

Bulletin

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Results of the most comprehensive scientific study on the effects of asbestos dust exposure

Fourteen years of research by a multidisciplinary team of scientists

"In cases where a substance has been shown to be carcinogenic, it is important to consider whether the possible risks to man are outweighed by the social, economic and medical benefits of the substance. Scientists must play a major role in the decision-making process, by providing and interpreting the available data. However the final decision must be taken by society in the widest sense, through the intermediary of official organizations". This in brief is the conclusion of the Sub-Committee on Environmental Carcinogenesis of the National Cancer Advisory Committee (1977) of the United States regarding the guidelines for risk/benefit appraisal relative to exposure to carcinogenic substances.

14 years of research

In the perspective of such a statement, the results of a fourteen-year epidemiological study on a group of asbestos workers take on particular significance.

The results of this study have recently been published in a scientific journal. They show among other things that the risk of lung cancer among asbestos workers who are continuous-

ly exposed in the workplace to one airborne fibre per cubic centimetre is equivalent to the risk involved in smoking just a few cigarettes per week.

This important scientific research project was carried out under the direction of Professor J.C. McDonald, Director of the TUC Centenary Institute of Occupational Health at the London

School of Hygiene and Tropical Medicine, assisted by his wife, Alison McDonald, Professor of Epidemiology at St. Mary's Hospital Medical School, by Douglas Liddell, Professor of Medical Statistics at McGill University, by Graham Gibbs, Director of the Institute of Occupational Health and Safety of McGill University, and by Gail Eyssen who is currently working in cancer epidemiology at the University of Toronto.

A key work

The research was part of a program established in 1966 at McGill University, at the invitation of the Canadian Government and with encouragement from the Government of Québec, to study the health effects of work in the asbestos industry.

The entire asbestos industry of Québec contributed to the study, from company management and unions to workers and their families. In addition to government backing, McGill University and the London School of Hygiene and Tropical Medicine, the joint organizers of the project, received financial support from the Institute of



Dr. Alison McDonald and Dr. J.C. McDonald.

Results of the most comprehensive scientific study...

Occupational and Environmental Health of Montréal.

The results of the first three years' work, which included the reading of 16 000 chest radiographs, comprehensive tests on a sample of workers, and studies of mortality to the end of 1969, were summarized by Dr. C. McDonald and his colleagues in 1974.

After a number of interim reports discussing various aspects of the data analysis, the final report — a summary of which has been published in the British Journal of Industrial Medicine — goes into greater depth on the issue of asbestos dust exposure than any other epidemiological survey yet carried out. Moreover Professor C. McDonald considers that he has made the optimum possible use of the data currently available on the subject. It must also be stressed that after duly analyzing the preliminary reports and the final version, the international scientific community has acknowledged the value of this study, conferring upon it a degree of credibility that makes it a key work and reference document. The Simpson Report,⁽¹⁾ for example, made use of this survey.

Objectives

The survey's primary aim was to define as accurately as possible the quantitative relationship between exposure to chrysotile asbestos fibre and the incidence of lung cancer.

Since lung cancer is also associated with smoking, a second objective was to attempt to separate the hazards and to determine the importance of each factor in the cause of mortality.

Additional aims of the survey were to measure the exposure-response relations for other diseases including cancers of the gastrointestinal tract and larynx, and for pneumoconiosis and other respiratory diseases.

Methodology

The members of the sample group were chosen according to the following criteria: being born between 1891 and 1920 and having been employed for at least one month in the asbestos indus-

try. These criteria ensured the widest possible range of levels of exposure and of duration of employment. Considerable effort was deployed to trace every person in the sample. For those who had died, once copies of the death certificates had been obtained, the causes of mortality were coded according to the International Classification of Diseases.

After checks and more stringent application of the criteria for admission to the group, the study sample was reduced from the original 11 788 to 11 379 (10 939 men and 440 women).

A great deal of work went into determining the level of dust exposure for each subject, according to norms set by Drs Gibbs and Lachance. This was particularly difficult for the years prior to 1949 when there had been few measurements. Drs Gibbs and Lachance obtained their assessment of dust levels prior to 1949 by means of interviews with long-service employees and comparisons with more recent conditions.

