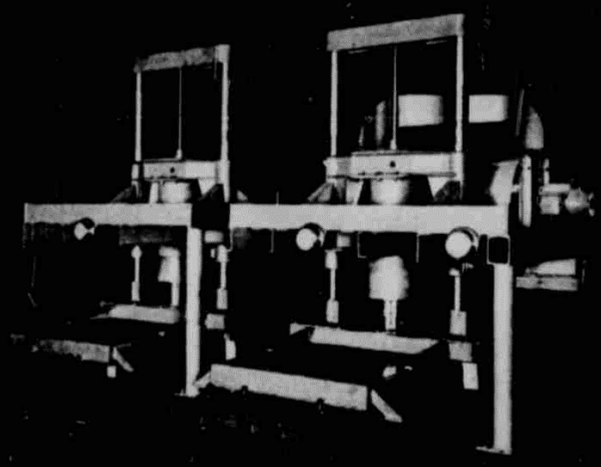
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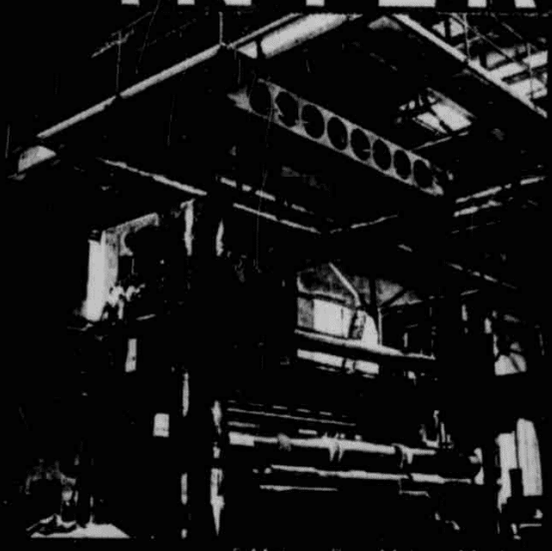
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1977 among retail outlets and secondary processors to determine the level of response to the British asbestos industry's *voluntary labeling scheme* introduced for goods manufactured since October 1, 1976. Results indicate that all asbestos-containing goods are now being labeled or marked by the manufacturers, although undesignated products are still being sold at the retail level due to large inventories in the hands of retailers prior to the cut-off date. A second survey has been commissioned and if results do not show significant improvement, the industry intends to request the U.K. Government to make labeling mandatory.

U. K. GOVERNMENT MOVES

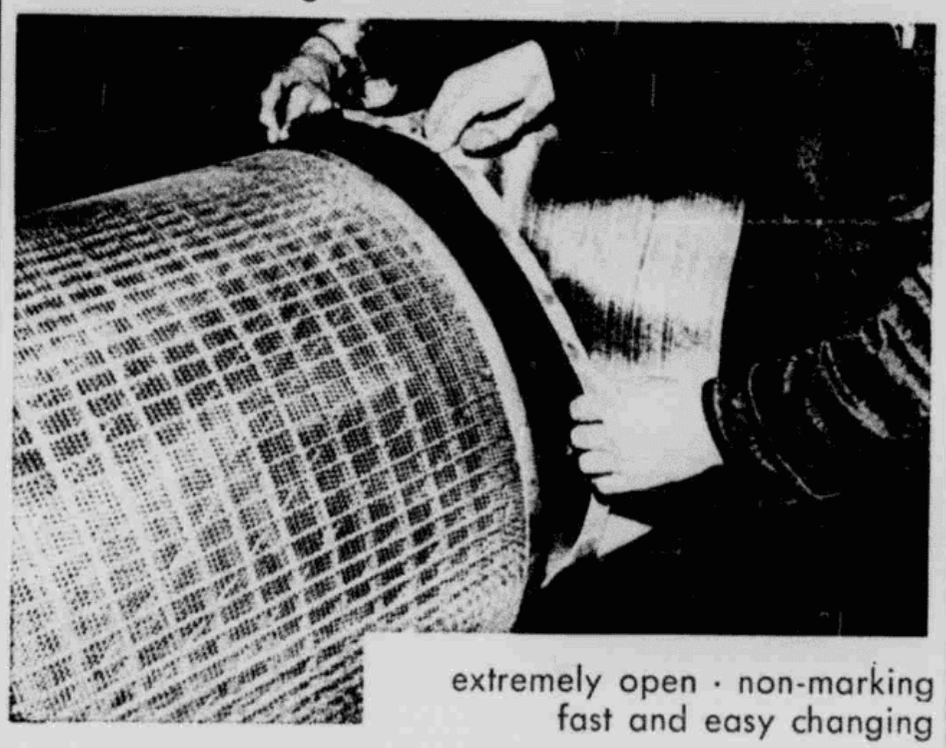
In the United Kingdom, functions of the Factory Inspectorate and the Employment Medical Advisory Service are now included under the Health and Safety Executive (HSE) which, in turn, is advised by the Health and Safety Commission (HSC), a government-appointed body of labor union and industrial representatives. . . . In the latter part of 1977 HSC submitted its first report covering the two-year period ending March 31, 1976, which includes its *work plan for the next five years*. Primarily the Commission is concerned with implementation of the Health and Safety at Work Act of 1974. Asbestos is the first item listed in the section titled "Ongoing Problems". Awareness was expressed that more information is needed concerning the risks of asbestos and, therefore, the establishment of a wide-ranging review committee on asbestos was proposed. After consultations with pertinent Ministers, HSC announced the formation of an *Advisory Committee on Asbestos (ACA)* on March 30, 1976. Among the 17 members serving on ACA are H. D. S. Hardie, a Director of Turner & Newall Ltd., plus representatives of unions, the medical-scientific community and government. . . . On January 25, 1977, ACA published an interim statement titled "Asbestos Health Hazards and Precautions", designed to put the risks from asbestos into perspective in the light of present knowledge. . . . Until its review is completed, ACA recommends that exposure to all forms of asbestos dust be reduced to the minimum reasonably practicable. Moreover, occupational exposure to dust should never exceed two fibers per milliliter when measurements are averaged over a 4-hour period and short-term exposure should not exceed 12f/ml when measured over any 10-minute period. For Crocidolite (Blue) asbestos, the limitation is 0.2f/ml when measured over a 10-minute period.

ACA PUBLIC MEETING

The Advisory Committee on Asbestos held a *three-day public meeting* in June to receive testimony concerning the risk from exposure to asbestos. Organizations such as the *Trades Unions Congress* and *Asbestos Action*, a pressure group, strongly recommended a lowering of permissible asbestos dust concentration levels to less than 2f/ml. In the long-term the TUC suggested a complete banning of all asbestos products. . . . Speaking for Turner & Newall Ltd., *Managing Director J. K. Shepherd* explained that groups of T&N workers who have been exposed for many years at around 2f/ml have experienced no asbestos disease whatever. The TUC proposal for a maximum allowable concentration ten

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times lower would, if accepted, close T&N's entire U.K. operation immediately, causing severe economic consequences. He supported the indispensability of asbestos in several applications. . . . Oral evidence at the hearing on behalf of the *Asbestos Cement Manufacturers' Association* included the statement that of all the asbestos products used today, a/c is the safest to manufacture, the safest to use and the safest for the general public. This statement was supported by the *Transport and General Workers' Union* which concluded that any reduction in permitted concentration is unnecessary and would almost certainly put jobs in jeopardy. . . . A spokesman for *Asbestos Action* agreed it would be irresponsible to call for an end to the use of asbestos when some substitutes might be as dangerous, or more so.

