FILE NAME: Johns-Manville (JMA)

DATE: 1968 June 10

DOC#: JMA338

DOCUMENT DESCRIPTION: Summary of Seminar on Respiratory Protection for Asbestos Workers

Draft
June 10, 1968

Summary of Seminar on Respiratory Protection for Asbestos Workers

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Discussion Summary

Dr. Selikoff opened the seminar with a discussion of the problems of lung cancer and mesothelioma among asbestos workers. He stated that the problem of asbestosis, the pneumoconiosis which occurs in asbestos workers is now a relatively minor effect. He presented tables of data and X-rays to illustrate his point. A principal effect was said to be thickening of the pleura. This is a unique physiological effect resulting from asbestos exposure. Unlike the development of asbestosis, pleural thickening was not directly dose-dependent.

Pleural calcification was given as another physiological effect which was unique to asbestos workers. He presented data on calcification versus length of time from begining of asbestos exposure. Very little calcification was seen at less than 20 years from onset of exposure. (More detailed information on pleural calcification may be found in his paper in the Annals of the New York Academy of Science, "Biological Effects of Asbestos," pp 351-367.)

In a discussion of the finding of lung cancer among asbestos workers he referred first to the findings of the Chief Inspector of Factories in Great Britian. These findings are discussed by William

Buchanan in "Biological Effects of Asbestos," pages 507-518. For those workers dieing of asbestos-related diseases, one out of every five died of cancer of the lung or pleura. This was compared to a normal lung cancer rate of about one out of thirty.

He referred also to the finding of Wagner, Blake and Marshon (British Journal of Industrial Medicine, 17 pp 260, 1960) who found 47 cases of mesothelioma, an invariably fatal disease, among people with low levels of exposure to asbes s.

He then presented the results of his study of deaths among New York City asbestos insulation workers. The deaths in the group occuring between 1943 and 1962 were given as initially reported by Selikoff, Hammond and Churg in 1964. This was updated by presenting also those deaths which had occurred between 1963 and 1968. (The findings through 1964 are discussed in Biological Effects of Asbestos pp 519 to 525.) His current data are presented in the following table.

Deaths of NYC Asbestos Insulation Workers

	1943-1962	1963-1968	Total
Bronchogenic carcinoma	42	25	67
Pleural mesothelioma	3	3	6
Peritoneal mesothelioma	1	10	11
Cancer of stomach, colon and rectum	29	9	38
Cancer of all other sites	20	8	28

Deaths of NYC Asbestos Insulation Workers (Cont.)

	1943-1962	1963-1968	Total
All other	148	35	183
Total deaths	225	107	332
Cancer (all)	95 (37%)	55 (51%)	150
Asbestosis	12	17	29

He summarized his data on insulation workers by saying that more than 50 percent of insulation workers who died in the last 5 years have died of some form of cancer. Therefore, in the present union membership of 18,000, we may expect in excess of 9,000 deaths to be attributed to cancer.

Dr. Selikoff also presented results of radiological surveys of populations in two countys. In county A which contained an asbestos mine, 499 cases of calcification out of 6312 total were found. In county B there were no cases of calcification out of a total population of 7,701.

The finding of Drs. M. L. Newhouse and H. Thompson (as reported in Biological Effects of Asbestos pp 579-588) were also mentioned. They compared the cases of mesothelioma in a London hospital with a control group which had other diseases as shown in the following table.

Asbestos History of Mesothelioma and Control Groups

	Mesothelioma Series	Control Series
Industrial exposure to asbestos	31 (41%)	6 (8%)
Relatives worked with asbestos	9 (12%)	1 (1.5%)
Lived within 1/2 mile of asbestos factory	11/36 (31%)	5/67 (8%)

He also mentioned the study of Dr. Lieben of mesothelioma in the neighborhood of a factory in Pennsylvania.

Dr. Selikoff's thoughts on respirators were that such respirators for asbestos workers must be able to provide protection for the workers even when the exposure is low. The respirators must be efficient for very small particles, and fibers with extremely small diameters. The mask should provide protection for intermittent exposures to high peak concentrations in otherwise low level environmental exposures. The respirators themselves should not use filters which contain asbestos fibers since the asbestos fibers may slough off and create an asbestos exposure independent of the occupational exposure.