Thus for each person the survey established the period of exposure per employment and the total of annual dust exposures (accumulated exposure); for almost all subjects it also determined smoking histories, and distinguished the following categories: non-smoker, moderate smoker or heavy smoker, the latter indicating a consumption of 26 to 50 cigarettes per

day. The information was obtained by means of a questionnaire answered by the subjects themselves or by their friends or relatives.

Conclusions

One of the conclusions of the study shows that mortality increases with exposure in the cases of asbestosis, lung cancer, cancer of colon and rectum, respiratory tuberculosis and other respiratory diseases. The trend is most clear-cut in asbestosis and lung cancer.

Here the authors emphasize the importance of having examined subjects exposed to a wide range of dust concentrations in order to determine the increase in risk with the increase in exposure. In fact, even using a sample of workers who were exposed continuously over a period of 20 years to 20f/cc., it would have been difficult to establish an increase in risk.

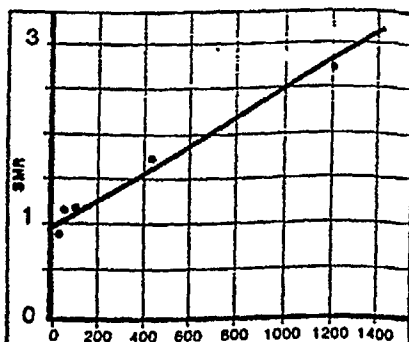
Thus it would seem that, if it is almost impossible to discern an increase in risk at an exposure rate of 20f/cc., a level which has not been found for many years, it is all the more so at 2f/cc., i.e. at the present standard for dust levels in the asbestos industry.

Exposure and smoking

For each category of smoker the risk of lung cancer increases with the level of exposure, thus strengthening the argument that for lung cancer the

Deaths from lung cancer in relation to dust exposure and smoking habit

Smoking habit	Accumulated dust exposure to age 45 in millions of fibres per cubic foot/year.							
	Less than 30		From 30 to 300		more than 300		total	
	Deaths	SMR ⁽²⁾	Deaths	SMR	Deaths	SMR	Deaths	SMR
Non-smoker	5	0.18	6	0.36	8	1.24	19	0.38
Moderate smoker	73	1.14	64	1.35	52	2.31	189	1.41
Heavy smoker	13	2.12	11	2.39	10	4.50	34	2.63
All smoking habits	91	0.93	81	1.18	70	2.25	242	1.23



This graph showing the relation between the standardized mortality ratio due to lung cancer and accumulated dust exposure to age 45 has been weighted using a graphical computation technique. The horizontal line represents accumulated dust exposure to age 45 in millions of fibres per cubic foot/year; the vertical line represents the standardized mortality ratio due to lung cancer.

dose-response relation is linear (see table). The effect of smoking is particularly harmful with heavy smokers whose standardized mortality ratio⁽²⁾ is 4 times higher than that of non-smokers at the highest exposure level.

In recent years, after a number of shorter research projects, less comprehensive than the present one, the industry had already seen fit to make workers aware of the dangers involved in smoking associated with exposure to asbestos. Not only do the published results justify such action, they may also give rise to stricter legislation on smoking in the workplace.

The fact that the dose-response relation for dust exposure and lung cancer is linear is of major importance for the determining of acceptable risk.

Critical analysis

There are obviously a great many factors which can influence a study of this kind: the risk of error exists, and every criticism must be closely examined. But the fact remains that this study is as solid and valid as the figures on which it is based.

Some doubts have been expressed as to the value of the relation established between exposure and smoking.

The data in this survey do not invalidate the argument that asbestos exposure in itself increases the risk of cancer even for non-smokers. But they do confirm the results of several other research projects which conclude that smoking increases, and even multiplies, the risk of lung cancer.

Quantification

According to Dr. C. McDonald's report, the risk run by asbestos workers before the implementation of dust controls in the mines and mills, i.e. in conditions which no longer exist, was equivalent to that involved in smoking heavily; today's asbestos workers, continuously exposed to 1f/cc., run a risk equivalent to smoking just a few cigarettes per week.

The establishing of a relation between risk in the workplace, considered to be "imposed", and the risk of smoking, considered to be a "free choice", should throw new light on the issue of acceptable risk which the industry may ask man to accept in view of the benefits which it provides.