INTERNATIONAL ASBESTOS ASSOCIATION

The International Asbestos Association (IAA), formerly called the International Asbestos Information Conference, established *new quarters* at 68 Gloucester Place, London, W1H 3HL, England. The organization is well on its way toward fulfilling the objectives of its 1977/78 work program. . . . In line with the program, the Executive Committee of IAA is working toward the *development of data on methods of dust control* in the manufacture and use of asbestos which can be distributed in booklet form to countries and organizations seeking authoritative information on the safe handling of the material. . . . Several expert medical people have been selected to serve on the *IAA Medical Advisory Panel* to represent industry interests from the medical point of view. Among the responsibilities of the Panel are the summarization of all information currently available on the incidence of asbestos-related disease in all countries using the material and distinguishing as much as possible between different activities, e.g. textiles, friction materials, asbestos cement, sprayed asbestos, insulation, mining and milling, and general populations. The Panel is also to make an appraisal of the criteria for diagnosis used in these countries and to include such information as is available on the general incidence of cancer and lung cancer without relation to asbestos.

In Summation . . .

Because of space limitations it is not possible to include all available details on asbestos-related occupational safety and health activities around the world, although they are numerous. We do note a continuing and growing commitment on the part of all segments of the International Asbestos Industry toward finding and implementing measures to ensure safe working conditions in all phases of asbestos mining, processing and use. The coordination of efforts along this line by the various asbestos information associations throughout the world and the excellent cooperation of Industry members should guarantee the future viability of the entire Industry.

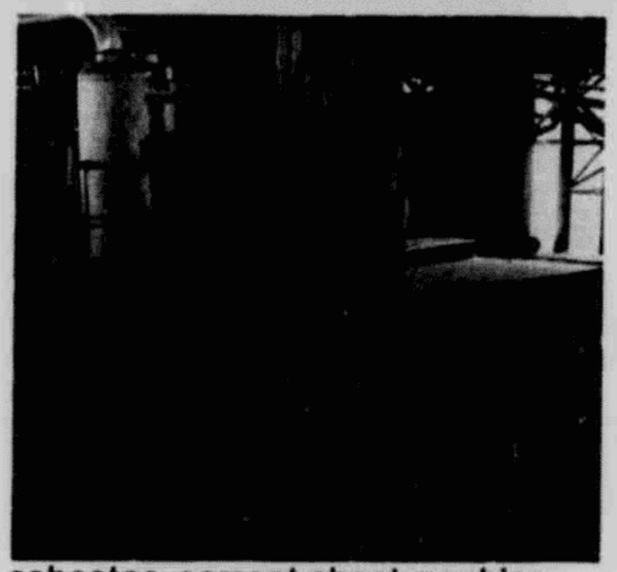
We hope you have enjoyed reading this three-part Review of the Year 1977 and have found it informative and of value.

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As of July 1, 1976 *U.S. Dollars*

No. 1 Crude (Soft)	$	$3000.00
No. 2 Crude (Soft)		1800.00
AAA		1300.00
Group No. 3—Nonferrous Filtering—Plastic	750.00—	840.00
Group No. 4—Nonferrous Filtering—Plastic	750.00—	840.00
Group No. 7—White Shorts	100.00—	200.00

QUEBEC *Per Ton of 2000 Lbs., F.O.B. Mine*
As of January 1, 1978 *Canadian Dollars*

No. 2—Crude		2165.00
No. 3—Spinning Fiber	965.00—	1501.00
No. 4—Asbestos Cement Fiber	642.00—	945.00
No. 5—Paper Fiber	323.00—	501.00
No. 6—Paper and Shingle Fiber	307.00—	311.00
No. 7—Shorts	107.00—	213.00

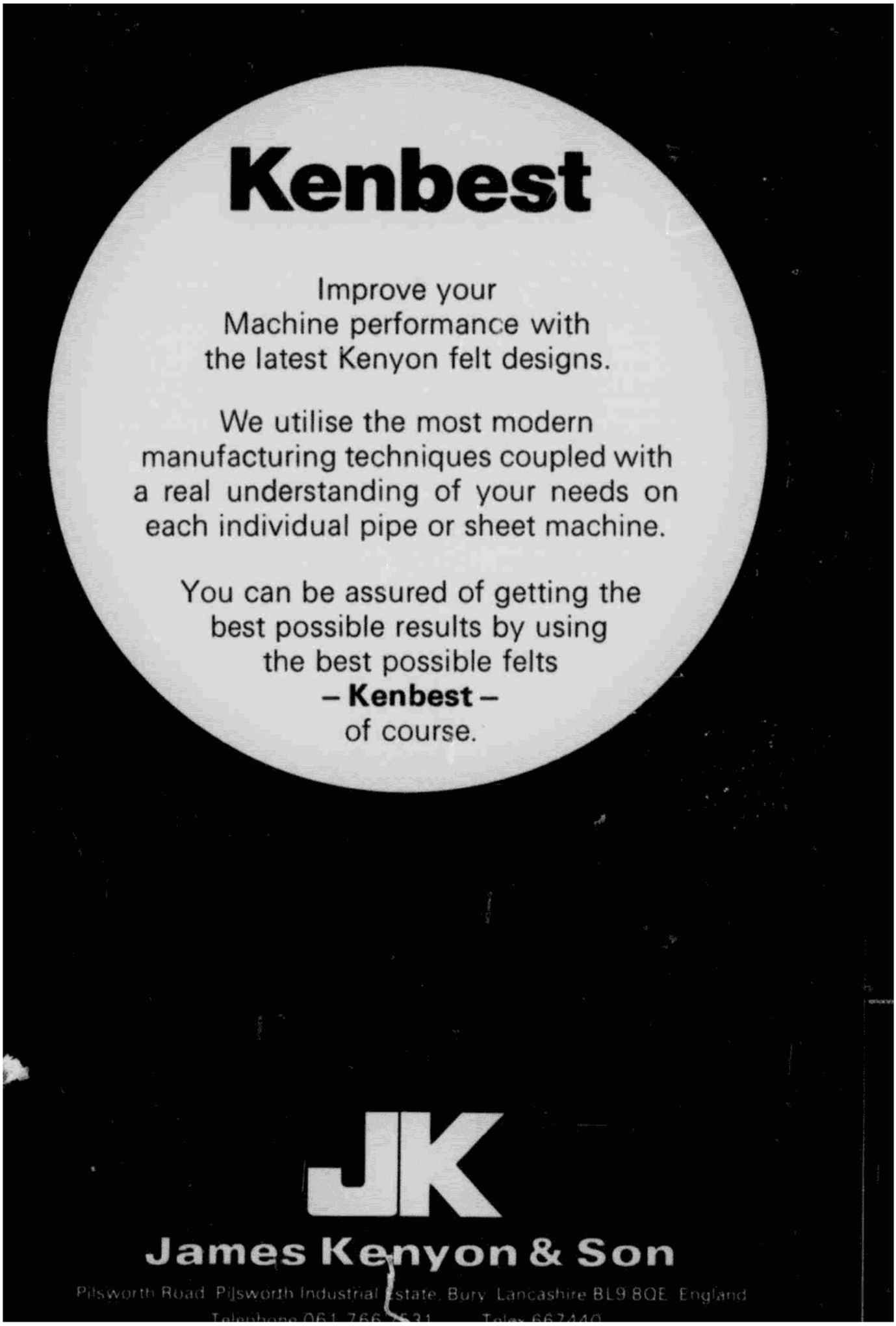
CASSIAR *Per ton of 2000 Lbs., F.O.B. North Vancouver, B.C.*
As of January 1, 1978 *Canadian Dollars*