Dr. Cooper spoke briefly of the study of West Coast insulation workers. He was dealing with a younger population; few had been in the trade more than thirty years. Some mesothelioma had been found; there was a definite excess of lung cancer; the general trend was as reported by Dr. Selikoff and he saw no reason to disagree with Dr. Selikoff's conclusions.

Dr. Selikoff mentioned that in a review of 70,000 deaths in the general population only 11 had been reported as mesothelioma. He felt that it might be too early for deaths to be occurring in the community from this cause because that the tonnage of asbestos imported had increased in recent years, and there appeared to be a long wait for the development of mesothelioma after exposure to asbestos.

or when provided were sometimes not satisfactorily maintained. The general impression of industrial hygienists who worked in industry during those years was that exposures were generally very much higher than they should have been.

Mr. Sheckler, in reference to Dr. Selikoff's discussion on the African asbestos workers, stated that; (1), the exposures in South Africa were unique. The workers were continually exposed to asbestos, specifically crocidolite. In the area where these cases occurred, crocidolite was used to pave roads, provide a floor and a roof for their homes, the children played in it, and there were all sorts of incidental exposures; (2) Further studies by Wagner have not detected many cases of mesothelioma in other South African crocidolite mining areas; (3) In most instances in the U. S. we are not aware of what type of asbestos the workers have been exposed to. It is certainly unproven that all mesotheliomas occurring in the U. S. were caused solely by asbestos; (4) It must be kept in mind that smoking habits of the workers are important.; (5) It should be remembered that mesothelioma is a rare disease. Even the study in Pennsylvania so indicated.

With reference to the concentration of asbestos in shipyards previously discussed, Mr. Schall recalled that studies of workers in the New York shipbuilding industry showed impinger counts to be on the order of 12-15 mppcf.

Mr. Balzer, in reference to the statement on crocidolite and its relationship to mesothelioma and other cancer, stated that he had thoroughly reviewed the use of insulation materials by west coast insulation workers. In the period from 1913 to 1968 there was no crocidolite used in insulation products on the west coast.

The question was raised of the reliability of mesothelioma rates among the general population in the U. S. Drs. Selikoff and Cooper agreed that there were no reliable data on the general population. From a study of death records in the Bay Area, Dr. Cooper is convinced that mesothelioma is under-dignosed at present. As the disease becomes more widely recognized the number of cases is likely to increase.

Mr. O'Neill spoke briefly of a study which the Department of Labor is having conducted on compensation cost, present and projected , for asbestosis and berylliosis. He stated that the number of cases were considerably larger than they had expected, even though they may have only scratched the surface of the number of cases actually existing. He felt that other causes should be considered. Radon daughters, for example, may have influenced the development of cancer. He felt studies should be extended to other factors in the environment.

Mr. Sheckler brought out the point that pleural plaques have no direct relation to lung cancer. Such plaques are seen in one specific mining area in Canada; not in another area quite similar and only 50 miles away.

Dr. Selikoff stated that he could not explain the reason for the lack of plaques in one area. He could relate the plaques to the occupation of the indivual; the specific cause is not known.

Mr. Lynch briefly reviewed the exposures which occur now in the manufacturing of asbestos products in the U. S. In the asbestos textile industry the exposure is almost entirely to chrysotile. Amosite is used, in extremely small amounts in only one or two factories. In two plants there is also a small amount of crocidolite yarn which is braided. In the better controlled factories the dust concentrations are about one to two mppcf in general and perhaps slightly greater than 2 fibers per cc longer than 5μ. In the less well controled factories concentrations exceed 5 mppcf at times, with fiber concentrations about 20 fibers per cc for fibers longer than 5 μ.

In the manufacture of friction products only chrysotile asbestos is used. Although exposures are continuous throughout the factories, the concentrations are greater near the machines. In general, concentrations are lower in the manufacture of friction products than in textile manufacture. Dust counts will go up to three mppcf, and fibers longer than 5 μ will range up to ten f/cc.

In the cement pipe industry the exposure is principally to chrysotile, however in some factories there is a significant amount of crocidolite used for pressure pipe manufacture. Dust counts go up to 3 mppcf although several mills are completely under 2 mppcf. Fibers longer than 5 μ are on the order of 1 to 8 f/cc.