This study was conducted without a break for fourteen years and aimed to determine the quantitative relations between mortality and workplace exposure in the Québec chrysotile asbestos industry. The analytical methods used were varied and precise; the results obtained remained constant. It may be assumed that the purpose of the study was achieved.

By using these environment quality measurements, the mortality risk associated with work at different dust levels can now be assessed with some confidence. The precision of this risk assessment should now make it possible to determine an acceptable dust level and to take the appropriate social and political decisions.

- (1) Final report of the Advisory Committee on Asbestos, published in 1979 in Great Britain. The Committee, presided by Mr. Simpson, was established in 1976 to review the risks to health arising from exposure to asbestos or products containing asbestos.
- (2) SMR: Standardized Mortality Ratio, i.e. the ratio between the actual mortality rate of the study sample and the expected mortality rate, the latter being based on the actual mortality rate of the population as a whole.

The Scientific Committee of the IRDA

President of the Institut de recherche et de développement de l'amiante (IRDA) Michael Prus, President of Carey Canda Inc., has announced the names of the appointees to the Scientific Committee which will be responsible for evaluating research projects submitted to the IRDA.

The members of the Committee were selected from research agencies and university institutions and from private enterprise. They are: Chairman, Gaétan J. CÔTÉ, consultant engineer and surveyor, Montréal; Louis BERLINGUET, First Vice President of the Centre for International Research and Development at Ottawa; Paul D. CLARK, Group Leader, Research and Development for Latex products, Dow Chemical of Canada Ltd, Sarnia, Ontario; Michel CLOUTIER, Vice President Marketing at La Presse Ltée, Montréal; Louise DUPUY, economist, Royal Bank of Canada; Graham GIBBS, M.Sc., Ph.D., Director of the Institute of Occupational Health and Safety, McGill University. Jacques DUNNIGAN, who is Director General of the IRDA, will act as secretary to the Scientific Committee.

Founded in 1979 following an agreement between the Québec government and the Association des mines d'amianté du Québec, the IRDA is essentially intended to stimulate, by means of its research work, technological innovation which will serve two principal objectives: the creation of new asbestos-based products and the guarantee of safe asbestos use in all its many applications.

Starting with their next meeting, due in early July, the members of the Scientific Committee will devote their energies to examining the first research projects submitted to the Institut with a view to recommendation for approval and financing by the Board of directors of IRDA.

Asbestos transportation from packsack to container

Great changes have come about since those early days when asbestos was stuffed into packsacks or loaded onto horse-drawn sleighs, depending on the season, to be carried from the mill to the nearest railway station, 30 miles away from Thetford. No direct means of transportation existed at that time between the mining towns and the major industrial centres.

The Québec Central Railway reached Thetford Mines in 1879, thus making it possible to ship out asbestos fibre by rail via Sherbrooke to the Atlantic ports and manufacturing centres in the United States. Then in 1882 the connection of the Québec Central line with the Lévis and Kennebec Railway at Vallée Junction opened a route for asbestos to be shipped directly to Lévis. Undoubtedly the construction of a rail network contributed to the growth of the asbestos industry; but it is equally true that the viability of the Québec Central Railway, originally based on revenue from the lumber industry and from passenger traffic, became rapidly dependent on the asbestos mining industry, and that this trend became even more marked after the first world war.

Leading role

Since mining operations began, the need to transport asbestos, whether from the mine to the mill or from the mill to the manufacturing plant, has played an essential role in the conception of new equipment and the development of the region's communications network. Thus to ease the burden of work and deal with the ever growing quantities of asbestos ore, several steam locomotives and ore cars were specially designed and developed in the Bell company workshops as early as 1892. The locomotive that was generally adopted by the entire asbestos industry in 1910 was first designed and built by George R. Smith, then Manager of Bell Asbestos.

The introduction of a standard gauge track around 1910 made it possible to use the same type of rolling stock on

the mining properties as on the normal rail network; thus a special siding was brought to the asbestos mill where the bagged fibre could be loaded directly into rail cars. Eventually in the 1950s the steam locomotives gave way to diesel-electric locomotives which are still in use at the present time.