	Cassiar Mine	
C-1	—No. 1 Crude	$3621.00
AAA	—Nonferrous Spinning Fiber/Canadian Group 3	2000.00
AA	—Nonferrous Spinning Fiber/Canadian Group 3	1600.00
A	—Nonferrous Spinning Fiber/Canadian Group 3	1050.00
AC	—Nonferrous Spinning Fiber/Canadian Group 3	960.00
AK	—Asbestos Cement Fiber/Canadian Group 4	810.00
AS	—Asbestos Cement Fiber/Canadian Group 4	705.00
AX	—Asbestos Cement Fiber/Canadian Group 4	610.00
AY	—Asbestos Cement Fiber/Canadian Group 5	430.00
AZ	—Asbestos Cement Fiber/Canadian Group 6	330.00
	Clinton Mine	
CP	—Asbestos Cement Fiber/Canadian Group 4	760.00
CT	—Asbestos Cement Fiber/Canadian Group 4	680.00
CY	—Asbestos Cement Fiber/Canadian Group 5	430.00
CZ	—Asbestos Cement Fiber/Canadian Group 6	330.00

VERMONT *Per Ton of 2000 Lbs., F.O.B. Morrisville, Vermont*
As of January 1, 1978 *U.S. Dollars*

Grade 4T—Fiber	$ —$	501.00
Grades 5D thru 5R—Fiber	330.00—	387.00
Grade 6D—Waste	——	239.00
Grades 7D thru 7T—Shorts	95.00—	182.00
Grade 7TF—Floats (Shorts)	——	82.00
Grade 8S—Shorts	——	62.00
Hooker No. 1—in 50-lb. woven polypropylene bags		1166.00
Hooker No. 2—in 100-lb. woven polypropylene bags		583.00

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IMPORTS INTO THE UNITED STATES

From: U.S. Bureau of the Census

UNMANUFACTURED ASBESTOS:		OCTOBER 1977	
Amosite, South Africa	s.tons	13	$ 1,190
Crocidolite (Blue), South Africa	s.tons	445	259,935
Chrysotile Crudes, South Africa	s.tons	711	423,864
Chrysotile Spinning Fibers, Canada	s.tons	674	632,169
South Africa	s.tons	1	1,192
Chrysotile, Other, Canada	s.tons	48,099	10,238,039
Mexico	s.tons	8	1,487
South Africa	s.tons	6	3,570
Other Crudes & Fibers, Canada	s.tons	702	88,529
Rhodesia	s.tons	345	199,195
South Africa	s.tons	26	27,972
Taiwan	s.tons	312	6,976
		51,342	$ 11,884,118
MANUFACTURED ASBESTOS PRODUCTS:			
Asbestos yarn, cloth, tape, etc.	Lb	805,870	$ 1,180,214
A-C pipes, tubes & fittings	Lb	1,300,785	177,231
Other asbestos-cement articles	Lb	1,509,290	288,668
Other asbestos articles		..	531,862
			$ 2,177,975
UNMANUFACTURED ASBESTOS:		**JANUARY-OCTOBER 1977**	
Amosite, Canada	s.tons	1	$ 570
South Africa	s.tons	486	237,010
Crocidolite (Blue), South Africa	s.tons	10,587	4,666,848
Chrysotile Crudes, Canada	s.tons	134	65,576
Rhodesia	s.tons	2,451	2,368,050
South Africa	s.tons	3,098	1,814,338
Chrysotile Spinning Fibers, Canada	s.tons	5,601	5,271,470
South Africa	s.tons	284	197,786
USSR	s.tons	2,190	443,348
Chrysotile, Other, Canada	s.tons	460,405	103,235,950
Mexico	s.tons	22	4,702
South Africa	s.tons	43	36,145
USSR	s.tons	166	49,454
Other Crudes & Fibers, Canada	s.tons	9,115	1,441,464
Mexico	s.tons	220	133,000
Rhodesia	s.tons	345	199,195
South Africa	s.tons	1,665	833,444
Sweden	s.tons	1	495
Taiwan	s.tons	312	6,976
USSR	s.tons	5,494	1,069,696
		502,620	$122,075,517
MANUFACTURED ASBESTOS PRODUCTS:			
Asbestos yarn, cloth, tape, etc.	Lb	9,683,535	$ 13,858,209
A-C pipes, tubes & fittings	Lb	15,719,696	1,752,356
Other asbestos-cement articles	Lb	41,623,923	6,719,274
Other asbestos articles		..	5,044,841
			$ 27,374,680

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EXPORTS FROM THE UNITED STATES

From: U.S. Bureau of the Census

OCTOBER 1977

UNMANUFACTURED ASBESTOS:

Fibers not further processed than beaten, washed or graded to length	s.tons	1,625	$ 605,207
Waste and refuse	s.tons	1,689	471,093
		3,314	$ 1,076,300

MANUFACTURED ASBESTOS PRODUCTS:

A-C shingles & clapboard	Lb	728,600	$ 122,919
Other a-c fiber-cement articles	Lb	1,962,766	309,372
Gaskets	Lb	55,855	148,050
Packing	Lb	312,605	723,150
Heat or sound insulation		..	145,296
Textiles & yarns	Lb	767,833	697,114
Protective clothing		..	76,072
Mfrs. other than friction materials		..	822,425
Clutch facings & linings for auto. use	No	124,622	200,594
Other clutch facings & linings	No	14,298	28,321
Brake linings for automotive use	Lb	792,271	753,266
Other brake linings	Lb	253,356	278,372
			$ 4,304,951

JANUARY-OCTOBER 1977

UNMANUFACTURED ASBESTOS:

Fibers not further processed than beaten, washed or graded to length	s.tons	14,624	$ 6,166,619
Waste and refuse	s.tons	16,721	3,709,998
		31,345	$ 9,876,617

MANUFACTURED ASBESTOS PRODUCTS:

A-C shingles & clapboard	Lb	9,025,698	$ 1,549,630
Other a-c fiber-cement articles	Lb	41,227,609	11,036,493
Gaskets	Lb	2,245,445	2,436,190
Packing	Lb	4,345,275	10,127,217
Heat or sound insulation		..	3,909,864
Textiles & yarns	Lb	15,269,731	9,334,693
Protective clothing		..	1,093,635
Mfrs. other than friction materials		..	13,167,341
Clutch facings & linings for auto. use	No	583,975	1,383,606
Other clutch facings & linings	No	239,270	291,276
Brake linings for automotive use	Lb	8,640,521	7,983,922
Other brake linings	Lb	2,160,250	2,811,113
			$65,124,980

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EXPORTS FROM CANADA

From: Statistics Canada

OCTOBER 1977
Short Tons

UNMANUFACTURED ASBESTOS:	Crude	Milled Gp 3	Milled Gp 4&5	Shorts Gp 6-9
Western Europe	..	574	17,853	12,729
Eastern Europe	..	330	2,020	480
Middle East	..	..	1,240	607
Africa	..	..	3,085	790
Asia	..	86	4,862	7,549
Oceania	..	..	5,466	884
So. & Cen. America & Antilles	..	210	6,192	4,307
United States	..	726	11,917	38,254
	..	1,926	52,635	65,600

The total amount of unmanufactured asbestos exported in *October 1977* was 120,161 short tons, valued at $41,815,000.

MANUFACTURED ASBESTOS PRODUCTS:

Asbestos cloth, dryer felts & sheets	$ 58,000
Asbestos brake linings & facings	318,000
Asbestos-Cement building materials	2,005,000
Other basic asbestos products	481,000
	$ 2,862,000

JANUARY-OCTOBER 1977

UNMANUFACTURED ASBESTOS:	Crude	Milled Gp 3	Milled Gp 4&5	Shorts Gp-6-9
Western Europe	..	8,796	217,041	140,176
Eastern Europe	..	2,091	25,502	4,522
Middle East	..	198	20,507	3,701
Africa	..	..	17,378	6,254
Asia	..	2,354	84,166	110,639
Oceania	..	5	54,328	8,317
So. & Cen. America & Antilles	..	1,661	76,696	31,328
United States	1	6,779	111,775	362,108
	1	21,884	607,393	667,045

The total amount of unmanufactured asbestos exported in *January-October 1977* was 1,296,323 short tons, valued at $447,922,000.

MANUFACTURED ASBESTOS PRODUCTS:

Asbestos cloth, dryer felts & sheets	$ 866,000
Asbestos brake linings & facings	2,768,000
Asbestos-Cement building materials	11,916,000
Other basic asbestos products	4,499,000
	$20,049,000

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ASBESTOS STOCK QUOTATIONS

Close—January 17, 1978

Abitibi Asbestos	C$.75	G&W (pfd 3.87)	57½
Advocate Mines	Bid C$3.30	IC Industries	23½
	Asked C$3.50	IC Ind (pfd 3.50)	42¼
Armstrong Cork	16⅞	Jim Walter Corporation	28¾
Armst. Cork (pfd 3.75)	50¼	Jim Walter (pfd 1)	11¾
Asarco	14⅞	Jim Walter (pfd 1.60)	31
Asbestos Corporation	C$38.75	Johns-Manville	29¼
Bendix	34⅛	Kennecott Copper	25⅛
Carlisle	21	Lear Siegler	13⅞
Cassiar Asbestos	C$9.125	Lear Siegler (pfd 2.25)	38⅛
CertainTeed	20¼	Maremont	17¾
Charter Conso.	pence 132	McAdam Mining	C$.27
Colt Industries	44½	National Gypsum	14⅛
Colt Ind. (pfd 1.60)	24⅛	Pathfinder	Bid C$.24
Colt Ind. (pfd 4.25)	65		Asked C$.25
Conwest	C$4.15	Porter (pfd 5.50)	71½
Flintkote	18⅝	Raybestos-Manhattan	29⅞
GAF Corporation	11⅛	Rio Algom	C$25.25
GAF (pfd 1.20)	15¾	Rio Algom (pfd C$5.80)	C$75.50
Gulf & Western	11¼	Supradur	Bid 5⅞; Asked 6⅜
G&W (warrants)	1/256	Union Carbide	39⅛
G&W (pfd 2.50)	29½	Woodsreef Minerals	C$.70



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MEN ON THE MOVE

ATLAS ASBESTOS COMPANY

John D. Zacharias was appointed Executive Vice President of Atlas Asbestos Company effective January 1, 1978, it was announced by *George Barge,* President. Mr. Zacharias' responsibilities include corporate development, manufacturing and marketing.

BELL ASBESTOS MINES LTD.

Germain Masson was named Director of Purchasing for Bell Asbestos Mines Ltd., following the transfer of *G. R. Smith* to other special duties. Mr. Masson had been with Bell's Marketing Department. The announcement was made by *Octave Mousseau,* Vice President and Secretary-Treasurer.

JIM WALTER CORPORATION

Robert A. DeWitt has been named a Vice President and Group Executive of Jim Walter Corporation. Previously an Assistant Controller, Mr. DeWitt is now responsible for four company divisions, i.e., Georgia Marble Company, Carey-Canadian Mines, Gamble Brothers and Hamer Lumber. He joined Jim Walter in 1971 as Manager of Audit Operations.

RAYBESTOS-MANHATTAN, INC.

Robert M. Sturm was appointed Vice President-Marketing for Raybestos-Manhattan Industrial Products Company, it was announced by *Gabriel Ferrucci,* President of that Division of Raybestos-Manhattan, Inc. Mr. Sturm joined RMIPCo in 1975 as Director of Research and Development. He most recently had been Technical Director. . . . *Frank G. Mestnik* was named to the newly-created position of Director of Business Development and Planning for RMIPCo and *Donald L. Davidson* was advanced to Director of Marketing and Sales for Transportation/Industrial/Aerospace Products. Mr. Mestnik had been with Franklin Electric Company. Mr. Davidson, who has been with R/M since 1957, had been Director of Automotive Marketing.