In insulation manufacture, five plants have been surveyed up to this time. Of these, two have used all amosite and the others a mixture of amosite and chrysotile. Where chrysotile only was used, plants were relatively clean; dust counts would run less than 5 mppcf, and fiber counts would be low. Where amosite is used, however, counts were relatively high as compared with either the U. S. and British limits. Fiber count would average over 5 f/cc, with some running as high as 50 f/cc. Exposures were heavyest in mixing, forming, sawing, and scrap handling.

Mr. Lynch mentioned Dr. Enterlines' data on lung cancer in an asbestos manufacturing cohort. Enterline found a standard mortality ratio of 2.3 for the textile plants, and 1.3 for the friction plants. Since the textile plants are normally twice as dusty, this suggested a dose-response relationship in the development of lung cancer.

Mr. Baier of Pennsylvania reported that some areas had relatively constant concentrations over the years and had remained consistent for 30 years. Some areas have tended to decrease with time. Weaving and similar operations were among those which seemed to be constant with time. In the application of asbestos insulation some operations, such as sawing, generate tremendous quanities of asbestos dust. Other operations, such as cementing, produc low concentrations. This leads to very fluctuating concentrations with a tremendous exposure for a short period of time, then very little dust, then another high. The friction plants are quite different in exposure from the textile plants.

Mr. Schall commented that in new building construction exposure seems to be near the threshold limit value of 5 mppcf. He had not encountered sawing operations.

Dr. Selikoff stated that steamfitters were exposed to asbestos in these projects.

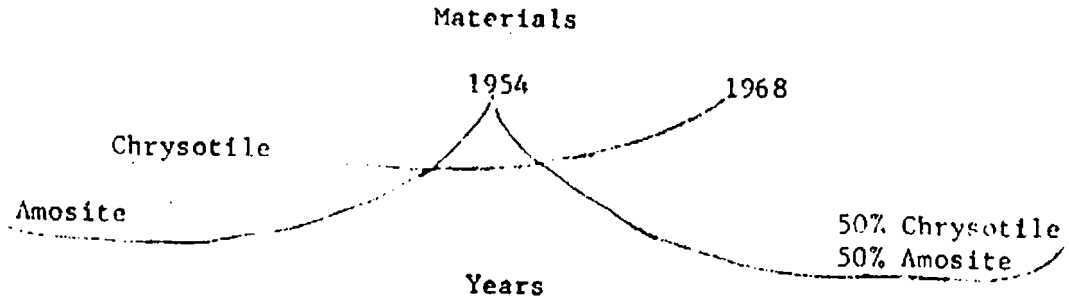
Mr. Hutchinson noted that on large jobs certain men were assigned full time to prefabrication.

Mr. Baier added that they were now surveying large construction projects. They were trying to obtain ventilation controls and the use of Bureau of Mines approved respirators.

Mr. Brodie said that the calcium silicate insulation with 10 to 15% asbestos was usually applied only on high temperature projects at heights of over 300 feet. At this height the worker must stand on a small plank, cut with a hand saw, and be able to communicate with fellow workers. Dust can fall 300 feet to the ground. He was not sure how you could solve the problem. He found difficulty in even making workers wear hard hats.

Mr. Balzer reported his findings in surveys of the insulation workers Local 16 in the San Francisco Bay area. The industrial exposures of these workers were more or less in open air; in the shipboard application many of the workers were in small confined spaces. He outlined his findings with Local 16, in the San Francisco Bay area.

The use of the materials has varied more or less as illustrated by the following sketch.



Insulation workers averaged 45% of their time with material containing asbestos, 45% of their time with material containing fiber glass, and 10% of their time with foam glass, styrofoam, and many others. Insulation work is divided into 6 categories; Prefabrication, application, mixing, finishing, tearing-out, and general clean-up and repair. The grand mean for these operations was 2.6 mppcf. The average of means for prefabrication, mixing, and tearing-out run 4 + mppcf. These operations account for 30% of the 45% time spent with asbestos (13.5% of total time). Peaks run from 1-26 mppcf; with those in sawing up to 183 mppcf. Approximately 1/3 of the fibers run>5μ. 88% of the men in the union work in heavy and light construction. In marine construction and repair the grand mean equals 5-6 mppcf for 45% of the time. Fiber counts have a grand mean of 10 fibers/cc for 45% of the time. More detailed findings are reported in Journal of Occupational Medicine 10 (Jan. 1968).

The ancillary trades also received substantial exposure. In answer to a question he stated that essentially all fibers seen in the samples are asbestos. At the present time asbestos workers do not wear respirators.