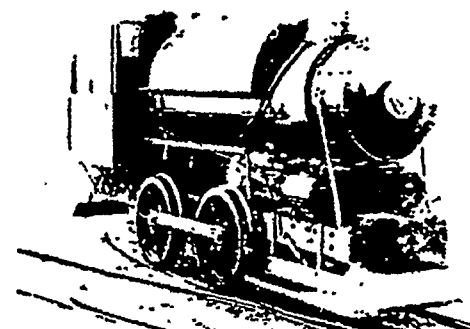
Growth in trucking

Research and technological innovation, and the choice of one form of transportation rather than another have always had a single objective: to improve the quality and reduce the cost of fibre transportation. Important changes were already underway in the 1950s, with polythene bags instead of jute, automated bagging, fibre compression and mechanical loading operations eliminating much of the long and burdensome handling process. The fibre was no longer handled bag by bag but despatched in one-ton units, rapidly and efficiently. At that time asbestos was shipped almost exclusively by rail to the ports of Québec and Montréal.

In 1958, of the 900 000 tons of fibre produced, 750 000 were shipped by train and 50 000 by truck. Greater use of road transportation did not seem

practical in those days, since it was considered unreliable and even impossible in winter, when some roads were completely closed. Yet it was increasingly apparent that trucking offered a much greater degree of rapidity and flexibility than rail transportation, and that in addition it would link the asbestos region to the nearest St. Lawrence port Trois-Rivières, which offered the mining companies better rates and storage conditions than Montréal and Québec.

1958 was the year in which the rail



This type of locomotive, designed by George R. Smith, of the Bell Mines, was generally adopted in the asbestos industry in 1910.



One of the first steam locomotive used for ore transportation.

companies lost the monopoly on asbestos transportation and, faced with competition from trucking companies, were obliged to lower their rates. The economic implications of this change in asbestos transportation policy were numerous: the road transportation companies increased their annual asbestos tonnage from 50 000 in 1958 to 500 000 in 1964; the port of Trois-Rivières was expanded to handle 300 000 tons of fibre per year; several maritime companies altered their schedules in order to dock at Trois-Rivières, where they loaded asbestos and dropped off other goods instead of continuing as far as Montréal.

Regional infrastructure

Regionally the increase in trucking led to the improvement and maintenance of roads and the construction of the Lavolette bridge in order to replace the Trois-Rivières ferry, which

was having to carry 100 asbestos-loaded trucks per day. The trucking companies which already existed in 1958 have since that time doubled in size, in terms of both personnel and equipment, creating large numbers of new jobs and boosting the demand for goods and services, while new transportation companies established themselves in the asbestos region.

Thus, asbestos transportation has in less than a century become a full-scale industry which, by the 1960s, was worth approximately one million dollars per month to road, rail and maritime transportation companies.

At the present time, asbestos transportation represents an annual income of the order of \$25 million for the rail companies, \$10 million for the trucking companies, and \$50 million for the maritime companies.

Containers

Containers first appeared in 1963

but only came into general use around 1967. There are numerous advantages to the container: its weight and volume stability and the standardization and mechanization of handling bring down the cost of transportation and make possible an exact cost estimate for clients, from the mill to the manufacturing plant, whatever the number and variety of the forms of transportation used.

Container usage considerably reduced fibre transportation costs by bringing down the cost of handling. Whereas in the early 1970s it cost some \$15 to load a ton of bagged fibres, due to containers the cost has now been cut back to around \$4.50 per ton.

The company which launched container transportation in 1967 was DART, being followed some years later by CAST, for which asbestos was for many years the principal cargo.

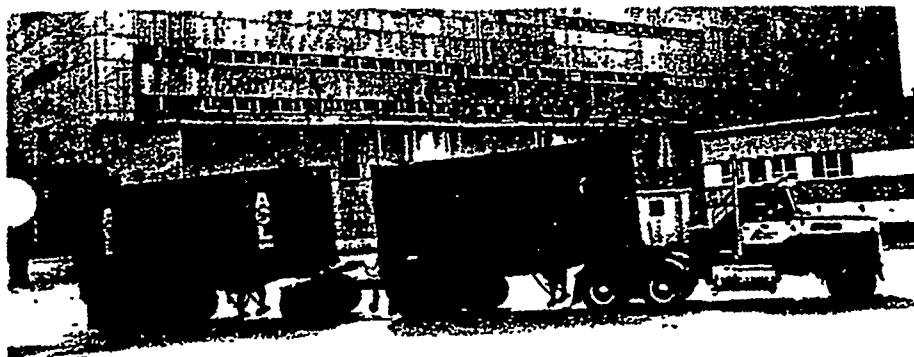
The resurgence of Atlantic port activity dates from this time, since the tonnage of the container ships prevents them from passing through the St. Lawrence Seaway.