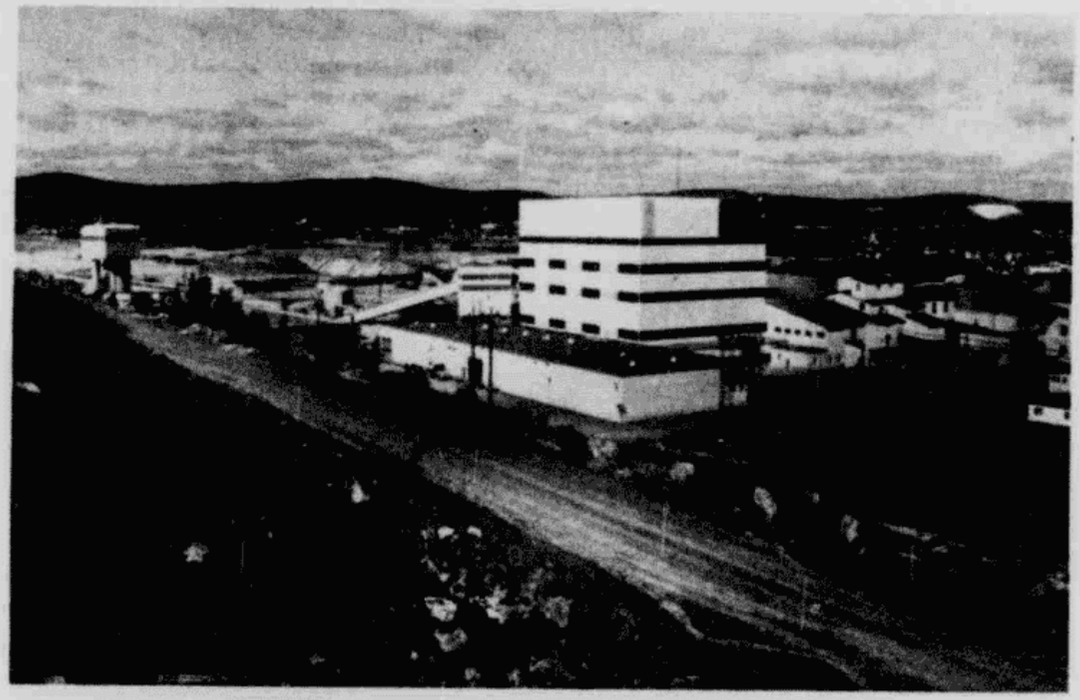
SOUTHERN ASBESTOS COMPANY

Southern Asbestos Company announced the appointment of *James L. Petrick* as Sales Representative for southeastern United States. He will serve customers in Virginia, North and South Carolina, Georgia, Tennessee and the panhandle of Florida. He was most recently associated with Regal-LaFrance Textiles. . . . *R. Frank Carmazzi* was appointed Sales Representative to service Southern Asbestos accounts in Western Pennsylvania, Ohio, Indiana, Kentucky, Michigan and West Virginia. He had been a chemist with H. K. Porter Company, Inc.

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BIRTHDAY GREETINGS to . . .

H. Keith Conn, Director of Exploration, Mining Division, Johns-Manville Corporation, Denver, Colorado, March 16.

Harry M. Hay, Manager, Asbestos Products Plant, Canadian Johns-Manville Co. Ltd., Asbestos, Quebec, March 18.

William H. Johnston, President, Atlas Textile Co., North Wales, Pennsylvania, March 21.

Thomas C. Osborne, Director of Exploration, Asarco Inc., New York City, March 21.

R. K. Day, Deputy Chairman, TAC Construction Materials Ltd., Trafford Park, Manchester, England, March 22.

T. P. O'Hagan, Manager, Private Brand Accounts, Industrial Products Division, Johns-Manville Corporation, Denver, Colorado, March 22.

Douglas O. Cooke, Director of Corporate Product Liability and Special Projects, Johns-Manville Corporation, Denver, Colorado, March 23.

Edward A. Corbett, President, A & M Insulation Co., Chicago, Illinois, March 24.

Alvin P. Tiedemann, Vice President-Manufacturing, Raybestos Manhattan Industrial Products Co., North Charleston, S.C., March 24.

Peter Buchholz, Sales Manager, Lake Asbestos of Quebec Ltd., Black Lake, Quebec, March 26.

William A. Krivsky, a Senior Vice President, CertainTeed Corporation, Valley Forge, Pennsylvania, March 26.

K. E. Vitek, President and Managing Director, Scandura, Inc., Charlotte, North Carolina, March 26.

George Barge, President, Atlas Asbestos Co., Montreal, Quebec, March 27.

J. B. Dorsey, Vice President for Corporate Marketing and Growth Planning, Johns-Manville Corporation, Denver, Colorado, March 27.

D. K. Macfarlane, a Director, James Hardie Asbestos Ltd., Sydney, New South Wales, Australia, March 27.

A. E. Alpine, Senior Vice President and General Manager, Cement Asbestos Products Co., Birmingham, Alabama, March 29.

Ross E. Sampson, Vice President and Plant Group Manager, Canadian Johns-Manville Co. Ltd., Asbestos, Quebec, March 31.

A. M. Phillips, Traffic Coordinator, Cassiar Asbestos Corporation Ltd., Vancouver, British Columbia, April 1.

Grant V. Wilson, Jr., Secetary, Grant Wilson, Inc., Chicago, Illinois, April 1.

Francis H. May, Jr., Executive Vice President for Finance and Administration, Johns-Manville Corporation, Denver, Colorado, April 2.

Gordon A. Coats, President, Calaveras Asbestos Ltd., Copperopolis, California, April 3.

John F. Matousek, Vice President, Electronic Data Processing, Johns-Manville Corporation, Denver, Colorado, April 3.

W. C. Thurber, Product Manager-Asbestos, Union Carbide Corporation, Metals Division, Niagara Falls, New York, April 3.

Joseph E. Kindregan, Director of Corporate Marketing Projects, Johns-Manville Corporation, Denver, Colorado, April 4.

Peter Reiser, Export Sales Manager, Carey-Canadian Mines Ltd., East Broughton Station, Quebec, April 4.

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E. Paul Burke, Senior Vice President-Transportation & Business Logistics, Johns-Manville Corporation, Denver, Colorado, April 5.
Andre Gauthier, General Manager, National Mine Division, Lake Asbestos of Quebec Ltd., Thetford Mines, Quebec, April 5.
James L. Petrick, a Sales Representative, Southern Asbestos Co., Matthews, North Carolina, April 7.
K. S. Andrews, a Director, Cape Asbestos Fibres Ltd., Uxbridge, Middlesex, England, April 8.
A. C. Beguin, Manager of Operations, Chrysotile Corporation of Australia Pty. Ltd., Barraba, N.S.W., Australia, April 8.
Stuart Charbula, Executive Vice President, Hedman Mines Ltd., Timmins, Ontario, April 8.
F. G. Carter, Deputy Chairman and Joint Managing Director, Ferodo Ltd., Chapel-en-le-Frith, Derbyshire, England, April 11.
G. L. Kingston, Plant Superintendent, Clinton Mine, Cassiar Asbestos Corporation Ltd., Clinton Creek, Yukon Territory, April 11.
Henry B. Moreno, Senior Vice President-International, Johns-Manville Corporation, Denver, Colorado, April 11.
J. K. Shepherd, a Managing Director, Turner & Newall Ltd., Manchester, England, April 12.
William I. Robinson, President, Hamilton Ohio Division, and a Corporate Vice President and a Director, Nicolet Inc., Hamilton, Ohio, April 13.
J. Vermeer, Managing Director, Chemische Productenhandel J. J. van de Vrande, Haarlem, The Netherlands, April 13.