Dr. Selikoff gave some figures on importation of asbestos. In 1930 and 1935, we imported 500 and 100 tons respectively of amosite; at the present time we import 25,000 tons per year. He further stated that in studies using some "orginal" amosite discovered in store rooms of the major suppliers, mesothelioma has been developed in animals. Fleischer's study in 1940 to 1945 also found that workers were exposed to less than the threshold limit value.

Balzer stated that from 1941 to 1950 only amosite was used for marine construction. His measurements of airborne fibers indicated that 99 per cent were less than 3.5 μ in diameter, with a minimum ranging from 175 to 250 Angstoms.

Mr. Hutchinson presented findings of a survey of members of the asbestos workers union made in 1967. Out of a 17,996 membership, 11,593 (65%) responded to the questionnaire. Of these 85% are regularly employed. The questions and answers follow.

1. Are present masks satisfactory?

   a. Yes - 31%
   b. No - 41%

2. What are the difficulties with the present masks?

   a. Comfort of fit - 37.6%
   b. Breathing - 21.4%
   c. Filter difficulties - 10%
   d. Vision - 4.0%

3. Do you wear masks on dusty jobs?

a. Never - 30%
b. Sometimes - 50%
c. Usually - 12%
d. Always - 4%

Smoking habits make very little difference as to whether or not a person wears a mask.

In trying to further break down the complaints, several categories were listed, with the following results for the leading ones:

a. Restriction of breathing - 17.6%
b. Uncomfortable - 7.8%
c. Hot - sweating - 7.1%
d. Irritation - 6.9%
e. Clumsy and uncomfortable 5.0%
f. Rapid clogging of filters - 4.7%

Dr. Cooper stated that responses of 200 West Coast insulation workers indicate approximately the same results.

1. Never recommended or required - 50%
2. Never worn - 30%
3. Sometimes worn - 35%
4. Usually or always - 38%

Of those who wore respirators, only 5 or 6% wore Bureau of Mines approved respirators. In most cases, the mask consisted simply of a piece of gauze, similar to a surgical mask.

Some typical objections are:

1. Breathing restrictions
2. Hot and sweaty
3. Irritation
4. Can't communicate

Typical quotes which were encountered:

1. "I wear one when it's very dusty"
2. "I wear one when I work in a confined space"
3. "I wear one when I work with glass"
4. "I never wear one. They drive me crazy"
5. "I wear one only when the dust is so bad I can't stand it"
6. "I wear the handy, disposable 3M type"

In a discussion of these findings Mr. Balzer noted that on the West Coast only 10 out of 400 were wearing Bureau of Mines approved respirators; these were in cases where extreme dust concentrations were encountered. Younger employees seem to be using masks much more than the older workers. He attributed this to the apprentice school training (only 3 out of 30 in the "never wear" group were appentice school graduates).

Mr. Hutchinson would like to see all workers, even auxiliary workers who may be exposed, wear some kind of respirator so that it would become a habit.

Mr. Brodie, as chairman of the apprentice committee, stated that they were presently working on a syllabus which should make the worker more aware of the hazard and how to reduce it. They were looking towards a substitution of other products for asbestos where this was practical. Mr. Horowitz said that it was very important that the asbestos worker be aware that a hazard existed. Mr. Balzer pointed out that there is no correlation between apparent dustiness and count. As a result it is impossible for a worker to tell whether he is being exposed or not. Mr. Hutchinson said we are all being exposed to fibrous dust to some extent. There is insulation lining the ventilation systems in most of our buildings. He suggested that we should insulate the outside rather

than the inside of these ducts. Mr. Balzer stated that he had found that the dust coming out ventilation system is usually not respirable. Mr. Schall agreed, stating that after a duct is blown out very little additional material comes out.

There was some discussion of the use of safety equipment, including respirators, by asbestos workers. In some cases, it was pointed out, the worker was required to wear eye protection, a hard hat, ear plugs were desirable for hearing loss prevention, and now he was being asked to wear a dust mask in addition. The work was often very arduous; the worker might have to work long hours where it was hot and uncomfortable. Over the years there have been many improvements in hard hats but few in respirators.

Mr. Schutz, of the U. S. Bureau of Mines than gave a statement which is summarized as follows:

The Bureau of Mines is of the opinion that engineering control of hazards is far superior to respiratory protection.