World's biggest user

With the tightening of health and environment legislation, the container has now become absolutely essential in asbestos transportation, more than for most other products. This is no doubt why the Canadian asbestos industry is the world's biggest user of containers, shipping 35 000 containers annually, of which 18 000 pass through the Port of Montréal, 13 000 through St. John and Halifax, 1 000 through the Pacific ports, and another 1 000 through New York.

Like all other sectors, the transportation of Canadian asbestos is influenced by various factors in the national and international economy. Among these are oil price increases, fluctuations in exchange rates and Canada's trading policies. To meet the effects of these, the AMAQ's Traffic Committee plays a leading role in negotiations around the world to obtain the best possible conditions for the transportation of Québec fibre, thus safeguarding its competitiveness relative to fibres produced nearer the markets, and ensuring that Québec producers obtain stable and standard rates.

The latest phenomenon that the Committee is having to deal with is the demand by clients for increasingly rapid deliveries, smaller in quantity but



Québec legislation is among the few in Canada to allow the carrying of two containers per truck, on all roads. This represents substantial savings in fibre transportation.



Some 200 000 tons of fibre are still being shipped in bulk to countries not equipped to handle containers.

Asbestos transportation...

on a more frequent basis. This is due mainly to the rise in interest rates, which no longer permits customers to maintain large inventories.

This new demand will require greater versatility in means of transportation and is likely to give a further boost to the trucking industry, or possibly to the piggy-back system which combines the flexibility of road transportation and the economy of rail over long distances. It will be up to the Traffic Committee to decide how best to keep down shipping costs, while satisfying the increasing needs of the customers.

Container manufacturing plant

Another item for the Committee's consideration is the relative shortage

of empty containers required to meet fibre transportation needs, particularly to Europe, arising from Canada's present export surplus by which a great many containers leave the country and do not return promptly due to lack of cargo. Because of this situation, together with the cost of transporting the empty containers from the plant where they are manufactured to their loading point, a project is being examined to build a container manufacturing plant in the asbestos region itself, where the container industry would be close to its largest client, thereby reducing transportation costs.

Communications between the asbestos region and the major commercial centres were developed large-

ly to meet needs in fibre transportation. Today the increasing emphasis on trucking is likely to favour the development of a road network which corresponds more closely to the industry's new requirements. In particular, this will mean linking the Thetford-East Broughton region to Highway 20 by means of an expressway. This would help stabilize the cost of transportation of asbestos, more of which, in terms of volume, is transported by road in Québec than any other product.

Given the competition from producers situated closer to the market, it is more vital than ever that the Canadian asbestos industry should be able to count on stable transportation costs in order to maintain and increase its share of the world market.

LAQ embellishment program

In a major program of waste dump embellishment, Lac d'amiante du Québec, Ltée completed in May the planting of pine and spruce saplings to

cover the waste dump which overlooks the Plessisville and Vimy roads in Black Lake. The program is the result of several years of research, involving