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VALUABLE PAPERS & ARTICLES

PHOTOCOPIES OF THE FOLLOWING ARTICLES ARE AVAILABLE FROM THIS MAGAZINE @ 20¢ PER PAGE. PLEASE INCLUDE REMITTANCE WITH ORDER AND SPECIFY FEBRUARY 1978 AS DATE OF LISTING.

MOLECULAR IDENTITY OF POWER PLANT STACK PARTICULATES—E. S. Etz and G. S. Rosasco report on a new application of the laser-excited micro-Raman spectrometer; the results of the samplings are considered important in determining the chemical state of toxic elements in airborne particles. [Dimensions, an NBS publication; 2 pages]

PORTABLE AEROSOL-PARTICLE COUNTER—Reviews work done by F. N. Weber, Jr., of the University of South Alabama for the Lewis Research Center, Cleveland, Ohio; the air-pollution detection device measures aerosol size in real time, measures size precisely and has high sensitivity in the size range of greatest biological concern, viz from 0.5 micron down to 0.01 micron; the measurement combines laser velocimetry and light scattering. [NASA Tech Briefs; 2 pages]

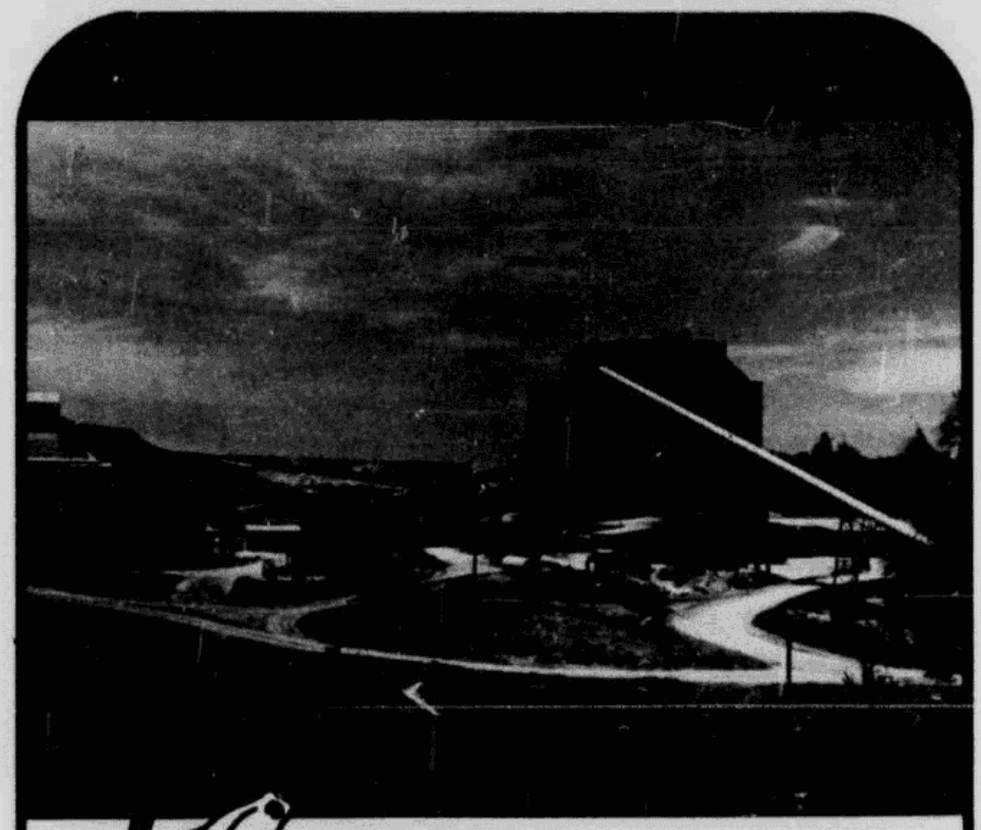
WORKERS' ENVIRONMENTAL PROTECTION—An interview with Dr. I. J. Selikoff, Director, Environmental Sciences Laboratory, Mt. Sinai School of Medicine, City University of New York; article concludes with the statement: "Measures for asbestos control are now social decisions, no longer scientific ones." [EPA Journal; 2 pages]

DETERMINATION OF SUBMICRON ATMOSPHERIC AEROSOL SIZE DISTRIBUTIONS BY USE OF CONTINUOUS ANALOG SENSORS—G. M. Sverdrup and K. T. Whitby present a method for determining size distributions of submicron atmospheric aerosols; the results of 15 data inversions are compared with direct size distribution measurements obtained with an electrical aerosol analyzer and optical particle counter; values for the total particle number concentration and the aerosol light-scattering coefficient are identical for the two types of measurement. [Environmental Science & Technology, a publication of The American Chemical Society; 6 pages]

RESPIRATORY-FUNCTION CHANGES IN TEXTILE WORKERS EXPOSED TO SYNTHETIC FIBERS—The prevalence of respiratory symptoms and acute and chronic changes in ventilatory function were studied by F. Valic, Ph.D., and E. Zuskin, M.D., D.Sc., in three groups of textile workers; the prevalence of dyspnea, grade 3 or 4, was significantly lower in workers with a history of exposure to synthetic fibers only; no case of byssinosis was found in any of the workers studied. [Archives of Environmental Health, a publication of the American Medical Association; 5 pages]

TECHNOLOGICAL INVESTIGATIONS INTO THE POSSIBILITY OF PRODUCING INSULATION MATERIALS FROM DIATOMACEOUS EARTH AND ASBESTOS—A paper written in Yugoslavian with a summary in English; the production technology is new since insulating material synthesis does not develop in autoclaves but in special treatment of the materials in driers. [Rudarski Glasnik/Bulletin of Mines; 8 pages]

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CALENDAR OF EVENTS

NATIONAL HOME IMPROVEMENT COUNCIL—Annual Convention; Hyatt Regency Hotel, Atlanta, Georgia, *March 9-11.*

NATIONAL INSULATION CONTRACTORS ASSOCIATION—23rd Annual Convention; Hilton Hotel, Atlanta, Georgia, *March 12-15.*

APPLIED X-RAY SPECTROMETRY AND X-RAY POWDER DIFFRACTION—Course which includes lectures, laboratories and several tutorial and problem-solving sessions; University of Denver, Denver, Colorado, *March 13-17.*

RECOGNITION OF OCCUPATIONAL HEALTH HAZARDS—Course co-sponsored by the American Industrial Hygiene Association and the National Institute for Occupational Safety and Health; *March 13-17* in Atlanta, Georgia; *April 24-28* in Ann Arbor, Michigan; *June 5-9* in Philadelphia, Pennsylvania.