It is expected that the Bureau of Mines will intensify and expand its program for respirator testing. The Bureau believes that respirators should be improved. Present approval schedules are to be reviewed. Those scheduled to be revised include 19B for air supplied respirators, 21B for filter respirators, and 13B for self-contained breathing apparatus.

Air line respirators afford a higher degree of protection than filter type respirators; in general they are more comfortable, and it is often recommended that asbestos workers wear air line respirators.

However there are limiting factors in the use of air line respirators such as the availability of respirable air and the hazards of a trailing hose. By the use of pressure demand regulators the facepiece may be kept under a positive pressure at all times, very much reducing leakage. Air purifying respirators are more satisfactory from the standpoint of convenience, but the facepiece is always under a negative pressure and leakage is therefore likely. In the revision of respirator approval schedules greater consideration is to be given to facepiece fit. It is recognized that a full facepiece offers at least 10 times the degree of protection because of better facepiece fit. The revision of the filter respirator schedule will also provide for lower breathing resistance.

In discussion of Mr. Schutz' statement it was brought out that there are no restrictions on air supply other than that the air must be respirable, that there is no restriction on "biologically active materials" or filter media, and that respirators which presently have Bureau of Mines approval do not normally have their approval revoked as requirements are changed. Asbestos dust is approved as just another pneumoconiosis producing mineral dust. Air line respirators are recommended because this is the general recommendation of the Bureau where greater protection is desired. The Bureau does not develop respiratory protective equipment but merely tests it. Although desirable, it was agreed that air line respirators were usually impractical for insulation workers.

It was pointed out that the respirators are now approved for material with a toxicity no greater than that of quartz, which has a TLV of 2.4 mppcf. In this light it was asked whether all respirators so approved were safe for asbestos. Mr. Ayer presented very preliminary data on efficiency of two commercially available media. Both media showed filter efficiency greater than 99 per cent for either chrysotile or amosite. Refering to this, Mr. Burgess stated that if filter efficiencies are greater than 99 per cent, then the limiting factor seems to be facepiece fit. Practically, it is difficult to do better than a protection factor of 10 for a filter type respirator. Mr. Lynch suggested that we should aim at a protection factor of 10 in a respirator that is acceptable to the workers. We still do not know what is a safe level of exposure. Mr. Balzer's data indicates that exposures are higher than the new British hygiene guide, and this is probably true in Dr. Selikoff's population as well. He asked whether protection factors of 10 could be obtained with unapproved types of respirators to bring insulation workers' exposures below the exposures of manufacturing and also below the British hygiene guide. Mr. Burgess replied that a protection factor of 10 could not be obtained with unapproved respirators. There are, however, new low resistance types which will give a protection factor of 10 and be more acceptable.

In further discussion it was pointed out that worker education is necessary, along with good supervision, and examples of respirator wearing by supervisory personnel. However, though worker education goes

a long way, and can even be made a condition of employment, there still exists the problem that respirators are hard to wear for 8 hours a day, 5 days a week. Even if employees are theatened with discharge they are not likely to wear them.

Discussion of potential improvements in respirators included lower resistance media, better design half masks with pneumatic seals, and a proposal for a revision of the resistance requirement to effectively cut in half the allowable resistance of filter type respirators.

Mr. Burgess presented a discussion on powered air purifying respirators. These offer possible improvement in protection factors (protection factors of up to 10,000 have been obtained in laboratory tests) while still maintaining most of the advantages of the half mask, air purifying type respirator. A powered air purifying respirator is said to be available commercially. The cost of this first powered air purifying respirator will be about $150.00. Noise of the blower is not a problem.

It was pointed out that in a recent reconstruction of a British aircraft carrier the wearing of full air-supplied suits was required for workers engaged in tearing out insulation.

It was brought out in a discussion that a typical situation was for about 50 per cent of the employees in any local union to stay with a job for 5-10 years. The other 50 per cent of the Local moves from job to job.