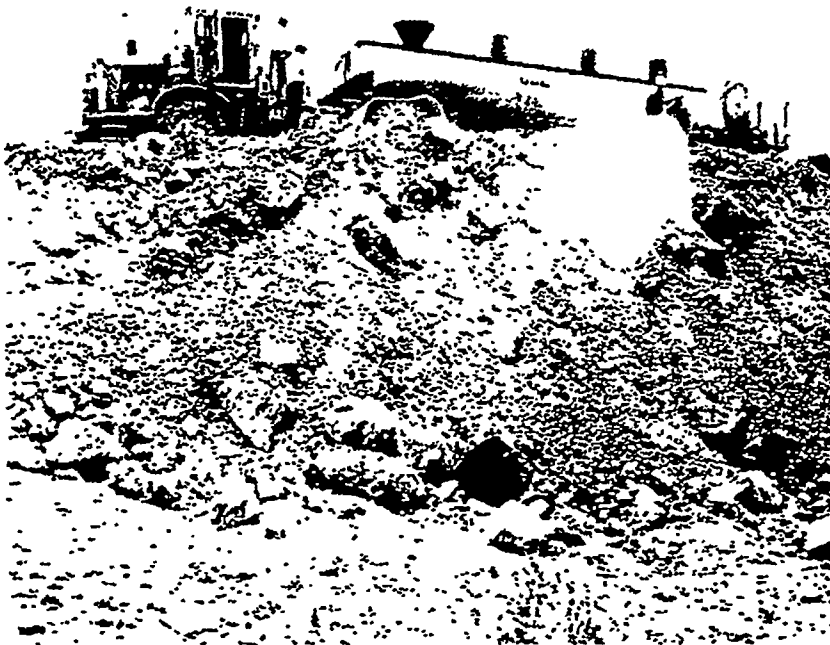
scientists from McGill University and forest engineers from the private sector. To carry out the project, LAQ has also had the collaboration of the Québec Department of Energy and Resources, with particular advice from the Direction de l'Inspection des mines.

Difficult operation

Concomitant with the tree planting, several tests of grass sowing have been carried out, an operation made difficult by the very nature of the soil which is mostly sterile stone. Having obtained good results on a few acres of land bordering on route 112, a hydraulic sowing truck has been developed to spread on the terrain a mixture of grass, weeds, clover, mulch and fertilizers.

This program, which requires major investments and continuous work, provides for the covering within 20 years of a total of 145 acres spread along the Normandie road and route 112.

Following an important program of air purification, this initiative, aimed at conciliating the realities of mining with aesthetic values, shows LAQ's interest and dedication in taking up its responsibilities as regards the work and community environment.



Tank truck developed for sowing on the waste dumps at LAQ

Asbestos-cement and the plastic arts

For several years now asbestos-cement has been used in a variety of ways architecturally for interior and exterior facings. Fibrocement is obtainable in several forms, colours and textures which make it an attractive and relatively inexpensive material which has been consecrated by architects and contractors, just as concrete was granted recognition many years ago through the achievements of Le Corbusier.

The results can be seen in, for example, entire nail-head facades, old-style

ceilings or resolutely futurist ceilings where the lighting is incorporated in the mouldings. Similarly asbestos-cement is frequently used in design: flower pots, shell-seats, wind-breakers, etc. In interior decorating, engraved, textured or moulded sheets are used for wall coverings.

Artistic status

Thus as early as 1965 the Salon des Artistes Décorateurs in Paris raised asbestos-cement to the rank of the so-

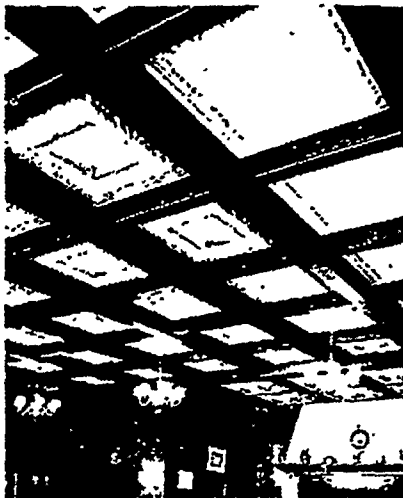
called noble materials, such as stone and wood, by exhibiting wall coverings designed from asbestos-cement sheets.

More recently a group of artists took the theme of "brighter walls" as the basis for original works on Glasal (trade-name for coloured asbestos-cement sheets) executed by sand-jet engraving.

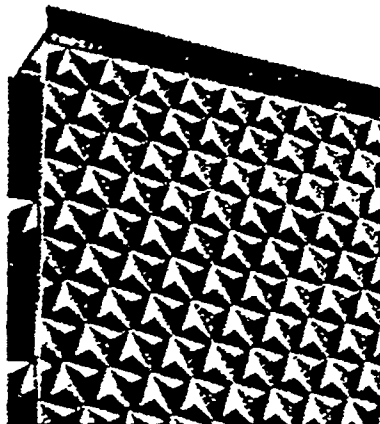
Picasso

The fact of its being an industrial product has not deterred artists from using fibrocement in their efforts to keep abreast of the times, or even ahead of them. Picasso discovered the material in 1946 when he was looking around for "large surfaces to paint". He was offered his surfaces in the most important museum of modern art in the world, after Paris, the Musée d'Antibes, which now contains several of his works on asbestos-cement.