INTERPIPE '78—6th International Pipeline Technology Convention and Exhibition; Albert Thomas Convention and Exhibit Center, Houston, Texas, *March 21-23.*

GOVERNMENT AFFAIRS—6th Seminar of the Air Pollution Control Association; will be concerned with the new Clean Air Act and its impact on energy and growth; Hyatt Regency Hotel, Washington, D. C., *March 22-23.*

HEATING, VENTILATING AND AIR CONDITIONING—10th International Exhibition; National Exhibition Centre, Birmingham, England, *April 3-7.*

INDUSTRIAL HYGIENE— Workshop on evaluating the control of occupational hazards; Harvard School of Public Health, Boston, Massachusetts, *April 3-7.*

ENVIRONMENTAL IMPACT OF MINING—Short Course sponsored by the Mackay School of Mines; University of Nevada, Reno, Nevada, *April 3-7.*

MINERAL ECONOMICS AND STRATEGIES—Seminar organized by the Ecole Nationale Superieure des Mines de Paris; Paris, France, *April 3-28.*

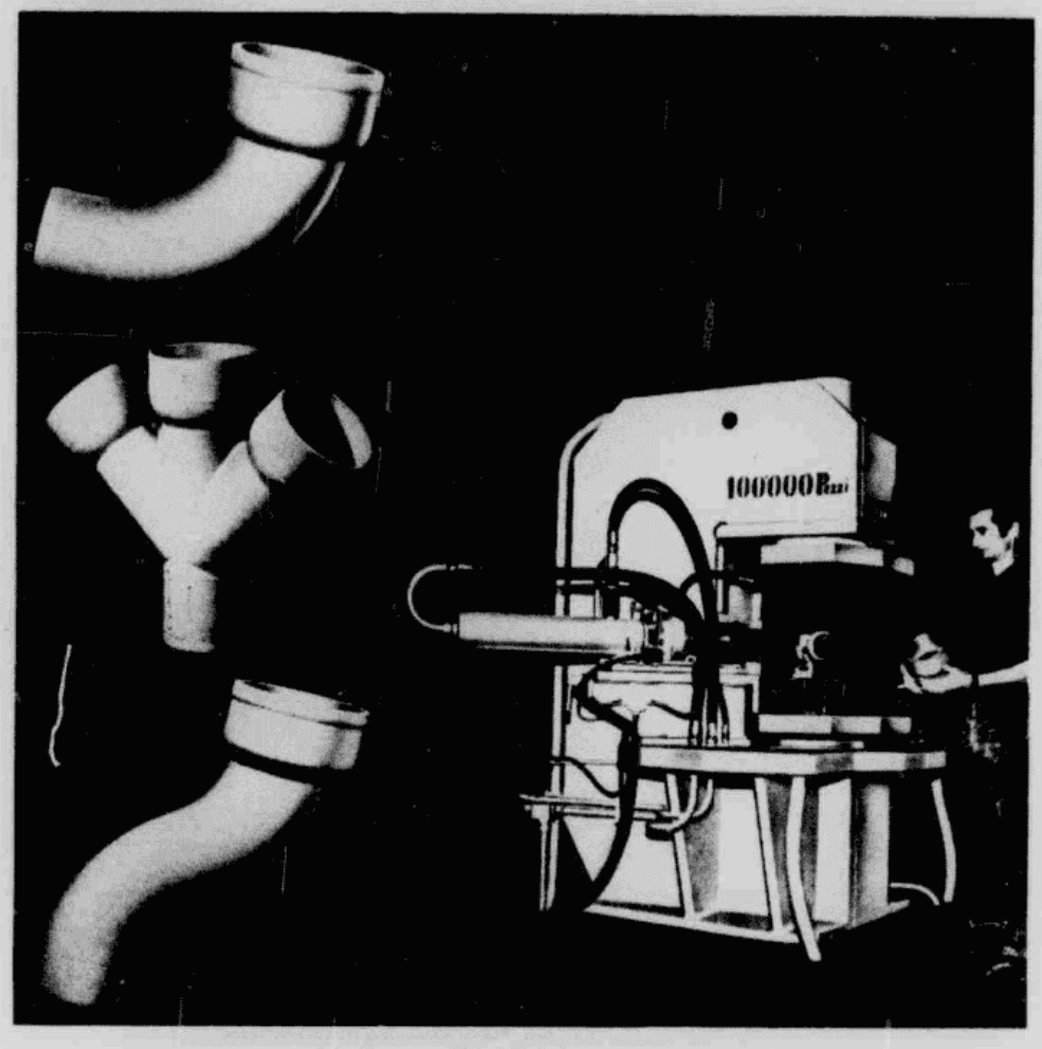
TESTING AND TEST METHODS OF FIBER CEMENT COMPOSITES—International Symposium supported by the Reunion International des Laboratoires d'Essais et des Recherches sur les Materiaux et les Constructions (RILEM), the American Concrete Institute, the American Society for Testing and Materials and the University of Sheffield; Sheffield, England, *April 5-7.*

GEOLOGICAL INFORMATION AND DOCUMENTATION—International Conference sponsored and organized by the Geological Information Group of the Geological Society of London and the Geoscience Information Society (USA); Imperial College of Science, London, England, *April 10-12.*