There was a lengthy discussion on the requirements of a good respirator program and its applicability to insulation workers. In general the policy in an industrial respirator program is to issue a respirator to each man, and to have it cleaned and maintained daily. Mr. Brodie suggested that a respirator was a personal item of equipment. It should be issued at the union hall, and maintained by the man himself. He suggested that a seminar could be set up for on-the-job training in the use and care of a respirator. Mr. Edmiston stated that a respirator was a piece of equipment which involved considerable maintenance and stated that a worker could not be relied on to maintain it himself. The maintenance, to be successfull, must be done by trained maintenance people and maintenance is required daily. Mr. Brodie stated that such a program would not work on a construction job where men are scattered over a 400 mile area. They do not even check into a common area daily. Mr. Sheckler stated that the respirators must be cleaned and the filters changed daily, and that each individual must have the opportunity to choose from at least 3 types of mask. It is the contractor's program to supervise. It is his responsibility, morally, financially, and legally. This must be recognized as a problem. Mr. Burgess stated that three choices is enough for respirators but that the selection should be made on the basis of fit rather than of preference.

There was a considerable discussion of disposable masks. It was agreed that disposable masks would be desirable, and that the cost of the mask would probably be less than the cost of proper maintenance.

There was a discussion of a cost of a disposable mask which would be acceptable; but no general agreement on what cost could be accepted. The cost of a proper maintenance program for non-disposable respirator appeared to be prohibitive. Mr. Hutchinson stated that present masks could not be worn on typical jobs; that production would be cut by 2/3 if this were attempted. Another suggestion was that conventional air purifying respirators should be issued and treated like tools of the worker. An option between disposable respirators, and conventiaonal respirators to be treated as a tool, might be offered to the worker. A suggestion was offered that by reducing the number of hazardous operations, respirator use might be required only 10 per cent of the time. For example, if all prefabrication were done outside, than dust could be cut down considerably. Housekeeping could be improved.

In addition to the insulation workers, it was pointed out that other construction workers are also exposed to asbestos, perhaps 1600-1700 men on a construction job may have some exposure to asbestos.

The specific need for respirator improvement were than discussed. Mr. Edmiston stated that respirator manufacturers could produce any product as long as too many conditions were not set. Therefore, which is the most important point? Mr. Hutchinson stated that the major problem is the closeness of jobs. Insulation workers must crawl through manholes carrying pipe covering, cement, and other materials. Their job is not comparable to that of a painter, carpenter or other construction workers. They are often working within a cluster of pipes with no room

for an air-supplied respirator. Mr. Edmiston stated that requirements of a mask sometimes conflicted. A very small respirator with a very efficient filter and a very low resistence was probably not within the state of art. If the size of the filter is increased to decrease resistance, than the size of the mask is increased. It was generally agreed that small masks are necessary. It was suggested that manufacturers go to the jobs and see the problems. It was suggested that an ad hoc committee of users and manufacturers be set up to develop the requirements for improved respirators for asbestos workers. The market for such respirators would include many more than the 18,000 insulation workers; in fact it was pointed out the 18,000 included only those who are members of the Asbestos Workers Union. About 30,000 workers are in the trade. Further, sheet metal workers, carpenters and iron workers do some insulation. In the roofing industry there is also exposure to asbestos and perhaps 100-200 thousand persons are applying materials containing asbestos.

It was suggested that the climate for developing improved respirators has never been better than at present. We are looking for a respirator which is comfortable and convenient enough to be made a condition of employment, and yet that is efficient enough and fits well enough to provide adequate protection. In the manufacture of filter media it was generally agreed that mineral fibers which could themselves cause pneumoconiosis should not be used. The formation of an ad hoc committee was mentioned several times but the exact composition of such a committee or when it would meet was not decided.

Mr. Ayer summarized the conference as follows:

It is recognized that asbestos dust, if breathed in large enough quanities over a sufficient period of time can cause lung cancer and mesothelioma as well as asbestosis. The development of such diseases may not follow a simple dose-response relationship but is not completely independent of the amount breathed. There is a considerable range in the concentrations to which workers are presently exposed and much would be accomplished if the higher exposures were eliminated. It is agreed that there is considerable need for a generally accepted limit. While it appears that the exposures within the insulation trade are generally within the present threshold limits, the established TLV may not be too reliable, since it was established in the textile industry where only chrysotile was used. It was agreed that engineering controls at the job site, combined with prefabrication, might considerably reduce the existing exposure of insulation workers. The effienciency of respirator filter media for asbestos fibers is not known at this time. Respirators with lower resistance would be helpful in increasing acceptability so that they could be used to reduce the present hazards. There has been considerable discussion of the formation of an ad hoc committee for the development of improved respirators to be approved by the Bureau of Mines. Such a committee is encourged. Participation of all present is most appreciated.