Consecration by one of the "greats" of modern art might have been thought tribute enough, but fibrocement went on to attract the interest of a large number of European artists, some of them of international standing. Fernand Léger, wishing to contribute to what he called the museum of modern society, painted several frescoes on asbestos-cement, of which some were to ornament the Salon des Arts Ménagers.



Asbestos-cement mouldings can be adapted to all architectural styles.



Nail-head facade moulded in asbestos-cement, at the Papeete College (Tahiti)



"La Jore de vivre" a painting on asbestos-cement by Pablo Picasso

Asbestos-cement.. Sculpture

By exploiting the varied possibilities of a simple flat sheet of profiled or coloured asbestos-cement, and its plasticity during the hours immediately following its manufacture, some artists have found the material ideal for forming shapes which then harden for all time.

Thus the works of Thomas Gled currently embellish several private and public collections, and three of his statues greet visitors to the head office of the Eternit company in Belgium. Robert Juvin has exhibited his work in fibrocement at some major artistic events such as the Biennale des Formes Humaines at the Rodin Museum (1964), the Biennale de la Sculpture (1964) and the Salon d'Automne (1964).

Favourite material

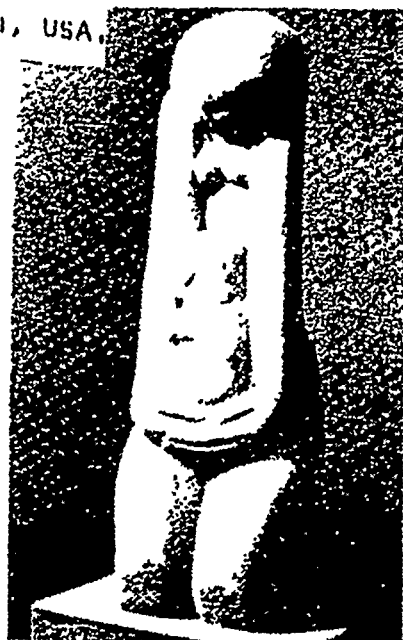
Today there exist innumerable works of art in asbestos-cement which has become the favourite material of many sculptors, and about which it has been written that "obtained in sheet form, it

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can and can't without causing stress in the work that it protects, like all moulded and malleable materials it can be cast into all sorts of forms; yet it is better than any other at resisting fire and frost".



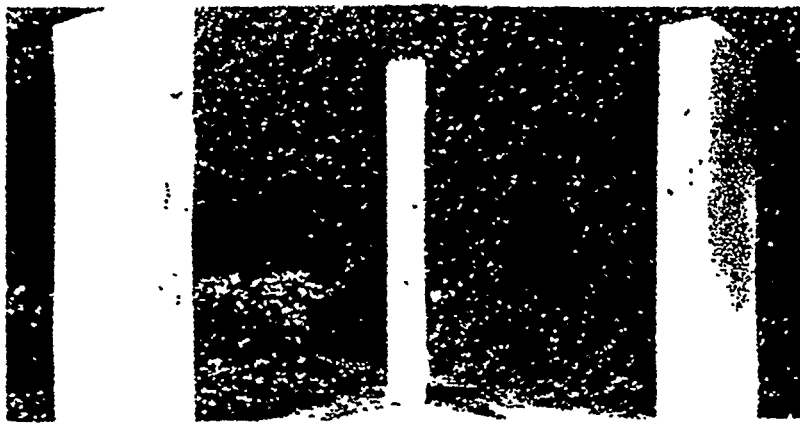
Detail of a bas-relief executed by Juvin for the Fiers Collage (France).



"La Maternité" by Juvin; an asbestos-cement moulding.



Detail of a bas-relief executed by Juvin for the Fiers Collage (France).



A montage of fibrocement sheets: Biennale des formes humaines, Rodin Museum, 1964.

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