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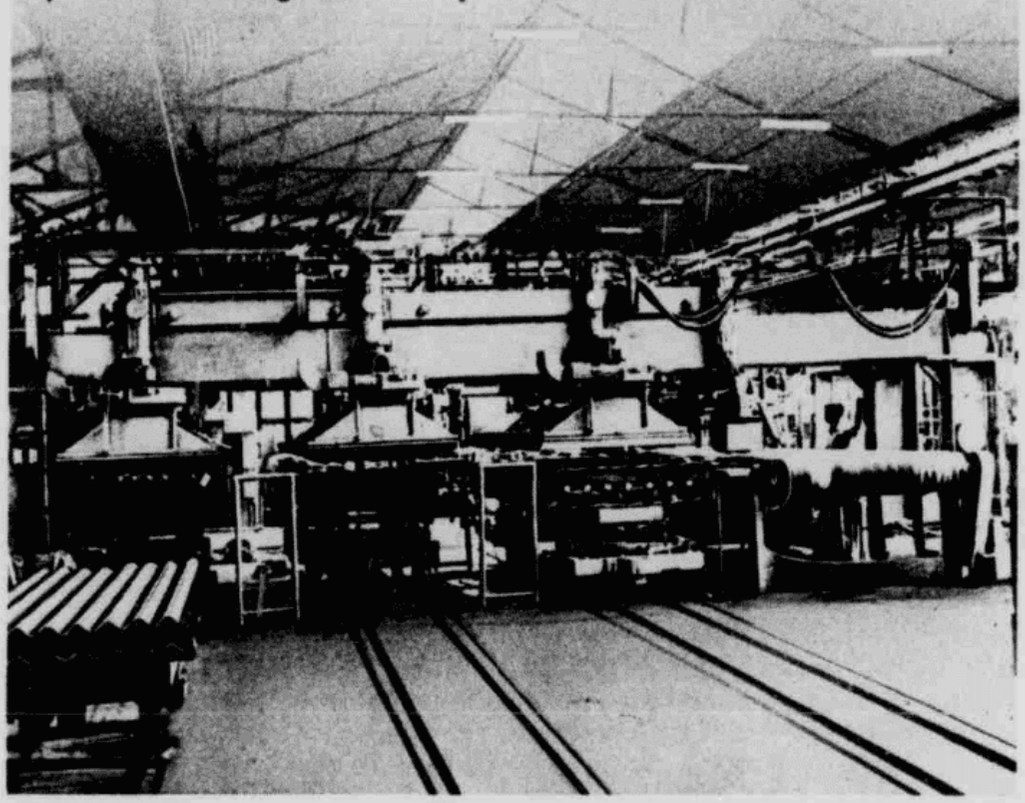
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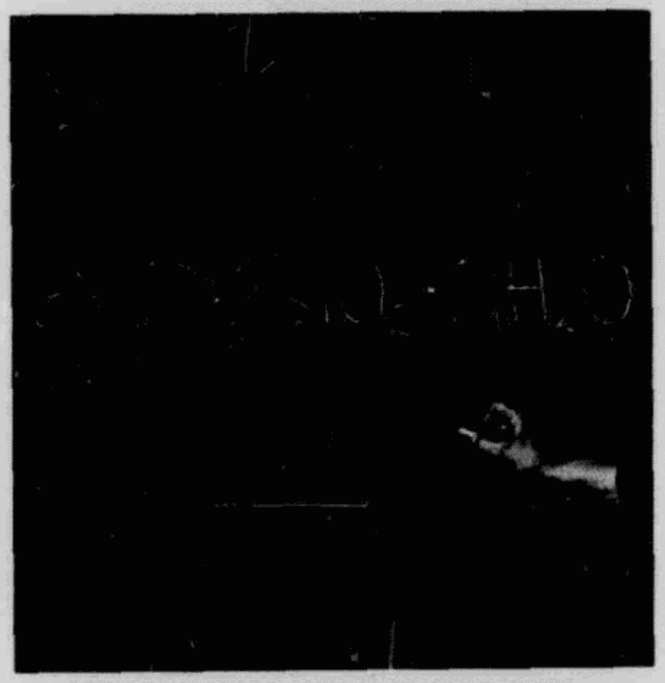
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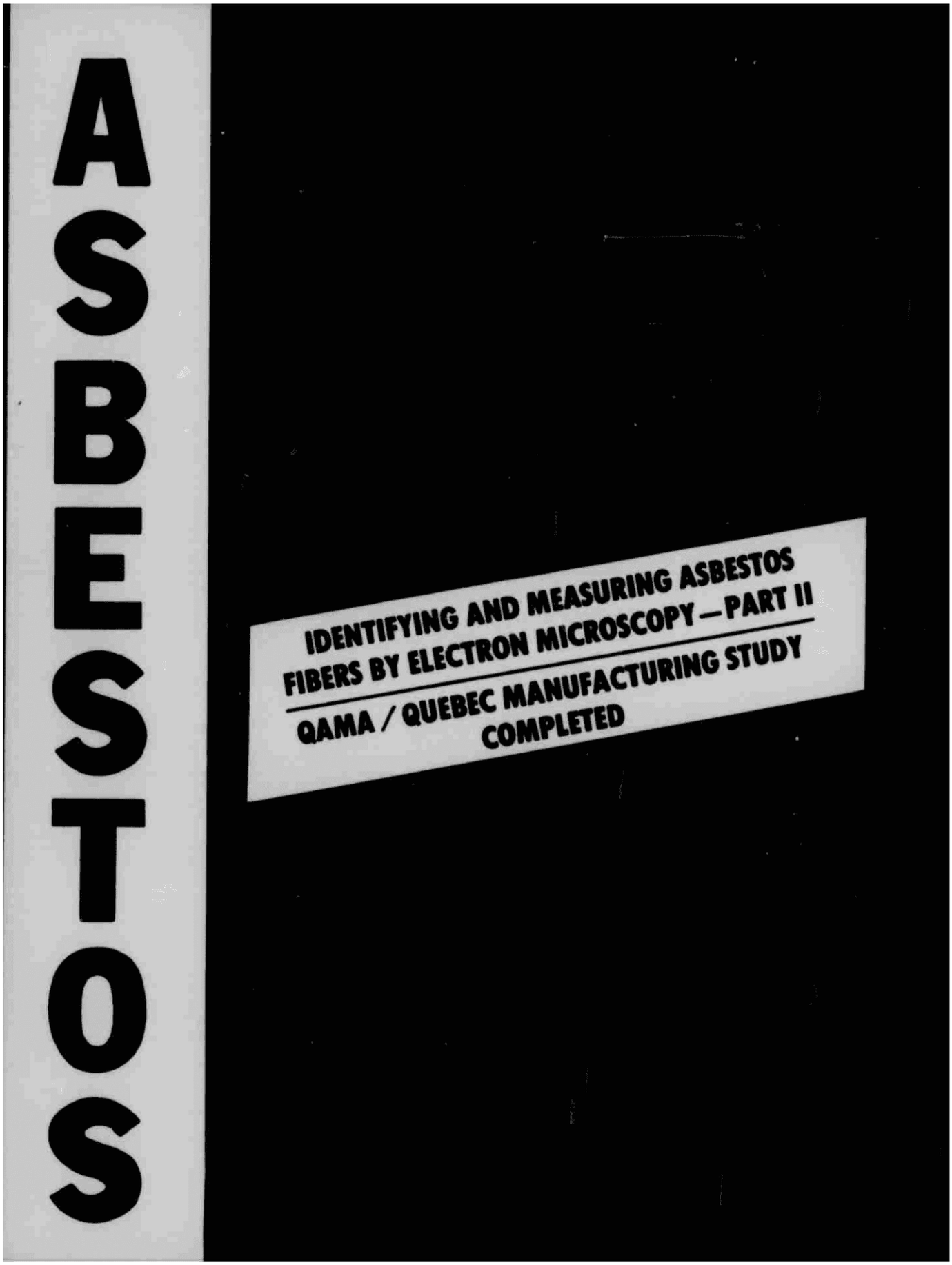
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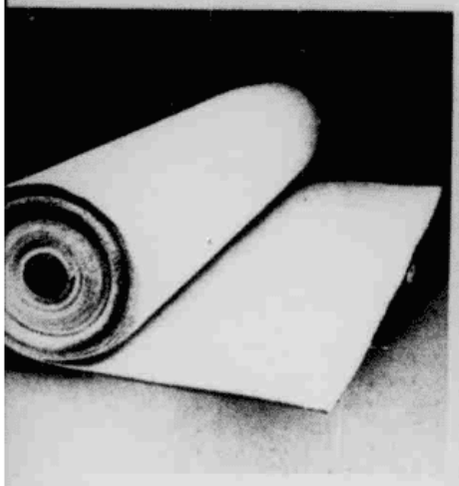
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